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THE SYNCHRONIC AND DIACHRONIC PHONOLOGY OF EJECTIVES

Volume I

Dissertation

Presented in Partial Fulfillment of the Requirements for the Degree Doctor of Philosophy in the Graduate School of The Ohio State University

By

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* * * * *

The Ohio State University
1998

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ABSTRACT

Although ejectives are the fourth most common type of stop and are found in 18% of the languages of the world, their phonological patterning has never been explored in depth. Based on a sample of over 180 dialects from genetically diverse languages, this thesis presents a typology of the major phonological processes involving ejectives, using the feature geometry of Clements and Hume (1995) and the phonological operations of spreading and delinking.

Spread of the Laryngeal node specified for [constricted glottis] is shown to account for ejective assimilation. A Laryngeal Markedness Statement formalizes the asymmetric spreading behavior of [voice] and [e.g.].

It is proposed that most ejective lenition processes may be formalized as the delinking of various feature geometric structures. Delinking of the Laryngeal node or of the feature [e.g.] results in deglottalization. Delinking of other structures often yields debuccalization. There are four parameters in Universal Grammar for debuccalization: delinking of the Root node, the Oral Cavity Node, C-place, and individual place features. Evidence is provided for all but C-place delinking, which depends on various theoretical assumptions. Data from Individual Place Feature Delinking demonstrates the independence of primary and secondary articulations, since primary place may debuccalize but leave secondary articulation under Vocalic intact. Dissimilation is also viewed as delinking.

The voicing of ejectives is phonologically straightforward, and is shown to result from the spread of [voice], or from delinking with fill-in of [voice] as default. Historical
linguists, however, have criticized this change in the Glottalic Theory of Proto-Indo-European, which reconstructs ejectives in PIE, and requires the change of ejective to voice in daughter languages. Synchronic and diachronic examples are presented which support this contested aspect of the Glottalic Theory.

Evidence is provided that the creation of ejectives through fusion with an obstruent and glottal stop requires the admission of fusion as a basic phonological operation. The converse change of fission of an ejective into a sequence of plosive plus glottal stop is much rarer.

This study deepens the empirical understanding of ejectives and contributes to both phonological theory and to typologies of sound change.
To my wife,

Christina Kakavá
ACKNOWLEDGMENTS

Without a doubt the foremost influence on this dissertation has been my mentor, David Odden. I thank him for his patience and perspicacity, for his criticism and caution, for his energy and enquiries, and his skepticism and skill. The readers of my committee, Elizabeth Hume and Brian Joseph, have also saved me from various blunders and provided insightful comments and suggestions. Of course none of the above agrees with everything I have written, and all errors remain my own responsibility. I am also grateful to the Graduate School representative, Sara Garnes, for comments made at my oral defense.

I must thank Ian Maddieson and Peter Ladefoged and others at UCLA for making available to the linguistic community Sounds of the World's Languages, and UPSID (1992), whose bibliography formed the nucleus of this thesis.

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I also thank the Ohio State Department of Linguistics for a University Fellowship, and for its liberal use of Language Files funds to support my studies at the 1989 Linguistic Institute in Tucson; for providing consultant fees for my work with Chechen; and for travel funds to present at conferences in Berkeley, Boston, Chicago, San Diego, Washington, DC, and Reading, England. I thank Susan Sarwark, Director of the Spoken English Program, for scheduling flexibility while I attended courses, and for granting me a leave of absence while I wrote part of this dissertation.
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Resonant Root node of a consonant Root node of a sonorant spread glottis spread glottis spread glottis something stative transitive Vowel Voice Onset Time

The Sound Pattern of English (Chomsky and Halle 1968)
CHAPTER 1
INTRODUCTION

1.1. Overview
A small number of autosegmental operations in phonology such as spreading, deletion, fusion, and fission, in conjunction with a hierarchical structure of features, accounts for the major processes which ejectives undergo. Ejectives are relatively common but understudied speech sounds which have never received systematic treatment in terms of their phonological effects, both synchronic and diachronic. This thesis proposes a typology of phonological change and alternations for ejectives, drawing together widely-scattered information on the phonological behavior of ejectives.

The second part of this introduction answers the question, What are ejectives? It briefly explains their physical production and recounts their discovery and description by linguists. The next section notes the paradox that ejectives, far from being an 'exotic' sound, are found in almost one in five languages of the world, including occasionally in English and French, yet they have never been the subject of a thorough phonological study. The fourth section provides the three chief motivations of this study: theoretical, empirical, and historical. Ejectives play an important role in the theoretical arena with respect to feature privativity, and they can also be used to test models of feature geometry. Empirically, since little is known about ejectives as a whole, it is important for phonology to account for these sounds. And historically, ejectives and their possible sound changes are one of the most contentious issues surrounding the Glottalic Theory of Indo-European, which reconstructs ejectives in PIE. This will be discussed more in §1.4.3.

The methodology of this thesis is described in Section 1.5. Over 150 grammars of languages with ejectives were studied, based on a quota sample of the UCLA Phonological Segment Inventory Database (UPSID), and later expanded on the basis of available grammars. This thesis thus has a thorough, empirical, and cross-linguistic basis involving a wide range of various types of data. Section 1.6 explains the use of the IPA in all the transcriptions of this dissertation and discusses problems of transcription. The last section provides an overview of the organization of this work.
1.2. What Are Ejectives?

Ejectives are speech sounds, typically a stop or affricate (and rarely a fricative), made with a glottalic egressive airstream mechanism. Ejectives are formed with roughly simultaneous closure of the vocal folds and a constriction in the oral cavity (which could be between the lips and the uvula). The larynx is then raised like a piston about one centimeter, compressing the air between the glottis and the oral constriction (Ladefoged 1982:120). Then the oral stricture is released, followed by the opening of the vocal folds. A ‘popping sound’ is created as the compressed air is released from the mouth. Because these sounds are quite rare in Europe, their description and production have caused linguists problems for hundreds of years. Take, for example, Ludolf’s (1661) *Grammatica Æthiopica*, a grammar of Amharic, which, incidentally, according to Ullendorff (1955), was the first to introduce the apostrophe notation for ejective sounds:

‘However, among all these the most notable and difficult in pronunciation are the following: k’, t’, s’, z’, p’ which examples are not found in the whole of Europe. They closely resemble those letters, which on account of the difference we note in our syllabary by an apostrophe, but in so strong collision of articulators, and which are carried out in a reverberation of sound, that one can fully imitate them only slowly and with difficulty.’ [Translation: PDF]

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1 Troike (1981:659) speculated that Fray Bartholomé García, putative author of a 1760 confessor’s manual in Coahuilteco, ‘was perhaps the earliest writer to use the apostrophe to represent glottalization’. This may be true in the Spanish tradition, but Ludolf precedes García by a century.

In more modem literature, the apostrophe is used in Lepsius (1863) for glottal stop as well as ejectives, e.g. in Ossetian (Lepsius 1863:138-140), perhaps influenced by the tradition of transliterating Hebrew and Arabic aleph/aleph (glottal stop) by an apostrophe. The apostrophe in ejectives is employed for ‘an exploded sound or hiatus’ in Powell (1880:15). The International Phonetic Association has long used the apostrophe symbol for ejectives, e.g. in Passy 1888 as ‘glottal catch’ and in various versions of the IPA since at least 1912:13). Passy and Chahtaxtinsky (1899), for example, transcribed a brief passage of Shapsug (Northwest Caucasian) using the apostrophe for ejectives. Ejectives were also transcribed with an apostrophe in work on Native American languages, as shown in the Committee of the American Anthropological Association (1916:5), though it also maintains the exclamation point for ‘fortis’ exploded ejectives (Swanton 1905; Committee of the AAA 1916:14; Boas 1911; cf. Grout 1893. See also §7.6). The apostrophe was used in Swadesh (1934) for both ejectives and glottalized resonants, foreshadowing modern feature theory, which describes both sounds with the feature [constricted glottis] (for more of which see §2.2.4.2).

2 ‘Inter omnes autem maxime notabiles et pronunciatione difficillimae sunt sequentes: k’ t’ s’ z’ p’ quorum exempla in universa Europa non reperiantur...Proxime accedunt ad literas illas, quas differentiae causa in syllabario nostro apostropho notavimus, sed tam
Ludolf’s last remark was echoed by other Europeans. Doke (1923:706-707) mentions later attempts at describing the velar ejective affricate in Zulu:

‘This is perhaps the most difficult Zulu sound for a foreigner to acquire, and one of the most difficult to describe without practical demonstration. In fact Elliott, in his Tebele Dictionary3, writes of it as totally indescribable and impossible for a European to acquire, with the added encouraging remark that it is very seldom used. Döhne4, too, describes it as “a kind of choking, very difficult to describe and more so to utter”.

Such sounds also provided difficulty for linguists working with Native American languages; see, for example the confused description by Powell (1880:11-12), which was an early attempt at standardizing a phonetic alphabet.

Even respected linguists, linguistic anthropologists, and speech scientists in the early part of this century had difficulty describing ejectives. Swanton (1911:210), for example, thought that ejectives were due to ‘urging more breath against the articulating organs than can at once pass through them’ (cited in Sapir 1923), though Sapir denied this. Meinhof (1915) referred to sessions of phonetic fieldwork involving ejectives that were conducted in Berlin in which he was accompanied by Eduard Sievers and Hermann Gutzmann. Meinhof states that ‘We had great trouble over the “glottal-stop” sounds, of which one was sometimes disposed to think that there could be no such thing, and which nevertheless do exist.’ (1915:56). Sievers himself, author of Grundzüge der Lautphysiologie (1876), which is considered by Bronstein, Raphael, and Stevens as one of the two major works (along with Sweet 1877) in the nineteenth century ‘to lay the groundwork for the advances in twentieth century experimental phonetics’ (1977:193), had been wrestling with glottalized sounds for some time, as mentioned in Sweet (1877, reprinted in Henderson 1971:162-3).

Sapir (1923) and in more detail, Trubetzkoy (1926) gave admirable attempts at description, though it was Doke (1923, 1926) who described ejectives quite accurately.
Doke (1923:707) in fact coined the term 'ejective'5 (where the symbol \(<\tilde{k}\>\) below, used to describe the Zulu \([\tilde{k}\tilde{x}']\) is actually a turned \(<k>\) in Doke):

>'\(\tilde{k}\) is an affricate sound, but it differs from other affricates in that it is pronounced with simultaneous glottal stop. To designate such glottal stop plosives, I have selected the term “ejective”, as being descriptive of the action and the type of sound resulting. Hence \(\tilde{k}\) is made up of three elements, the plosive, the fricative, and the glottal stop; and if the special symbol were not adopted, \(\tilde{k}\) would have to be indicated by \(\tilde{q}\tilde{x}\).'

The term was also used in Doke (1926), and has been widely adopted since then. Their importance in descriptive and field phonetics is reflected in the fact that by 1933 Daniel Jones included ejectives and implosives in his ‘short examination in practical phonetics’ given to J.C. Catford (Catford 1989).

Beach (1938) proposed a phonetic framework which combined ejective release into his description of clicks in Hottentot (Xhosa), and according to Catford (1977:247), he introduced the terms pulmonic, glottalic, and velaric, though it was not until Catford’s (1939) pioneering work that ejectives were integrated into a basic phonetic description with other obstruents6. It was this work that first described them as ‘glottalic pressure stops’.

Pike (1943) built on Catford’s description, adding the terms ingressive and egressive and ‘pharyngeal air-stream mechanism’ (90), which has since been renamed ‘glottalic’ airstream mechanism. Thus in current work, ejectives are known as ‘glottalic egressive stops’, a description which has been widely adopted in standard phonetics textbooks (Abercrombie 1967; Ladefoged 1975, 1982, 1993; Catford 1977, 1988; Laver 1994).

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5 Incidentally, the first and second editions of the Oxford English Dictionary give Daniel Jones’ (1932) Outline of English phonetics (3rd edn.) as the earliest citation. The citation in which Doke coined the term should appear in the third edition of the OED.

6 Catford (1989:34) discusses the motivations that led to his seminal 1939 paper. He relates the following incident, which occurred at the Third International Congress of Phonetic Sciences at Ghent in the summer of 1938:

‘Among topics discussed at that Congress were several papers on ‘clicks’. I remember sitting beside George Trager, who was an excellent phonetician, and exchanging with him glances of disbelief. At least two of the speakers were quite clearly confusing ejectives with clicks and that stimulated me to write the short article On the Classification of Stop Consonants that appeared in the Maître Phonétique in 1939.’
Many additional terms for ejectives cloud the picture. They are often known as 'glottalized' consonants, a term which Catford (1977) objects to on phonetic grounds, since the suffix -ized implies secondary articulation, as in palatalized or velarized; he proposes the term glottalic. Trubetzkoy (1939/1969:217, fn 136) discusses various other names for ejectives in use at the time. I combine his list with other terms I have encountered:

Abruptive (usually only in Russian; Bokarev and Lomtatidze 1967)
Checked stop (along with other sounds; Jakobson, Fant, and Halle 1952)
Consonant of supraglottal expiration (Jakovlev 1923)
Consonant with glottal occlusion (cited in Trubetzkoy 1939[1969])
Evulsive (Rousselot 1897-1908)
Glottalic pressure stops (Catford 1939)
Glottalic egressive consonant (Ladefoged 1982)
Glottalized consonant (Committee of American Anthropological Association 1916)
Glottal stop sounds (Meinhof 1915)
Glottocclusive / glottal occlusive (Trubetzkoy 1931a)
Recursive (Trubetzkoy 1922, 1939 [1969:145-6])

Although ejectives were finally accurately described impressionistically in the 1920s, they were not thoroughly examined instrumentally or acoustically until the past twenty years. The earliest instrumental work which I am aware of comes from Rousselot (1897-1908), who provided kymographic, laryngographic, and palatographic figures of various Georgian ejectives. Selmer (1935) contains a few instrumental measures, again on Georgian sounds, including ejectives. Another pioneering effort, though dated today, is Sumner's (1949, 1957) work on Amharic. Most of the more significant instrumental work is reported in Catford (1977a, 1992), Dent (1981), Fre Woldu (1979, 1986), Hogan (1976), Kingston (1982, 1985a,b), Lindau (1984), Lindsey, Hayward and Haruna (1992), Pinkerton (1986), Khachatrian (1996), and Warner (1996). In addition, several recent issues of UCLA Working Papers in Phonetics which treat 'fieldwork studies of targeted languages' contain useful descriptions of ejectives. For more detail on the phonetics of ejectives, see §7.6.

Now that we have seen what ejectives are and how they have been described phonetically, we turn to their distribution in the languages of the world.
1.3. The Commonness of Ejectives

According to Henton, Ladefoged, and Maddieson (1992), ejectives are the fourth most common type of stop in the world's languages, after voiceless unaspirated stops, voiced stops, and voiceless aspirated stops. Estimates of their occurrence in the world's languages vary slightly, ranging from 16.5% to 20%. The UCLA Phonological Segment Inventory Database (UPSID) version 1.1 (1992) contains 69 languages with ejective stops, affricates and/or fricatives, from a quota sample of 417 languages (16.5%). An earlier version of UPSID (published as Maddieson 1984) had a quota sample of 53 ejectives out of 317 languages (16.7%). Ladefoged and Maddieson (1996:78), referring to Maddieson (1984), note that ejectives occur in 'about 18%' of the world’s languages. Ruhlen's (1976) survey (cited in Bomhard 1984:138), contained 129 ejectives in 693 languages (18.6%), and Catford (1992:193) pushed the estimate to 'about 20%'. Compare this frequency with that of other 'exotic' sounds: implosives (10%) and clicks (1%) (Maddieson 1984).

In contrast to the quota samples, I have conducted a count of the number of languages in which I could confirm, through printed sources, the presence of ejectives, discounting potentially ambiguous terms like 'glottalized'. Of the 4,794 natural, living languages listed in Ruhlen (1991), at least 241 (5.0%) languages have been reported to contain ejectives. This is quite a conservative number, not controlled for sample; it simply reflects what I can confirm at the present time through published grammars. The number does not include ejectives found in languages now extinct such as Wiyot, Chemakum, Tillamook, etc. By my count, Ruhlen (1991) lists another 476 extinct languages, of which I can be sure at least 34 had ejectives. This would bring the minimum total to 275 of 5,270 languages (5.2%). Again, though, let me remind the reader that there are many grammars and languages that I have not been able to consult which may well contain ejectives, bringing the total more in line with the quota samples.

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7 Maddieson (1984:101) states that 52 of 317 (16.4%) UPSID languages contain ejectives. However, this number appears to have excluded Iraqw, which contains an ejective affricate but no ejective stops.

8 In addition, several languages contain ejectives at the phonetic level. Many have ejectives as the result of fusion with glottal stop (see Chapter Eight). Others have phonetic ejectives as allophones of voiceless stops (French and English, as discussed below in this section), or of voiced stops in final position, as in the speech of Somali speaker Isman Dubet of Adadleh (Armstrong 1934).
Ejectives can be found in many major language phyla listed in Ruhlen (1991). They are found in virtually all Kartvelian and North Caucasian language families, as well as Na-Dene, Wakashan, and Salishan. They are pervasive in the Ethiopian Semitic and Penutian families. Other language phyla in which they occur, some as the apparent result of borrowing, include: Khoisan (!Xôô); Niger-Kordofanian (Koma); Nilo-Saharan (Ilk); Indo-European (Eastern Armenian); Altaic (Kumyk); Austro-African (Yapese); and "Amerind" (Quileute). I have not found ejectives in Uralic-Yukaghir, Chukchi-Kamchatkan, Eskimo-Aleut, Elamo-Dravidian, Sino-Tibetan, Indo-Pacific, or Australian9, and many of the families listed under the controversial 'Amerind' such as Algonquian and Iroquoian.

We do not, however, have to go so far afield to encounter ejectives at the phonetic level, since they are found sporadically even in English and French (Abercrombie 1967:29). Gimson and Cruttenden (1994:146) describe phonetic realizations of stops in English:

'In other, rarer cases there may be some compression of the air between the glottal and oral closures by means of the raising of the larynx and a constriction of the pharyngeal cavity, resulting in a potential ejective release. In such a case the plosive is no longer glottally reinforced or glottalized but is instead produced using the egressive glottalic (or pharyngeal) airstream mechanism. This is rather more common in some dialects (e.g. South Lancashire) than in RP.'

Shukén (1984:120-121) has published a spectrogram of a Glasgow English speaker's pronunciation of the word great, which was phonetically realized as [gre:'t'], with creaky voice at the end of the vowel, simultaneous glottal and alveolar closure, and ejective release. Shorrocks (1988) reports that in the speech of Greater Bolton, twelve miles northwest of Manchester, for final /p, t, k/ 'occasionally an ejective consonant is encountered: [nii.r'] 'night', [wik'] 'week' (60). Similar reports may be found in Taylor (1995:224), who notes that 'in utterance-final position, the alveolar closure of /t/ may be released ejectively: [t']. This is particularly common in highly emphatic utterances like What!?' (See also Nathan 1986:219 and Ladefoged 1992:131).

As for their presence in French, Heffner (1950), citing Grammont (1930:40), says that Grammont

9 Hale (1992) notes that Darin, an auxiliary language used to replace Lardil for ritual purposes, contains a 'labio-velar lingual ejective', along with its clicks, which are otherwise found only in Southern Africa.
'distinguishes between French [p] and the [p] of certain Germanic dialects by ascribing to the French stop in detail the ejective mechanism of a glottalized pressure stop. What he says of [p] is equally valid for [t] and [k]. There may be some doubt as to the universal validity of his description for French, but that it fits the performance of considerable numbers of Frenchmen seems clear enough.' (1950:137; see also 1950:119).

Although ejectives may occasionally occur in French and English, they are better known in other language families. Sapir (1938) noted that 'It is well known that a very large number of American Indian languages number among their phonemes glottalized stops and affricates' (248). In fact, ejectives are often cited as an areal trait in the California and Northwest Pacific region, in the Caucasus, and in Ethiopian Semitic. See Sapir (1921, 1938), Jakobson (1938b [1990]), Milewski (1953, 1955), Haas (1969, 1976), and Hetzron (1972). Jakobson (1938b [1990:211-2]) provides some of the following examples in his famous study on linguistic affinities:

'...we may note, as examples, the phonological association encompassing the vast territory between southern Alaska and central California filled with numerous languages that belong to different families but that all possess a series of glottalized consonants (Sapir 1921:chap. 9); the association of the languages of the Caucasus whose consonantal system have the same characteristics and which includes the northern and southern Caucasian languages, Armenian, Ossetic, as well as the gypsy and Turkish dialects of Transcaucasia (Trubetzkoy 1931[b]:233)...'

Now that we have seen the important role that ejectives have played in the development of phonetic theory, and how they are in fact one of the most common of 'exotic' sounds, we turn next to the primary motivations of this study.

1.4. Purpose
There are three main areas in which an understanding of ejectives can contribute to linguistics. First, there is the formal, theoretical question regarding the representation of...

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10 Troubetzkoy (1931b/1949:349) himself simply states that the correlation 'with glottal occlusion -- without glottal occlusion' extends to 'all the languages of the Caucasus without regard for their origin: not only to the languages of the North and South Caucasus, but also to the Indo-European and Turkish languages of this region, although they do not appear in general neither in Europe nor in the neighboring parts of Asia and Eurasia.' Jakobson's addition of the 'gypsy' dialects of Transcaucasia may have arisen from conversations with Troubetzkoy. With the help of members of the Altaic and Caucasian electronic lists (see the Acknowledgments), I have been able to confirm the presence of ejectives in dialects of such Turkic languages as Kumyk, Karachay-Balkar, and Azeri.
ejectives in linguistic theory. Second, there is the empirical question of how ejectives pattern in the phonologies of languages. Third, there is the diachronic, historical question regarding how ejectives change over time.

1.4.1. Theoretical Questions
In her survey of phonological features, Keating (1988) makes the following startling observation:

‘considering that the main use for a feature theory is to appropriately characterize natural classes and express generalizations about what classes occur in rules, it is somewhat surprising that feature theory has yet to be based on a really systematic survey of phonological natural classes’ (282).

This sentiment is also echoed in Hume and Odden (1996), who note that ‘it is striking how little argument has been presented for certain of the assumed distinctive features’. They go on to deny the need for the feature [consonantal], a feature long assumed since Jakobson, Fant, and Halle (1952). And thus after more than sixty years, continues the ‘quest for the ultimate constituents’ (Jakobson and Waugh 1987 [1979], borrowing a metaphor of Pierre Delattre’s).

In response to this lack of a firm basis for feature theory, Keating notes that

‘it would be extremely valuable if a large-scale survey of groups of segments in rules were done to establish, independently of any particular feature system, what generalizations need to be expressed by such a system. While this would be an enormous undertaking, the success of Maddieson’s (1984) survey of phoneme inventories may well encourage someone to begin.’ (282).

With this in mind, I began doing research to contribute toward an understanding of how ejectives pattern as a prerequisite towards formulating a theoretical framework for them. It is commonly, and most likely, correctly, assumed that ejectives share a phonological feature such as [constricted glottis] with implosives, glottalized or laryngealized sonorants, and glottal stop. To set out to prove this is beyond the scope of this dissertation. Instead, I shall focus on one major class of these sounds, ejectives.

1.4.2. Empirical Questions
Ejectives are probably the least studied of relatively common speech sounds. Implosives have been studied more extensively in Blust (1980), Solnit (1992), and in Greenberg
(1970), who had an extensive sampling for implosives, but admitted a 'far less complete'
sample for the more widely distributed ejectives, especially for 'the course of events by
which these consonants originate and undergo characteristic developments which often
results in loss of the glottalic feature' (134). Glottal stop has played a large role in feature
theory, for example, regarding laryngeal placelessness (Lass 1976, Steriade 1987a,
McCarthy 1988). In addition, the importance of ejectives has arisen in relation to the
Glottalic Theory of Indo-European (discussed in more detail below). Briefly, this theory
posits that Proto-Indo-European had glottalic sounds (ejectives in most versions) which
have since been lost in most daughter languages. Yet despite the fact that this theory has
taken up gallons of ink in the scholarly literature, to my knowledge, besides cursory
reference by two of the founders of the Glottalic Theory (Gamkrelidze and Ivanov 1984,
1995), only Job (1984, 1989) has seriously examined and empirically verified some of the
sound changes of ejectives.

This lack of knowledge of sound changes involving ejectives is reflected in the fact
that no textbook or workbook of which I am aware has any problem sets involving
ejectives. Charles Ferguson (1990) believes that textbooks or handbooks of historical
linguistics provide relatively little guidance on

'the relative probabilities of various possible sound changes, as well as explanatory
factors accounting for them. Also, because of the centrality of alternations and
processes to the field of phonological theory, one might expect that general treatises
and introductory textbooks on phonology would devote considerable space to this
topic. Unfortunately...this simple but important concern tends to be neglected. As
a consequence, inexperienced students...have no place to turn for a convenient list
of possible changes with indications of relative probabilities and conditions
favoring or disfavoring them.' (Ferguson 1990:60).

This thesis is one such attempt to provide a list of and explanation for the common
processes involving ejectives, though I do not subject it to statistical or probabilistic
analysis. It covers the most common, and natural processes, though it does not cover
every possible change. The recent development in phonological theory of feature geometry
(Clements 1985, Sagey 1986, Clements and Hume 1995) provides important restrictions
on possible changes and will form the framework of this thesis, as detailed later.

The question then arises about what type of data to examine for such changes.
Croft, Denning, and Kemmer describe the 'Greenberg position', with which I am
sympathetic, as follows: 'This emphatically empirical, cross-linguistically-based approach
to theory has always been tempered with a recognition of the inseparability of diachronic
and synchronic considerations in linguistic research' (1990:ix). Ferguson (1990:60-61) posits two assumptions that reflect such a position. The first is that synchronic phonological phenomena are a slice in time for diachronic change, since they have both a source and a variety of possible changes:

'Every segment provides, by its phonetic characteristics, allophonic variation, phonotactic limitations, morphological alternations, relative frequency, and a host of details of acquisition, dialect variation, etc., a set of clues as to its source and its possible directions of change, and in some instances it offers a remarkably clear picture of its diachrony.'

The second assumption is that language change proceeds within 'universal human constraints—perceptual, articulatory, cognitive, social' (1990:61).

This second position is reflected in earlier work by Ohala (1983), who examines aerodynamic and articulatory properties of speech to explain how they 'influence the shape and patterning of speech sounds'. Ohala also notes that sound patterns can be the result of psychological and social factors in addition to physical factors. He emphasizes that since physics and physiology are universal, it is necessary to look for repeated sound patterns in unrelated languages to be sure that the patterns are also universal. Ohala suggests the following as evidence:

'allophonic variation, sound change, dialect variation, morphophonemic alternation (i.e. contextually determined variation in the phonetic shape of a given morpheme within a single language), and patterns in segment inventories. In fact, I believe it is safe to regard all of these as manifestations of the same phenomena caught at different stages or viewed from slightly different angles. I assume that the allophonic variations cited arise from constraints of the vocal tract, the topic of interest. Some of these allophonic variations become sound changes. If a sound change affects words in one linguistic community but not another, dialect variation results. If the sound change affects a given morpheme in one phonetic environment but not another, then morphophonemic variation results.' (189-90)

The Greenberg/Ohala/Ferguson positions seem to me the right approach to dealing with a phenomenon that at present is little understood. However, the relation of synchrony and diachrony has not been the domain of only these scholars. Although Saussure is generally credited with introducing a sharp division between synchrony and diachrony, Jakobson (1931:267), cited in King (1968:3), noted that 'the uniting of static and dynamic processes in language is one of the fundamental dialectic antinomies which serve to characterize the concept of language. The dialectic of language development cannot be
understood without observance of this antinomy.’ Bloomfield’s (1939) *Menomini Morphophonemics* recognizes the formal similarity between diachronic change and synchronic rules. Kiparsky’s work notes this interplay, and within more recent generative literature, Bromberger and Halle (1989) note that formally, a sound ‘law’ is indistinguishable from a phonological rule. For this reason, many monographs and textbooks in phonology include both synchronic and diachronic data, e.g. Chomsky and Halle (1968), Schane (1973), Hyman (1975), Kenstowicz and Kisseberth (1979), Halle and Clements (1983), Clements (1985), Kenstowicz (1994), and Clements and Hume (1995).

Diachronic changes may not show evidence of all intermediate stages of sound change. And several sound changes may be telescoped in some morphophonemic alternations. Jeffers and Lehiste (1979:2) note the distinction between phonetic correspondences and phonetic processes, as in the correspondence in Ancient Greek $s > \emptyset / V\_V$ versus the more likely set of processes $s > h > \emptyset / V\_V$. Or more unusual still, note the correspondence (and set of phonetic processes) of PIE *dw-* to Armenian *erk-* (e.g. Hock 1986:583-4). Because of this uncertainty, I have distinguished within each chapter the type of evidence used.

Each chapter begins with a brief overview and a theoretical introduction, then introduces the data, generally beginning with synchronic alternations, and moving to loanword adaptation, ‘free’ variation, dialect differences, and diachronic correspondences. Where possible, phonetic explanation is given to provide insight into these changes. This is particularly the case in Chapter Seven, in which I provide data to support the controversial change from ejective to voiced stop.

### 1.4.3. Historical Questions and the Glottalic Theory

The historical, diachronic importance of ejectives has come to the forefront of historical linguistics with the advent of the Glottalic Theory, developed first in Gamkrelidze and Ivanov (1972, and more extensively in 1984, 1995) and developed semi-independently by Hopper (1973); (see Salmons 1993 for a concise overview, and Job 1995 for a review of Salmons). The Glottalic Theory (or more precisely, Hypothesis) proposes that Proto-Indo-European (PIE) contained a series of glottalic sounds, which are usually thought to be ejectives. Subsequently, this series has changed in most Indo-European languages. What follow are some of the stronger reasons for reconsidering the traditional reconstruction.
First, it has long been noted by Pedersen (1951), Martinet (1955), and most influentially, Jakobson (1958), that the traditional reconstruction of Indo-European with voiced, voiced aspirate, and voiceless series is typologically problematic—no human language known has just such a series, without also having a voiceless aspirated series. However, if the voiced series were interpreted as ejective (and the voiced aspirates as allophonic with a voiced series), the reconstructed stops are well attested in languages of the world. The key insight of the Glottalic Theory has been the application of typology to reconstruction, so that reconstructions should not violate known universals, ceteris paribus, though universals are always subject to testing against new data.

Hock (1986: 626) has offered examples of Indonesian languages which seem to violate Jakobson’s universal. Javanese, which Hock posits with a system like /p, bh/, actually has a contrast between stiff and slack voice; the latter has a slightly increased glottal aperture and moderate increase in airflow compared to modal voice (see the summary in Ladefoged and Maddieson (1996:63-64)). Since there is no contrast between slack and voiced sounds, this case does not violate Jakobson’s universal. Hock’s other languages such as Madurese, Kelabit11 and Lun Daye are better candidates, though Gamkrelidze and Ivanov (1995:12, fn 13) interpret Kelabit’s stop series as voiced, voiceless, and half-voiced, (that is, [-bp-], [-dt-] after a stressed vowel, and voiced elsewhere). Thus both the phonetic descriptions and the distinctive features involved in the phonological oppositions are ill understood and require further instrumental and phonological study.

The traditional bilabial stop *b is exceedingly rare, with few cognates with this sound, or according to some analysts, it is nonexistent; see Matasović (1994) for a study of this. Voiced stops on the whole are much rarer in traditionally reconstructed PIE than in most languages (Gamkrelidze and Ivanov 1995:13 cite a frequency of 6.2% according to counts by Jucquois (1966), a fact which remains difficult to explain, especially when compared to the traditionally reconstructed voiced aspirates, which have a frequency of 8.9%). (Hopper (1973:156-57), citing Meillet (1936:84), made similar observations.) The bilabial ejective [p’] is often missing from synchronic inventories12, and ejective series

11 Kelabit’s apparent violation of Jakobson’s universal was first pointed out by Blust (1973).

12 The best empirical evidence of this is found in Maddieson (1984) (though noted earlier in Haudricourt (1950), Greenberg (1970), Javkin (1977), and Fordyce 1980)). Maddieson observes that in his UPSID sample, “no language has /p’/ that does not have a velar, whereas 17 languages have /k’/ but no /p’/” (103). The relative paucity of bilabial
are often more marked and infrequent than in other series. Reinterpreting as ejective the series that is traditionally considered voiced accounts for the bilabial gap and the relatively low frequency of that stop series.

Much has also been made of the fact that PIE has no roots with two voiced consonants like *deg. Almost no language has such constraints on voiced consonants (though proponents of the Glottalic Theory often forget the operation of Lyman’s Law in Japanese, which prohibits Rendaku voicing in roots which have a voiced stop). However, several languages disallow roots with two ejectives such as *t’ek’ (e.g. in Quechua, and various languages of the Caucasus). See Chapter Six for examples of ejective dissimilation. Job (1995), however, argues that such constraints have been overstated. But root structure constraints involving ejectives are more common than those involving voiced stops.

All of the above points have been disputed, yet what Trask (1996) called a ‘sizeable minority’ of historical linguists believe the theory to be both plausible and a much-needed correction to intractable problems of the old reconstruction. As we have seen, the revision is based upon typological considerations.

Hopper (1990:157) notes that

‘Typology is normally held to be a synchronic science, one which attempts to establish relevant parameters for classifying language structure as it exists at a particular point in time. While the nature of these parameters is very theory-dependent, all typologists appear to agree on the postulate of a static, synchronic system in language.’

Hopper observes that synchronic investigation leads to ‘(i) implicational typological statements about phonological systems, and (ii) hypotheses about the type of change which is antecedent to the synchronic system’ (158). The most productive attempt to create a diachronic typology (a term employed by Gamkrelidze and Ivanov 1984, and most vigorously by Job 1984, 1989) is ‘the investigation of natural paths of change’ (Hopper 1990).

One of the most controversial changes required of the Glottalic Theory is for daughter languages to change an ejective to voiced stop (a point treated in great detail in
Chapter Seven). Many linguists have called such a change impossible, and even advocates of the Glottalic Theory note that the theory's synchronic arguments are stronger than the diachronic changes it requires. However, many critics and supporters of the theory lack a firm empirical grounding in the phonological patterning of ejectives, a point mentioned in section §1.4.2 above. Therefore, the third key contribution of this dissertation lies in understanding how ejectives can change over time. The data provided here can act as a guide in determining the relative likelihood of reconstructions and thus may help solve practical problems concerning the Glottalic Theory, and problems in the reconstructions of many of the world's languages, which are still in the beginning stage.

1.5. Methods

Although ejectives are the fourth most common type of stop (Henton, Ladefoged, and Maddieson (1992)), and, as we have seen, occur in almost 20% of the world's languages (Catford 1992), there is relatively little known about their phonological behavior in both synchronic rules and diachronic sound changes. And yet ejectives have now become an important area of research in both phonological theory and in historical linguistics.

For this thesis, I have drawn upon a large database of languages containing ejectives. Initially, this database utilized most of the bibliographic material for languages with ejectives found in UPSID (1992), which is a typologically balanced quota sample of 417 languages, 69 of which have ejectives. That is, only one language per small family was included, e.g. one from West Germanic. Later, my database was expanded to include numerous other languages with ejectives based on a sample of available grammars. Thus although based on the UPSID quota sample, my sample is a convenience sample, which Bell (1978:128) states is 'appropriate when very little is known very well'. The type of convenience is bibliographic convenience, drawn from the universe of good or adequate descriptions of languages with ejectives.

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13 Of the 128 sources listed in the UPSID bibliography for ejectives, I consulted with 100 (78%). I consulted at least one source for each of the languages in UPSID, oftentimes more, and many additional sources which I used were more up to date than those in UPSID.

14 The list of references includes over 150 substantive synchronic grammars or phonological sketches, in addition to numerous theoretical works with data, and diachronic or dialectal studies. This work contains data from over 185 linguistic varieties with ejectives, and refers to many dozen more. In all, there are over 1200 bibliographic items, more than 80% of which I have consulted firsthand.
As Buckley (1994) notes, in discussing a theoretical problem, one can give 'evidence from a wide range of languages to support a specific solution to the problem. This sort of synthesis is also essential to draw conclusions from the large amount of data scattered in various sources, but complex aspects of the individual languages must often be overlooked.'

I readily acknowledge that some complex issues may have been missed. Not all of the grammars that I consulted are as descriptively adequate as one would like and some of the material may need to be revised in light of further investigation. I am also often dependent on the assumptions made by my sources, such as the direction of a particular change, which is not always clearly motivated, but often just asserted. I am also cognizant of Thomason’s (1994) discussion regarding the quality of data in linguistics articles and have tried to prevent any abuses from occurring. It is my hope that by including as much material as possible and by citing additional sources of evidence, even if one or two data points are questionable, the thesis as a whole will stand because of the plethora of cases I present.

Hyman (1985:359) has claimed that 'the major contributions to phonology have been accomplished by theoretically minded scholars, not by the hunters and gatherers…' Yet I would add that were it not for the hunters and gatherers, the theoreticians would not eat. In this dissertation I try to be a little of both. By gathering in one place much of what is known about ejectives, and in creating a typology of sound change, I hope I can contribute to linguistics both empirically and theoretically.

1.6. Use of the IPA
Throughout this dissertation, I have converted all data transcriptions to conform to the International Phonetic Alphabet (IPA). I have especially been concerned with consistency among consonants and thought it best to standardize them. If I were to simply provide data in the original orthography or transcription, the reader would constantly have had to adjust to new conventions. For example, ejectives are transcribed as simple

\[ \text{\textit{\textsuperscript{15}} Due to typographic limitations, I have made one exception. The glottalized palatal glide is indicated by a following apostrophe (''\textsuperscript{1}'), which normally indicates ejection, instead of a subscript tilde, which indicates laryngealization or glottalization (''\textsuperscript{2}j\textsuperscript{2}'}). This was done because of the poor legibility of the diacritic under the descender of this character. Although diacritics may be placed above a character with a descender, the dot of the \textsuperscript{3}j\textsuperscript{3} is lost, and there is potential confusion with the diacritic for nasalization.} \]
voiceless stops [p t k] in Nguni languages and in older Caucasian literature (distinguished from plain stops by a digraph for aspiration; in more contemporary Caucasian studies, ejectives are transcribed by an underdot or overdot, as in: [p̲, t̲, k̲]). Ejectives are also transcribed as consonant plus glottal stop (see Chapter 8 on Fusion) [pʔ, tʔ, kʔ], or with an overset diacritic [p̲, t̲, k̲], or with the IPA apostrophe [p', t', k']. Other symbols like [c] could be interpreted as a palatal stop [c], an alveopalatal fricative [ʃ], an alveopalatal affricate [tʃ], an alveolar affricate [ʦ], etc. I therefore thought it best to impose consistency from data set to data set. I have attempted to be consistent for vowels, where a symbol like [a̯'] could be [æ] or [e] or [a]. However, where the source is vague, I have not imposed a conversion to IPA format. A full chart of the most recent 1996 IPA chart may be found in the unnumbered center pages of the Journal of the International Phonetic Association 25:1.

Although it may be common practice to use transcription which is particular to a given language family, or from that of the source (see Kenstowicz 1993:25, or the Language Style Sheet, e.g. LSA Bulletin 154:73 §6d (1996)), I join Ladefoged (1990a) in urging linguists 'to abandon idiosyncratic systems of phonetic representation, and to adopt the new international standard'. Ladefoged hopes that 'the use of locally approved symbols should become as rare as the reporting of scientific results in other fields in local units.' For this reason, and for consistency's sake, all transcriptions will follow standard IPA conventions.

Despite the uniform transcriptions, there is a certain ambiguity in some transcriptions. For example, in Ethiopian Semitic, geminate ejectives are often transcribed with two apostrophes (or underdots): <č'č'>. Phonetically, however, this is a single segment, with a single release, whose closure component is held longer: [čč̲]. Compare this with Lushootseed [ʃʃ'ʃ'ʃ'əʔ] 'gravel', where the geminate has two ejective releases or with the Montana Salish sequence [ʃʃʃʃ's'əʔʃʃʃʃ'əʔ] 'wood tick', with separate releases on all three initial affricates (Fleming, Ladefoged, and Thomason 1994:12, which contains a spectrogram). Part of the problem is with different transcription traditions, and part has to due with the preservation of phonological information in phonetic transcriptions. Although I usually alert the reader of these ambiguities, this issue should be kept in the back of the mind.

Another potential problem with transcriptions here is that they have generally been taken at face value. For example, in a putative sequence of <pt',> the bilabial stop may in fact share some glottal closure with the following ejective, which may be evidenced by a laryngealization on a preceding vowel. However, because the bilabial may lack the distinct
pop characteristic of ejectives, the linguist may have transcribed the sound in question as a voiceless stop. Both phonetics and phonology may come in to play to help decide problems of transcription. Ideally, one would like to have spectrograms to help confirm impressionistic transcriptions. These would help one look for hints of glottal constriction or ejection on sounds in question, or their neighboring sounds. But such evidence is often hard to come by. The phonological oppositions of the language also help establish whether there is a contrast between, say [p’t’] and [pt’]. Finally, one must consider the reputation, reliability, and experience of the authority in question.

1.7. Overview of the Thesis
Fre Woldu (1988:707) has noted that

‘the exact relative timing of the three independent gestures, i.e. the lips or tongue, the glottis and the larynx box, which join to make an ejective consonant is utterly important. In particular, the coordination that takes place at the moment of closure is highly critical. This fact is even more interesting, since these coordinations are made in preparation for the acoustic event which is to happen at the end of the closure interval.’

Later he continues:

‘In general, each way in which a speaker may naturally fail to produce the optimal acoustic pattern points to a possible line of development. Also, each alternative method of naturally producing essentially the same effect suggests a possible direction for further developments’ (709).

Fre Woldu’s phonetic comments find their parallel in the theory of phonology known as feature geometry. Feature geometry (explained in greater detail in §2.4.2) imposes a hierarchical organization on features. Coupled with the spreading or deletion of association lines, we can account for the vast majority of phonological processes which ejectives undergo. The thesis is organized around the relation between feature structure and the change of association lines, and provides a typology of sound alternations and change for ejectives.

Chapter Two provides a review of the phonological proposals for distinctive features to describe ejectives, from Trubetzkoy’s recursion, Jakobson’s [checked], and Halle and Stevens’ [constricted glottis] ([c.g.]), to Lombardi’s current proposals that the feature [glottal] is in fact privative. The chapter also explores the debate of the nature of
features (binary, multivalued, or privative), and traces the influence of feature geometry, particularly the role of the Laryngeal node.

The spreading of association lines, which results in some form of assimilation, is covered in Chapter Three. Plain stops adjacent to an ejective often become ejective as the result of spreading of the Laryngeal node, though spread of the individual feature [e.g.] alone is rare. The chapter also examines cases of complete assimilation, which result from the spreading of the Root node.

Deglottalization, in which an ejective loses its laryngeal constriction but preserves its oral stricture, is viewed as the loss of laryngeal features or the Laryngeal node due to delinking. Chapter Four covers the major cases and circumstances in which laryngeal features are lost. These are typical weakening environments, such as in coda position and/or in preconsonantal position.

Chapter Five examines another type of lenition, debuccalization, in which ejectives preserve only a glottal constriction, but lose all type of oral stricture. The theory of feature geometry developed by Clements and Hume (1995) predicts there to be four possible types of debuccalization: deletion of the Root Node, deletion of the Oral Cavity node, deletion of the C-place node, and deletion of individual place features. This chapter provides empirical evidence to confirm most of the predictions of this model of feature geometry, and criticizes other characterizations of debuccalization.

The occurrence of two ejectives within the same morpheme or word often triggers a change in one of them due to dissimilation. Chapter Six provides a detailed look at various types of ejective dissimilation and their outcomes, most often involving loss of one feature (deglottalization), so that some ejectives become voiced.

Chapter Seven discusses the voicing of ejectives and the theoretical problems of feature changing. A wealth of potential cases of ejective voicing are scrutinized, and I conclude that feature theory does not need to admit direct feature changing since voicing can be accounted for by spreading and feature default. I examine the implications of these changes for the Glottalic Theory and conclude that while ejective voicing is not the most common of processes, there is ample universal precedent for such a change, and both critics and supporters of the Glottalic Theory should not view this as the weakest link of the theory. Because of the importance of this conclusion, I bolster the synchronic and diachronic phonological evidence with a detailed look at the phonetics of ejectives and propose various scenarios in which they may become voiced.
The last data chapter, Chapter Eight, argues that the processes of fusion and fission must be admitted as basic autosegmental operations. I provide many examples of glottal stops or a floating glottal feature merging (fusing) with a voiceless stop. Cases of fission are rarer, largely because of the rarity of this process and the rarity of ejectives.

The thesis ends with a brief concluding chapter. I include as an appendix a comparative list of subjective phonetic impressions of ejectives. Such insights complement the phonetic observations in Chapter Seven, and also provide phonetic background for the deglottalization of ejectives discussed in Chapter Four.
CHAPTER 2
LARYNGEAL AND PHONATORY FEATURES AND REPRESENTATIONS

2.1. Introduction
Ejectives are the fourth most common phonation type for stops (Henton, Ladefoged, and Maddieson 1992), yet relatively little is known about their phonological behavior. For example, which feature or features characterize ejectives? This question will be addressed in §2.2. Several different features have been proposed, from Trubetzkoy’s [recursion] and Jakobson’s [checked], to the little-used system of SPE. The system of Halle and Stevens (1971) has been partially adopted by phonologists and their feature for ejectives as [+constricted glottis] has won wide acceptance.

The nature of features will be discussed in §2.3. Some scholars have argued that the features are binary, while others insist that laryngeal features are scalar or multi-valued. More recently, several scholars have suggested that laryngeal features are privative, a point which I accept in this thesis.

Finally, the organization and representation of ejectives have also changed in phonology. From linear representations of segments, phonologists have generally recognized that laryngeal features pattern as a class and should be grouped as a node in feature geometry. Section 2.4 examines the structure of laryngeal features as a constituent, and dismisses attempts to find further structure within the laryngeal node. Lastly, Steriade’s proposal of aperture features is evaluated, and found to be insightful, yet lacking in their integration into a geometry.

2.2. Laryngeal and Phonatory Features
This section will deal with the laryngeal features, especially those of ejectives, proposed by Trubetzkoy (2.2.1), Jakobson and his colleagues (2.2.2), SPE (2.2.3), and Halle and Stevens, as well as features which derive from these frameworks. The practice of enclosing feature names in square brackets will be used consistently here, even when the original authors did not employ them.
According to Kenstowicz and Kisseberth (1979:241-2), there are four general criteria in motivating a feature system.

(1) (a) 'An adequate feature system must permit any two sounds that contrast in any language to be represented by distinct feature [representations-PF].'
(b) 'An adequate feature system should permit any natural class of sounds to be represented by the conjunction of features in a [representation-PF].'
(c) 'Some writers have suggested that a feature system should be able to explain why certain sound changes characteristically take place only in certain contexts.'
(d) A system should be able 'to formally exclude feature combinations which never describe a possible sound.'

To these criteria, Schane (1973:33-4) adds that features must be phonetically-based; features should accommodate the principal allophones of a language, and they must be adequate for describing 'important phonetic differences between languages'. For additional discussion, see Keating (1988b) and Ladefoged (1989).

In this context, we will examine in this section various proposals for the features that characterize laryngeal contrasts, particularly those involving ejectives.

2.2.1. The Distinctive Phonic Properties of Trubetzkoy

N.S. Trubetzkoy, who had an intimate knowledge of ejectives from his extensive fieldwork with Caucasian languages, was the first to develop universal phonological features. Regarding articulatory movements and their acoustic effects, Trubetzkoy believed that 'none of these "acoustic atoms" can be considered a phonological unit since all of them always occur in unison, never in isolation' ([1939] 1969:34). Nevertheless, he did propose an extensive analysis of what would be the forerunner to distinctive features in his 'phonic properties', which form 'phonological (distinctive) oppositions in the various languages of the world' ([1939]1969:91). These properties were enumerated to make it possible to analyze the types of oppositions in a given language and to compare the phonological systems of different languages.

Of the many properties proposed by Trubetzkoy, what concerns us most are the 'properties based on the manner of overcoming an obstruction' (Ueberwindungsarbeitige-schaften) ([1939]1969:94). There were two main types of these properties. The first,
‘overcoming an obstruction of the first degree’, covered stricture features, while the second type, ‘properties based on the manner of overcoming an obstruction of the second degree’, covered six or seven basic laryngeal qualities, or correlations. The one most relevant for ejectives was the correlation of ‘recursion’¹, the opposition between consonants produced by air flowing from the lungs and consonants that are only produced by the air accumulated above the closed glottis and expelled by means of a pistonlike thrust of the closed glottis’ (1969:145-6).

In examining possible combinations of laryngeal correlations and possible laryngeal contrasts, Trubetzkoy discusses languages with two correlations (which from his examples means three series). He notes that ‘one of these correlations is either the correlation of aspiration or the correlation of recursion’ (1969:152). The other is either tension, or a combination of tension and voice.

‘If one considers that the unmarked members of the correlation of recursion are usually realized as aspirates (in order to bring out more clearly the contrast to the recursives, which are produced with a closed glottis and hence with very little air), one must become aware of the close relation between the correlation of aspiration and the correlation of recursion: they are distinguished from each other only in that in the one the “strong,” in the other the “weak,” member of the opposition is marked. Phonetically this is expressed by an exaggeration of its “strength” (through energetic air pressure, that is, aspiration) or of its “weakness” (through lessening of the air pressure by means of glottal closure).’ (152).

Trubetzkoy claims that if the correlation of recursion is one element of the ‘correlation bundle’, then one member of the series is lenis (i.e. voiced or voiceless) (153).

These correlations were an important early contribution to typological studies of laryngeal contrasts. However, Trubetzkoy’s correlations were not widely adopted, in part because of his death in 1938 at age 48 and because of the outbreak of world war. When the war ended, Jakobsonian binary features would dominate phonologists’ conceptions of distinctive features for the next two decades.

2.2.2. Laryngeal Features of Jakobson, Fant, and Halle
Roman Jakobson developed distinctive feature theory in a number of ways. Perhaps most important of them was the fact that, unlike Trubetzkoy, he viewed features as components of phonemes, and hence the minimal phonological unit. According to Anderson (1985),

¹ Recursion is clearly Trubetzkoy’s term for ejectives, as noted in his footnote 136 in Chapter IV of Trubetzkoy (1939[1969]).
Jakobson contributed to distinctive features in three main ways. First, he viewed all features as binary, rejecting Trubetzkoy's multilateral oppositions. Second, he defined every feature both acoustically and articulatorily. Third, he developed a unified set of features for both consonants and vowels. The set of features was much smaller than Trubetzkoy's, and the definitions aimed for relative definitions which encompassed several phonetic distinctions in one phonological category. For example, [flat] was used for rounding, retroflexion, velarization, and pharyngealization, thought then not to be contrastive.

Jakobson first used the term 'distinctive feature' (which he took from Bloomfield [1933], according to Fischer-Jørgensen 1975:146) in his articles in 1949 (Jakobson 1949a; Jakobson and Lotz 1949). In them he developed six features in his analysis of French and Serbo-Croatian, in sharp contrast to the numerous ones proposed by Trubetzkoy. Relevant laryngeal features included [voicing] for Serbo-Croatian and [tense] for French. In these two articles, the notion of distinctive features as a matrix of binary feature specifications was first developed.

A fuller theory of twelve 'inherent' features was expounded in Preliminaries to Speech Analysis, first published in 1952 with co-authors C. Gunnar M. Fant and Morris Halle. In this system, there were three laryngeal features: [voiced], [tense], and [checked]. We will look at these in turn.

2.2.2.1. [voiced]/[voiceless]

In Jakobson, Fant, and Halle's system, voiced consonants 'are characterized by the superposition of a harmonic sound source upon the noise source' of voiceless consonants. Voiced consonants thus have 'a joint presence of two sound sources'. Voiced consonants show in spectrograms formants from the harmonic source and 'a strong low component' of the voice bar. In terms of production, 'voiced phonemes are emitted with concomitant periodic vibrations of the vocal bands and voiceless phonemes without such vibrations'. This feature is one of the few Jakobsonian features still in use today, though it was abolished in the Halle and Stevens (1971) system of laryngeal features.

2.2.2.2. [tense]/[lax]

The feature [tense] covers both consonants and vowels. In reference to consonants, the term fortis is often used interchangeably with [tense]. 'In contradistinction to the lax phonemes the corresponding tense phonemes display a longer sound interval and a larger
energy (defined as the area under the envelope of the sound intensity curve...') (1952:36).

In consonants, 'tenseness is manifested primarily by the lengthening of their sounding period, and in stops, in addition, by the greater strength of the explosion' (36). In terms of production, tense phonemes 'are articulated with greater distinctness and pressure than the corresponding lax phonemes' (38), with greater muscular strain. Jakobson and Halle (1956:30) note that the role of muscular strain 'requires further examination'. In Jakobson and Halle (1968:431), [tense] was listed as a 'protensity' feature (vs. sonority and tonality features) to parallel the prosodic features of quantity (vs. force and tone) (428). Jakobson and Halle (1964:554) write that [tense] for consonants is to refer specifically to the fortis variety, which are opposed to lenis consonants by 'a higher air pressure behind the point of articulation and by a longer duration'. They also imply that the feature may apply to aspirated vs. unaspirated consonants. As examples of tense vs. lax consonants in English, Jakobson, Fant, and Halle cite pill—bilL till—dill etc. (1952:36).

The feature [tense] for consonants was maintained in Chomsky and Halle (1968), though it has since been abandoned (for consonantal use at least) by most phonologists, who most often use a laryngeal feature to describe fortis consonants (e.g. [constricted glottis] in Korean).

Greenberg (1970:127) proposes to cross-classify ejectives vs. implosives (injectives) on the basis of the feature [tense/lax], whereby both are specified as [glottal] and ejectives are [tense], while implosives are [lax]; Jakobson preferred that they be distinguished by the feature [voice]. Greenberg argues that implosives are often reported to be laxer than plain voiced stops, and voiceless implosives of Kharia are reported to be lax (Pinnow 1959:30, cited in Greenberg 1970:127). However, Lombardi (1991:32) considers voiceless implosives to be just another possible realization of voiceless glottalized consonants and notes that there is no phonological evidence to distinguish voiceless implosives from ejectives. She begs the question, however, of how feature theory should characterize the allophonic differences among languages.

Catford (1977:203) has observed that 'the terms tense/lax, strong/weak, fortis/lenis, and so on, should never be loosely and carelessly used without precise phonetic specification'. Ladefoged and Maddieson (1996) attempt to provide such specification, yet the reader should be wary of the phonological use of this feature.
2.2.2.3. [checked]/[unchecked]

The Preliminaries feature for glottalic sounds is [checked] vs. [unchecked] for non-glottalic sounds\(^2\). The acoustic definition of [checked] was characterized as follows:

'In spectrograms, checked phonemes are marked by a sharper termination, but this is ordinarily less prominent than an abrupt onset' (1952:23). In terms of production, Jakobson, Fant, and Halle (1952:23) observe that 'the airstream is checked by the compression or closure of the glottis'. They go on to note that there are 'certain varieties of checked stops, called glottalized' which are found in many languages of America, Africa, the Far East, and the Caucasus. (The implicature, developed only ten years later in work by Jakobson (1962) and by Jakobson and Halle (1968), is that there are nonglottalized checked stops). They cite as examples of checked stops the ejectives of Circassian, and include spectrograms from Navajo and Circassian. The authors admit that the glottalization of constrictives (i.e. continuants) in Tlingit and Kabardian is 'less clear and most uncommon'. The authors conclude their section on [checked] with the comment that 'in languages that have an opposition of checked and unchecked stops, the checked glide (called "glottal catch") is related to the unchecked (even or gradual) glide as a glottalized consonant is to the corresponding non-glottalized' (1952:23).

Minor revised definitions of [checked] may be found in Jakobson and Halle (1956:31), and Jakobson and Halle (1957), which specifically mentions the 'rare combination of two distinctive features, tense and checked, within one and the same phoneme, such as the Avar /K/' (Jakobson and Halle 1957, reprinted in Jakobson 1971:497).

In answer to a question from P.S. Kucenov (1958, cited in Jakobson 1962a:453; see also 1962c:655) whether the opposition between implosives and explosives should be added to the list of distinctive features, Jakobson responded negatively. He thought the feature [checked] encoded the same difference, and that voicing distinctions were sufficient to distinguish ejectives from implosives, where, indeed this was necessary, since in some cases they are in free variation, and in others, the glottalic sound was realized phonetically differently according to place of articulation.

In the revised description of the feature [checked/unchecked] given in Jakobson and Halle (1968:430), the point is taken further. Not only are ejectives and implosives not generally distinguished (all things being equal), but another phonetic class of sounds,

\(^2\) This term should not be confused with the traditional phonetic terminology of 'checked' syllable or vowel, which refers to a closed syllable or vowel, i.e. one with a coda.
clicks, are subsumed under the feature [checked]: ‘Checked phonemes are implemented in three different ways – as ejective (glottalized) consonants, as implosives or clicks.’ Jakobson (1971:722) claimed that ‘ejectives, implosives, and clicks are phonemically incompatible’ and ‘are to be treated as different interpretations of one and the same distinctive feature: checked ~ unchecked’ (726). Jakobson defends the articulatory description, but notes that the acoustic definition needs further investigation. As late as 1979, Jakobson and Waugh (1979:145) continue to describe ejectives, implosives, and clicks with the feature [checked], where clicks were ‘merely... a different contextual, partly geographically conditioned implementation of one and the same distinctive feature, checked ~ unchecked’ (145).

Fischer-Jørgensen (1975:159) claims that the acoustic definition of this feature is ‘very questionable’ since it is difficult to give a common acoustic definition for ejectives, implosives, and clicks. Traill (1985) provides a devastating critique of the Jakobsonian features as they apply to the clicks and ejectives of Zulu and Korana. Furthermore, it is not a universal that languages cannot contrast ejectives and implosives at the same place of articulation; languages which contrast these sounds cannot therefore do so on the basis of [checked] alone (hence Jakobson’s use of the feature [voice]). Ladefoged (1971:27) cites Robin Thelwall’s fieldwork on Uduk, a Nilo-Saharan language, in providing contrastive environments of different phonation types at the same place of articulation. See also Thelwall (1983), Ladefoged (1982:123), and Ladefoged and Maddieson (1996:82).

(2)  t'ècf ‘to lick’
     dèk’ ‘to lift’
     dèd ‘to shiver’
     tèr ‘to collect’
     thèr ‘to pour off’

Koma, another Nilo-Saharan language, makes a similar contrast, as do Kullo and Hamer (Omoitic), Goemai (Chadic), Zulu (Southern Bantu), Maidu (Penutian), and Southern Nambiquara (Macro-Tucanoan). Otomi (Oto-Manguean) contrasts ejectives with voiced

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3 And as late as 1987, five years after Jakobson’s death, if we count the second edition of *The sound shape of language* (1987:148). However, the second edition recognizes ‘the retouches to be made in the delimitation of these three subspecies’ of checked consonants.
laryngealized stops. However, as noted earlier, these facts in themselves does not argue against the 'empirical adequacy' of the feature [checked] (Fischcr-Jørgensen 1975); they argue against it being the sole feature which distinguishes the two glottalic sounds.

Greenberg (1970:126) reports that in Mayan Chontal (Keller 1958), a voiceless bilabial implosive contrasts word-finally with a voiceless ejective, e.g. /seβ/ [seβ] 'fast' vs. /sop'/ [sop'] 'it is light weight'. If this is true, then this would pose a problem for the Jakobsonian conception of [checked], though other features, such as [tense] could possibly serve to distinguish the two; if this were the case, however, empirical verification of the phonetic implementation of these features would probably not confirm such a hypothesis. Owerri Igbo (Ladefoged, Williamson, Elugbe, and Uwalaka (1976) contrasts voiced and voiceless implosives, in addition to plain and aspirated voiceless stops, and plain voiced and breathy voiced stops. For example, [} Ça] 'to gather' vs. [} 6a] 'to dance' (Ladefoged and Maddieson 1996:60). Such a contrast is also found in Lendu (Goyvaerts 1988, Demolin 1995). However, with the above exception of Chontal, I know of no language which has a phonemic contrast between voiceless ejectives and voiceless implosives.

In sum, the use of [checked] has largely declined because of difficulties in formulating and empirically verifying the claims that ejectives, implosives, and clicks pattern together. The definition of [checked] has proven to be overly broad, but instead of restricting it to its original usage, linguists abandoned the Preliminaries laryngeal features in favor of the more complicated, if ephemeral, laryngeal feature system of Chomsky and Halle (1968), which soon came to command more immediate attention.

2.2.3. The Sound Pattern of English

Chomsky and Halle (1968), henceforth SPE, expanded the number of features used in an attempt to more accurately capture the phonetic descriptions. There are 'as many phonetic features as there are aspects under partially independent control' (297). Thus 'the totality of phonetic features can be said to represent the speech-producing capabilities of the human vocal apparatus' (297). Features were described mainly articulatorily; perceptual and acoustic correlates of features were not discussed in depth simply for reasons of space (299). There are two aspects to the phonetic features of SPE. First, features at the level of lexical representation take a binary coefficient, either plus or minus. Second, at the level of phonetic representation, that is, at the output of the phonology, feature values are scalar integers, from 1...n. (Scalar features in the phonology were utilized in the stress system, however). Another reason for the increase of features was to formally capture notions of...
simplicity in the operation of phonological rules. The evaluation metric and related notions of formal simplicity played an important theoretical part in evaluating grammars.

*SPE* proposed several relevant laryngeal features, including [glottal constriction], [(glottal) pressure] = [ejective], [heightened subglottal pressure], and [voice]. While these features were defined phonetically, Chomsky and Halle did not delve much into the phonological patterning since many of them were not relevant for English phonology. Keating (1988a:17) adds that ‘the various features interacted in somewhat complicated ways in determining vibration, aspiration, etc., and were therefore perhaps too hard to learn to use, rather than theoretically unacceptable...’.

The laryngeal/phonation/airstream features are classified in different ways in Chomsky and Halle’s exposition. Relevant cavity features include [glottal constriction], which involved ‘narrowing the glottal aperture beyond its neutral position’. Such sounds included ejectives, implosives, and Korean glottalized (fortis) stops, ‘as well as certain types of clicks’ (315). Under supplementary manner of articulation features, there are two chief categories: [suction], which includes implosion, and is also used for clicks, and [glottal pressure], or [ejection], which includes ejectives. The feature [tense] has a complex interaction with voicing, though Ladefoged (1971) criticizes the feature [tense] on phonetic grounds.

Two source features, [heightened subglottal pressure] ([h.s.p.]) and [voiced], were proposed. [H.s.p.] seems to be abandoned in the description of Indo-European root constraints later in their work (1968:386-7) in favor of the feature [±aspirated], perhaps inspired by Stanley (1967:433), who used [±aspirate]. Ladefoged (1971:95-6) criticizes Chomsky and Halle’s interpretation of [h.s.p.], since he claims that they imply that voiceless initial stops in English have heightened subglottal pressure. Ladefoged cites published studies which prove this is not the case, and discusses ambiguous data on voiced aspirates. The feature [voiced] has stood up better to subsequent criticism, and seems well supported on empirical cross-linguistic and phonetic grounds, though Halle would soon abandon it.

In response to the study of Lisker and Abramson (1964), in which voice onset time (VOT) was studied cross-linguistically, Chomsky and Halle ‘do not share Lisker and Abramson’s view that it is the timing of the onset of vocal cord vibrations that is being controlled in implementing the various feature complexes that in the phonetic literature have often been subsumed under the term “voicing”’ (327). Chomsky and Halle instead use four phonetic features: voicing, tenseness, glottal constriction, and subglottal pressure to
account for the different VOTs. Lisker and Abramson (1971) harshly criticize the SPE feature system, stating that 'it is unfortunate, in our view, that Chomsky & Halle have not only been highly selective in what they have chosen to recognize as relevant phonetic observations, but that they have apparently paid only just enough attention to the papers chosen for citation to note those findings which are compatible with their own descriptive scheme' (774). Despite these criticisms, Keating (1988a:18) observes that 'in general, however, Lisker & Abramson's work has had no impact on phonologists.' Two reasons for this suggested by Keating are Lisker and Abramson's lack of a formal featural or representational alternative, and their use of relative timing, as opposed to the static dimension used by SPE and other phonological accounts, which describe laryngeal differences in terms of feature combination, not by subsegmental timing.

In addition, phoneticians such as Catford (1977) and Traill (1985) provide detailed critiques of the SPE system. Because of the complicated nature of the proposed feature system; because it attempted to be thorough and precise in its phonetic descriptions, yet was severely criticized by phoneticians and phonologists alike; because the exposition was only adumbrated but never fully illustrated with concrete examples; and because Halle himself extensively revised the system three years after the publication of SPE, this system never won wide acceptance by phonologists.

2.2.4 Halle and Stevens' Laryngeal Features

2.2.4.1. Outline of the Feature System

Halle and Stevens (1971) proposed four laryngeal features based on (a) the two-mass model of the vocal cords proposed by Ishizaka and Matsudaira (1968), and on (b) unpublished work by Stevens. These four articulatorily-based features derive from two parameters suggested by the model: (1) stiffness of the vocal cords, and (2) static glottal opening. Halle and Stevens propose replacing 'such traditional features as voicing, aspiration, glottalization, vowel pitch, and so forth' (201) with the following four features: [spread glottis], [constricted glottis], [stiff vocal cords], and [slack vocal cords]4. Halle and Stevens' great innovation was the attempt to relate such diverse phenomena as

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4 These features have various interchangeable abbreviations. [Spread glottis] is called [spread], [spr. gl.], or [s.g.]. [Constricted glottis] is also referred to as [constricted], [constr. gl.], or [s.g.]. [Stiff vocal cords] is clipped to [stiff] or [stiff v.c.], while [slack vocal cords] is likewise [slack] or [slack v.c.].
laryngeal quality, airstream mechanism, and tonal features in a relatively simple system which strived for great phonetic detail.

Two of their features have been widely accepted by phonologists and are still in use today. The feature [spread glottis] refers to displacement of the arytenoid cartilages, so that the vocal folds are left with a large glottal width. If the vocal folds are stiff, voiceless aspirated consonants would result, and if they are slack, voiced aspirated, or more precisely, breathy voiced consonants would be described. This feature is thus used for 'aspirated consonants, breathy voiced or murmured consonants, voiceless vowels and glides vs. all others' (Halle and Clements 1983:7-8).

The second feature in the glottal width parameter, and the one most relevant to ejectives, is [constricted glottis], which, as its name implied, refers to sounds made with adduction of the arytenoid cartilages and other muscles such that the vocal folds are pressed together, making a narrow or closed glottis. This feature captures the natural class of 'ejectives, implosives, glottalized or laryngealized consonants, vowels and glides vs. all others' (Halle and Clements 1983:8).

Halle and Stevens' two vocal fold stiffness features have not won widespread support by phonologists and have been heavily criticized by phoneticians. The feature [stiff vocal cords] characterizes a stiffening of the vocal folds, which inhibits voicing. Natural classes captured by this sound include sounds traditionally labelled voiceless, such as plain and aspirated voiceless consonants, ejectives, and high-pitched vowels, vs. all other sounds. [Slack vocal cords] are formed by decreasing tension of the vocal folds and glottis walls. This feature captures voiced obstruents, low-pitched vowels, and is also used in creaky and breathy voiced vowels.

The feature combinations [+spread, +constricted] and [+stiff, +slack] are excluded for logical and physiological reasons. There are thus nine possible feature combinations, as shown below in (3), which illustrates the potential contrasts with bilabials. In column 1, [b_t] refers to a 'lax voiceless stop' of the type found in Danish and in initial position for some speakers of English. The [p_k] of column 4 refers to the moderately aspirated Korean stop. The sounds [W] and [Y] represent the voiceless glides [w] and [j]. The sound [ʔb] in column 8 is a laryngealized stop of the type found in Hausa, while [ʔ] is a so-called 'voiced glottal stop' allegedly attested in Jingpho (though see Catford 1977a and Ladefoged and Maddieson 1996 for discussions of the impossibility of this sound). Finally, [pʔ] in column 9 is simply an ejective stop [p'].

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After Halle and Stevens’ Table IX-5 (1971:203)

Catford (1977a) criticizes the Halle and Stevens system, noting that ‘it suffers from what is almost an inevitable defect of all purely theoretical and highly restricted systems of features, namely, a tendency to the procrustean forcing of items into particular categories, whether this categorization corresponds to reality or not.’ This criticism was also echoed by Keating (1984), who points out that one of the problems of the SPE and the Halle and Stevens approach to features is that they ‘don’t simply have the wrong features in these instances; they will always have too many features because they want to describe exactly how individual sounds are articulated’ (289). Ladefoged (1973:80) gives a detailed exposition on possible contrasts of sounds, showing that the maximal number of laryngeal settings contrasts appears to be six, as evidenced by languages such as Beja and Owerri Igbo (Ladefoged and Maddieson 1996:87). Iverson (1983) is a proposal which constrains the Halle and Stevens features to accord with these facts.

One of the major particular criticisms of the Halle and Stevens feature system is that voice is not represented by a single phonological feature. Instead, voiceless sounds are [+stiff, -slack], while voiced ones are [-stiff, +slack]. The common process of voicing assimilation requires that two features be changed (or spread in autosegmental treatments), and by the evaluation metric, this was a costly process for what is in reality a common phenomenon. In addition, as Ladefoged (1973:83) observes, natural rules of assimilation,
as in Japanese high vowel devoicing between voiceless obstruents would have to be formulated as:

(4) [+syl, +hi] → [+spread glottis] / [+stiff vocal cords] ___ [+stiff vocal cords]

This formulation does not formally capture the voicing assimilation which occurs. Likewise, intervocalic voicing would be expressed in an ad hoc manner.

Other criticisms relate to the definitions of the features or empirical contradictions between the definition and phonetic data. Keating (1988a) notes that Chen (1970) and other studies have provided evidence from laryngeal EMG data which shows that there is no difference in vocal cord stiffness between voiced and voiceless consonants; the Halle and Stevens system predicts that voiced obstruents will be slack while voiceless ones will be stiff. Furthermore, as Keating (1988a) observed, voiceless consonants are more commonly made with a spreading gesture than they are with stiff vocal folds. The feature [+spread vocal cords] (at the moment of release) entails both voicelessness and aspiration. Yet the same feature completed during stop closure would result in a voiceless unaspirated stop.

Concerning ejectives, Trigo, citing Kingston (1985a), suggests that because the state of the vocal folds may differ among ejectives and implosives, 'the vertical displacement of the larynx is not a mechanical consequence of the intrinsic laryngeal features' (1991:118).

Ladefoged (1972) has criticized the characterization of creaky sounds, and Catford (1977) has criticized the role of vocal fold tension in the distinction between voiced stops and voiced implosives. And numerous studies (Anderson 1978 and other papers in Fromkin 1978) criticized their feature system as it pertained to tone. Keating (1988a:22) concluded that

'there are enough problems with the H&S feature system that it should be used only with extreme caution and only after considering the difficulties discussed here and in the literature. To be sure, most of the difficulties center on the use of the vocal cord stiffness features, especially in connection with tone; the glottal stricture features are less problematic.'

Despite these criticisms, many scholars influenced by Halle continue to use them. Hayes (1984) suggests that the phonetic and phonological facts of Russian require two features for voicing. Sagey (1986) defends Halle’s system. Scholars such as Bao (1990) and
Duanmu (1990) incorporate these features as they interact with tone. Kenstowicz (1993:40) diplomatically hedges on the Halle and Stevens vocal cord features, stating 'if the distinction between the fully voiced [b] of French and the partially voiced [b] of English is simply a matter of phonetic implementation, we may replace [stiff vf] and [slack vf] with [voiced]'. But despite Halle's (1992, 1995) continued use of these features, most phonologists have abandoned the two vocal cord stiffness features in favor of a feature [voice]. (Stevens and Keyser (1989) appeared to have abandoned those features in favor of [voice]; however Keyser and Stevens (1994) reintroduce [stiff] and [slack] without comment.)

The features used in Halle and Clements (1983) drop the vocal cord stiffness parameter in favor of [voiced], defined as follows:

(5) [voiced] 'Voiced sounds are produced with a laryngeal configuration permitting periodic vibration of the vocal cords; voiceless sounds lack such periodic vibration. (Voiced vs. voiceless consonants.)'

(Halle and Clements 1983:8)

Clements and Hume (1995) essentially endorse the features of Halle and Clements (1983), which preserves Halle and Stevens' glottal constriction features [spread glottis] and [constricted glottis], while dusting off the Preliminaries and SPE feature of [voiced]. And this seems to be the most common practice of phonologists today. Lombardi (1991) proposed that laryngeal features are privative (a subject discussed in §2.3.3). Yet although she renamed the features [aspirated] and [glottal], along with [voice], they are essentially the same feature definitions as [s.g.], [e.g.], and [voiced].

Aside from the problems relating to vocal fold tension, the modified Halle and Stevens features, as given in Halle and Clements (1983) have enjoyed success. Part of this results from a system that is simpler than that of SPE. The newer feature definitions are intuitive and easier to grasp, and appear to have substantial phonological validity.

The feature [constricted glottis], for example, reflects the original conception of the Jakobson, Fant, and Halle (1952) feature [checked] in that it combines glottal stop, ejectives, implosives, and glottalized sonorants in one natural class. Next, we will review some of the evidence that these sounds do form a natural class.

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2.2.4.2. Evidence for [constricted glottis]

Boas, in his Kwakiutl work, and in more detail, Sapir (1923:149) for Nootka and other languages, were among the earliest to recognize the phonological unity of ejectives and glottalized sonorants, despite their different phonetic production. Sapir taught the native Nootka speaker Alex Thomas to write phonetically (1923:149; 1933[1975:28-29]). Sapir relates that while he wrote [p!j] and [t!j] (i.e. [p'] and [t']) for the ejectives, but ['m] for the bilabial glottalized sonorant, Thomas wrote of his own accord [m!] and ‘seemed puzzled’ to find that Sapir used different symbols for the glottalized obstruents and for the sonorants. Sapir realizes the significance of the fact that ‘we had valuable evidence here for the phonologic reality of a glottalized class of consonants which included both type $\hat{p}$ (with prior release of oral closure) and type ‘m (with prior release of glottal closure)’. He wryly comments that ‘once more, a naïve native’s phonetic “ignorance” proved phonologically more accurate than the scientist’s “knowledge”’ (1933[1975:28-29]).

In addition to simple native intuition, Sapir observed that in Nootka each onset begins with only one consonant and that the glottalized consonants were therefore one phoneme. The glottalized obstruents and sonorants share an affinity in that they, along with semivowels, nasals, glottal stop and /h/ cannot occur in syllable codas (though this point is very weak evidence). Morphophonemically, just as the “hardening suffix” (one which begins with a glottal element indicated here by a raised glottal stop) makes plain stops ejectives, so too does it make modal resonants glottalized (see also Chapter Eight on Fusion). For example, the suffix -ʔaʔa ‘on the rocks’ combines with a stem like /wiinap-/ ‘to stay, dwell’ to form [wiinap’aʔa] ‘so stay on the rocks’. Likewise, stems ending in a sonorant consonant like /tl’um-/ ‘to be hot’ become laryngealized (glottalized) like [ti’urnaʔa] ‘to be hot on the rocks’ (Sapir 1933[1975:29]).

Despite the physical differences between ejectives and implosives, scholars such as Greenberg (1941) treated them as ‘members of the same series’ in Hausa, where they vary according to place of articulation. Camochan (1952) dubbed Hausa ejectives, implosives and glottal stop ‘glottalized’ and observed that this class was subject to the same phonotactic constraints and that all three sounds induced a ‘marked strained and constricted quality’ on adjacent vowels. Wolff (1959) proposed the feature [glottalic] for Hausa ejectives and implosives, which were distinguished by [voice]. In addition, glottal stop was often treated as a member of the glottalized series in much of the work printed in the International Journal of American Linguistics and in the California Publications in Linguistics series.
Unified allophonic behavior for the class of [constricted] sounds may be found in languages like Mayan Chontal (Keller 1958), where, as in Hausa, vowels contiguous to ejectives, glottal stop, and the implosive /ɓ/ are laryngealized or creaky, e.g. /ʔu k’əʔnán/ → [ʔy k’əʔnán] ‘it gets ripe’.

Lloret (1992) describes in Oromo how glottal stop, ejectives and implosives undergo a different process from plain stops, thus constituting a phonological class of glottalics:

(6) a. bit-na binna ‘we buy’
    did-na dinna ‘we refuse’

b. fit’-na finda ‘we finish’

c. hid- na hiina ‘we tie’

d. a?-na aana ‘we push’

Lloret’s examples fail to show unified behavior; before nasals they are united only in the fact that they do not undergo complete regressive nasal assimilation as the voiceless and voiced stops do (6a). The ejectives undergo voicing and metathesis (6b), while the implosive and glottal stop are deleted, with subsequent compensatory lengthening (6c-d). Thus Lloret’s evidence is mainly negative and therefore not compelling.

Thus, shed of the misconception that glottalic consonants and clicks could be characterized by the same feature, the feature [constricted glottis] revived the original kernel of the feature [checked] and was reinforced by a long tradition in American linguistics of recognizing a similarity between glottal stop, glottalic obstruents, and glottalized sonorants.

2.2.4.3. Evidence for [spread glottis]

The feature [spread glottis] has also proven useful. Thráinsson (1978) analyzed Icelandic preaspiration as essentially the debuccalization (see Chapter Five) of the first half of an aspirated geminate, and he related aspiration and devoicing. Steriade’s (1982) study on Ancient Greek analyzed /h/ as occupying a different autosegmental tier than other features. The feature [spread] was involved in deletion with subsequent compensatory lengthening, various assimilation processes, as well as a type of fusion (e.g. [kai bateros] → [kʰateros] ‘and the other’. In Burmese (Ladefoged and Maddieson 1996:69), alternations between the simplex and causative forms vary according to aspiration for stops, and for voicelessness for nasals and laterals. For example, /páuʔ/ ‘be pierced’ aspirates to causative /pʰáuʔ/
'pierce', while a form like /nôu/ 'be awake' alternates with /nôu/ 'waken'. This has led phonologists to believe voiceless sonorants and aspirated obstruents share a feature like [spread]. Blevins (1993) and Buckley (1994) are two more recent studies which make extensive use of both [spread glottis] and [constricted glottis].

2.2.4.4. Conclusion of Halle and Stevens Features
In their study of the enhancement of primary features, Stevens and Keyser (1989) conclude that obstruents are 'best realized with a glottal configuration which is neither spread nor constricted' (93), since they inhibit voicing and weaken the frequency spectrum amplitude for consonants. Thus they correctly predict that plain voiceless stops will be the most common type of stop (Henton, Ladefoged, and Maddieson 1992). However, they make exceptions for obstruents 'which are produced exclusively with a constriction at the glottis, which, as we have seen, are [-consonantal]' (93). They do note, however, that plus specifications for these features may enhance the feature [-sonorant], which would account for why aspirated and ejective consonants are the third and fourth most common types of stop, respectively. The features [constricted glottis] and [spread glottis] on sonorants 'weaken the acoustic manifestation of sonorancy' (93), and so the relative rarity of these feature combinations is explained in part. Their study in markedness explains 'why certain combinations occur much more frequently than others' because 'from the listener’s point of view, they are maximally distinctive' (104).

In sum, an emerging majority opinion seems to hold that there are three laryngeal features: [voice], [spread glottis], and [constricted glottis]. There is a large body of phonological evidence to support the use of these features. However, there are still details to be worked out regarding the interaction of laryngeal features with tone (e.g. Bao 1990, Yip 1995) and pharyngeal shape (e.g. Trigo 1991), as discussed in section 2.4.2.2.

2.2.5. Alternative Features and Views
In addition to the more mainstream features proposed in the previous four subsections, there have been various other proposals. Foremost among these are the various feature systems described by Peter Ladefoged. Ladefoged (1971) proposed a detailed set of twenty-six features. Excluding the tone features, twenty are binary and the remaining six features can be used as binary in a majority of languages. One feature, [glottal stricture], covers a continuum of values from closed (glottal stop) to open (voiceless), for a maximum of three contrasts. There is a separate feature, [voice onset], with five phonetic values, of
which languages may contrast up to three. There are three values for the feature [glottalicness]: ejective, pulmonic, and implosive, and languages may contrast all three of these sounds.

Ladefoged illustrates the differences in airstream mechanism between his system and that of SPE:

(7) \[
\begin{array}{c|cccc}
& d & t' & t & \mid \\
\text{SPE} & \text{Velaric suction} & - & - & - & + \\
& \text{Glottalic suction} & + & - & - & - \\
& \text{Glottalic pressure} & - & + & - & - \\
\end{array}
\]

Ladefoged (1971)

\[
\begin{array}{c|cccc}
& d & t' & t & \mid \\
\text{Velaric suction} & 0 & 0 & 0 & 1 \\
\text{Glottalicness} & -1 & +1 & 0 & 0 \\
\end{array}
\]

(Based on Ladefoged’s Table 61, 1971:99, where he symbolized the dental click [[]] as [i].)

One problem with Ladefoged’s system is that the formal unity of ejectives and implosives cannot be captured with the feature [glottalicness], since they have different values. Thus the allophonic laryngealization triggered by glottalized sounds in Hausa, mentioned by Camochan (1952) above, could not be represented. Ladefoged could make use of the feature [glottal stricture], though the values of glottal stricture for ejectives and voiced implosives are different.

Ladefoged’s features have been revised in various accounts, e.g. (1972, 1973, 1985, 1989, and Ladefoged and Maddieson 1996), some of which are discussed in §2.3.2. All of his features are aimed at describing the systematic phonetic level of contrast. Yet none of them has been widely adopted or used in a more formal feature system. The reason for this is probably the fact that phonologists have tended to view his work as merely illustrative of the phonetic contrasts in language, rather than as a formal feature theory, despite Ladefoged’s occasional formalisms. In fact, Ladefoged and Maddieson (1996:369) themselves see their recent magnum opus in this vein: to ‘provide a basis for future work on phonological feature theories’; it is not yet a ‘coherent set of universal
features for use in phonological descriptions' (373). Ladefoged’s work has had a profound impact on linguists, particularly in the realm of data, rather than that of theory.

Lass (1984:93) proposes features based on the direction of the airstream and the initiator. One feature, [egressive], describes an airstream flow in the direction of the lips. The feature [glottal] is for airstreams ‘initiated by a movement (up or down) of a glottal closure’. Finally, [velaric] describes an airstream ‘initiated by a movement (forwards or backwards – though only the latter seems to be used linguistically) of a velar closure’. These three features serve to distinguish pulmonic, ejective, implosive, and click sounds as follows:

\[
\begin{array}{c|c|c|c|c}
 & \text{Pulmonic stop} & \text{Click} & \text{Implosive} & \text{Ejective} \\
\hline
\text{Egressive} & + & - & - & + \\
\text{Glottalic} & - & - & + & + \\
\text{Velaric} & - & + & - & - \\
\end{array}
\]

Durand (1990:58) follows Lass in his proposals, but suggests a feature such as [pressure] in lieu of [egressive]. Otherwise, Lass’s features have not been widely adopted.

Within the framework of dependency phonology, where features are termed components, one phonatory component, IC I is termed ‘periodic energy reduction’ and another, initiatory subgesture IG I, refers to ‘glottalicness’. Where IC I is dependent on IG I (formalized as \{IC;GI\}), this indicates glottalic ingressive sounds (implosives), and where the reverse holds, \{IG;CI\}, this indicates glottalic egressive ejectives (den Dikken and van der Hulst 1988:9). Dependency Phonology has held greater influence in Europe than in North America. It has proved to be one of the main generative sources for the proposal that features are privative (2.3.3), yet its proposed elements have not been widely adopted.

Finally, as an alternative to features, I should mention the work of Browman and Goldstein (1986, 1989). These authors model phonological representations as ‘constellations of articulatory gestures’ (1986:247). In their view, ‘gestures themselves constitute basic phonological units’ (1989:202); hence ‘the phonological system is built out of inherently discrete units of action’ (202). They define an articulator set as consisting of constriction degree (CD), stiffness, and, for oral gestures, constriction location (CL) and constriction shape. The CD is a continuum with the following ranges: [closed], [critical], [narrow], [mid], and [wide]. Although CL is only for oral gestures (1989:209), they indicate (223) that the glottal articulator has the CL dimension. They have a gesture of
glottal aperture but otherwise do not elaborate on phonatory or airstream mechanisms. Although these authors have published in *Phonology*, most phonologists have not accepted their willingness to abandon features in favor of gestural phonology.

2.2.6. Conclusion
Ray Jackendoff has stated that 'I would consider the discovery of distinctive features, and the continual refinement of their formulation over some decades, to be a scientific achievement on the order of the discovery and verification of the periodic table in chemistry' (1994:60). In §2.2 I have highlighted the development of the distinctive features, particularly as they pertain to features for ejectives. We have seen that the majority opinion of phonologists seems to center around three laryngeal features: [voice], [spread], and [constricted], the last of which best characterizes ejectives. The feature [constricted glottis] unites glottal stop, glottalized sonorants, implosives, and ejectives, and this appears to be the correct characterization. Its use here should not connote acceptance of the Halle and Stevens features [stiff] and [slack]. The features [constricted], [spread], and [voice] will be used in the rest of this dissertation.

2.3. The Nature of Features
In this section we will examine the debate surrounding the nature of features. In §2.3.1, I will discuss the view first developed by Jakobson that features are binary. In §2.3.2, I will examine claims that features should be scalar or multi-valued. And finally, in §2.3.3, I will examine recent proposals that features are privative.

2.3.1. Binary Features
Phonologists have long assumed that features are binary (e.g. Jakobson 1928 for binary oppositions, Jakobson 1939a, 1939b for true distinctive features, and Jakobson 1949a and Jakobson and Lotz 1949 for an exhaustive analysis of a language's phonemes in terms of binary features). Jakobson argued that binarity was a fundamental part of both language and nature. As Anderson (1985: 136) notes, Jakobson implicitly assumed that language is based on optimization of its use of the information channel, and that language is transmitted using the 'maximal use of a minimal set of basic contrasts.' Binary decisions are easier to make and process than more complex decisions. As Jakobson and Halle observe, language is acquired early in childhood and many psychologists believe that a child's first logical
operation is a binary opposition (1956:47). Halle (1957) was an early, spirited defense of binarism.

Language is said to make contrastive use of features at a binary level. For example, phonologically speaking, sounds are either [+nasal] or [-nasal]; no language is reported to contrast three distinctive types of nasality. On the phonetic level, however, sounds can be ‘somewhat nasalized’ as in vowels before a nasal, but the claim is that these sounds do not contrast in the phonology. Thus in The sound pattern of English, for example, phonological features were strictly binary (e.g. [+nasal]), while segmental phonetic features were scalar (e.g. [3 nasal]).

Chomsky and Halle (1968:295) argue for binary features by noting that ‘since the only question of interest here is whether or not a given item belongs to the category in question, it is natural to represent this information by means of a binary notation’. However, elsewhere they use circular reasoning: ‘In view of the fact that phonological features are classificatory devices, they are binary, as are all other classificatory features in the lexicon, for the natural way of indicating whether or not an items belong to a particular category is by means of binary features’ (1968:297). Jakobson, Fant, and Halle (1952:3) state that ‘any minimal distinction carried by the message confronts the listener with a two-choice situation.’ As Lass (1984:77) summed up, ‘the identity of a phoneme is defined as the sum of a set of answers to yes-no questions. Each successive answer eliminates one or more phonemes in the system, and the last question gives an identification.’ For example, in determining a given sound, the listener presumably identifies first whether the sound is consonantal or vocalic, then whether it is a sonorant or obstruent, then a continuant or a noncontinuant, and so on, finally arriving at an identification.

Because of the pervasive binary oppositions in language, Jakobson was determined to reduce all aspects of language to binary features, despite traditionally multivalued phonetic categories such as place of articulation and vowel height. As early as 1938, Jakobson disagreed with Trubetzkoy on whether multilateral oppositions such as place of articulation should be treated along a single dimension, according to Trubetzkoy, or they should be broken up into two or more binary distinctive features. Jakobson divided place according to a front/back dimension (distinguishing labials and dentals from palatals and

---

6 Palantla Chinantec has been reported to have three degrees of contrastive nasality: oral, lightly nasalized, and heavily nasalized (Ladefoged 1971). Ladefoged and Maddieson (1996:300) conclude that ‘a better description of the three Chinantec contrasts might be as being between oral vowels, oral-nasal diphthongs and nasalized vowels’.
velars); along a grave/acute dimension according to frequency (thereby distinguishing labials and velars from dentals and palatals); and along a strident/mellow dimension according to frictional noise (distinguishing stridents from nonstridents, and uvulars from velars, among others). Although the features themselves have changed over the years, the assumption of their binary nature has remained unchallenged until recently.

Phonologically, what determines whether features are binary is whether both values are referred to in phonological rules. This question will be examined in conjunction with the discussion on privativity in §2.3.3. Next we turn to systems that permit multi-valued features.

2.3.2. Multi-valued Features

One alternative to binarity is to permit multi-valued or scalar features. Often, the proposals which avoid binarism do so because of different goals of the feature system itself. For example, unlike Jakobson, Ladefoged's features are based not only on the phonological distinctions in an individual language, but also on distinctions 'necessary for the description of a particular language as opposed to all other languages' (1972:277, cited in Fischer-Jørgensen 1975:383). This view is similar to the SPE view; however, Ladefoged did not insist on binary features at the systematic phonemic level of representation. Ladefoged (1971:91) concurs with Jakobson (1962) that 'the binary principle is a major factor in human communication'. Yet he disagrees that binarity is a requirement for all features, and argues that since many features are multi-valued at the systematic-phonetic level, it is arbitrary to require that all features be binary. Those who seek to avoid binarity are themselves confronted with a choice between multi-valued and scalar features.

Ladefoged himself was unsure whether to 'regard the possible places of articulation as a linearly ordered set operating in a scalar feature, or an unordered set within a multivalued independent feature' (1971:43). Often the two systems can be made to formally describe the same phenomena. He notes that 'any multivalued feature can be reinterpreted in terms of a number of binary features; and any binary system can be supplied with marking conventions so that it acts as if it contained multivalued features' (98). In discussing the supplementary airstream features, for example, Ladefoged (1971:98) states that 'there is obviously very little difference between a multivalued feature system with the three possibilities corresponding to ejective, plosive, and implosive and a binary system which uses two features ±glottalic pressure and ±glottalic suction, together with a convention that prohibits the co-occurrence of plus values for both features.'
What is more relevant to a comparison of the systems is, according to Ladefoged, 'the difference in the claims that each system makes both about the phonological relations between sounds and about the phonetic facts' (98). Ladefoged argues that 'the use of a multivalued system allows the sound patterns which occur to be described in terms of a more explanatory set of rules' (1971:98), though Ladefoged in that work never illustrates how his rules are more explanatory. Ladefoged proposes 26 features and includes the maximum number of systematic phonemic contrasts and descriptions for the systematic phonetic level. The relevant laryngeal and phonation features are listed below; the display indicates the maximum number of attested contrasts, and how many linguistic phonetic distinctions Ladefoged's features make.

(9)

<table>
<thead>
<tr>
<th>Feature</th>
<th>Max. contrasts</th>
<th>Systematic phonetic realizations</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Glottal stricture</td>
<td>3</td>
<td>glottal stop —→ voiceless (9 points)</td>
</tr>
<tr>
<td>2. Voice onset</td>
<td>3</td>
<td>voicing throughout —→ large voicing lag (5)</td>
</tr>
<tr>
<td>3. Fortis-lenis</td>
<td>2</td>
<td>normal —→ heightened subglottal pressure</td>
</tr>
<tr>
<td>4. Glottalicness</td>
<td>3</td>
<td>ejective, pulmonic, implosive</td>
</tr>
<tr>
<td>5. Velaric suction</td>
<td>2</td>
<td>non-click vs. click</td>
</tr>
</tbody>
</table>

(Based on Ladefoged 1971:92)

Halle (1973) has pointed out some empirical inadequacies of Ladefoged's system, such as the inability to express Grassmann's Law, since there is not formal unity between breathy voiced stops and voiceless aspirated stops. However, given that the reduplication phenomena can be analyzed using McCarthy and Prince's (1995) notion of the emergence of the unmarked, whereby only unmarked features appear in the reduplicant, Halle's argument is not as compelling as it once was.

Ladefoged (1973) suggested scalar features including [glottalicness], [glottal stricture], and [voice onset]. In this version, the feature [voice onset] has three values: aspirated, unaspirated, and voicing throughout. Glottal stricture has eight degrees: spread, voiceless, murmur, slack, voice, stiff, creaky, closed. Ladefoged also incorporates pitch (high, mid, and low), and a cover feature for pitch (raised or lowered) in relation to glottal stricture. He notes that his features are more redundant than the Halle-Stevens features, 'but if we want to explain the phonetic and phonological processes that occur in languages.
then we must be prepared to accept this kind of redundancy' (1973:83). His overall scheme is given below:

\[
\begin{array}{cccc}
\text{Glottalicness} & \text{Voice Onset} & \text{Glottal Stricture} & \text{Pitch} & \text{Cover Feature} \\
+1 \text{ ejective} & 1. \text{ aspirated} & 1. \text{ spread} & \text{high} & \text{raised} \\
0 \text{ pulmonic} & 2. \text{ unaspirated} & 3. \text{ murmur} & \text{mid} & \text{ } \\
-1 \text{ implosive} & 3. \text{ voicing throughout} & 4. \text{ slack} & \text{low} & \text{lowered} \\
7 & & & & \\
\end{array}
\]

Ladefoged’s more recent versions may be found in his 1989 article, and a suggestive outline of a feature theory is found in his recent collaboration with Maddieson (Ladefoged and Maddieson (1996)\textsuperscript{7}.

Scholars other than Ladefoged have proposed scalar features. Gandour (1975) proposed two laryngeal features. One, which he termed [vibrating], was binary and referred to vibration of the vocal folds. The other feature, [glottal width], ‘consists of a linearly ordered set of terms along a single physical continuum’. Gandour uses data from tonal development in the Tai family to argue that the ‘classes of consonants needed to account for the tone splits consist of only adjacent subclasses’ and thus feature theory must admit linearly ordered features. On this data, Gandour claims the Halle and Stevens features fail to predict the correct results of Tai tonal data. He is more sympathetic to Ladefoged’s (1973) system, but modifies the values for the states of the glottis to account for his data.

Parker (1976) offers some insights on the debate of binary vs. multivalued features. He notes that proponents of multivalued features who argue that some languages have more than two contrasts for a given feature, and thus the feature is multivalued, are correct ‘only to the extent that the feature they have proposed is correct’ (68). He criticizes scalar features such as Ladefoged’s place features, since they posit more values than used by any one language. Binary features, he argues, never propose more values per feature than are

\textsuperscript{7} Quite recently, in Ladefoged and Maddieson (1996:372), ejective distinctions are removed from the traditional classification (Catford 1939) of airstream mechanism, into a Laryngeal parameter of Glottal Movement: Raising for ejectives, or Lowering for implosives. This move is interesting in that phonologists (e.g. Jakobson 1958) have long rejected raising vs. lowering as a valid featural difference between the two glottalic sounds.
used by at least one language. In addition, scalar features have no way to incorporate natural feature values (i.e. markedness), though Williamson (1977) later suggested neutral values are in the center of the scale. Parker argues that scalar features are observationally adequate but do not capture any generalizations about language. He proposes that ‘a distinctive feature defines every point on one and only one closed continuum, such that there are no more than two relevant points on any one such continuum’ (69-70).

Williamson (1977) argued for multivalued features using a wide array of data, proposing some useful criteria in determining when a feature might be multi-valued. First, if the plus features of two binary features which appear to form a phonetic scale cannot co-occur, they might be part of a single multivalued feature (e.g. *[+high, +low]). Glottal aperture may be a good candidate for this since the glottis cannot be both [spread] and [constricted]. Multivalued features should be used when articulatory changes take place in changes along a scale. Examples that Williamson gives include shifts of lenition in Ijo and fortition in Jukunoid, along a [stricture] scale applied to both consonants and vowels. Williamson’s proposal for a place feature has essentially been accepted in terms of feature geometry (e.g. Clements 1985; see also section 2.3), yet other proposals have not been adopted. Williamson’s work is a major and articulate, if neglected, argument for multi-valued features.

Lindau (1978) proposed a set of multivalued features for vowels, but Yip (1980) argued that Lindau’s main example for four vowel heights in Scanian Swedish can be analyzed using binary features.

Related to the issue of scalar features is Foley’s (1970) proposal for strength hierarchies to account for historical processes of fortition and lenition. He claims that ‘phonological strength is a parameter of a theoretical system, and has reality within that system’ (89). Yet his proposals do not account so much for features as for the implicature relations among phonemes (e.g. /g/ will lenite before /d/ or /b/). (See also Foley 1977).

Creider (1986) is the most recent defense of binarism of which I am aware. Using data from vowel coalescence in Nandi (Southern Nilotic) and from place of articulation assimilations in ‘Eskimo’, he suggests that use of multi-valued features is inappropriate and binary features are preferable. His impression is that binarism is adequate for underlying representation and morphophonemic alternations; multi-valued scales may be needed if they are to attend to allophonic rules or give greater detail than that required by an underlying representation (within a language). And this brings us back to the distinction made at the beginning of this chapter between phonological and allophonic/phonetic rules.
One plausible compromise between the two systems may be found in Keating (1984), which advocates a system in which possible contrasts (at a phonological level) are distinguished from possible differences (at the phonetic level). For example, the binary feature [voice] has three systematic phonetic realizations along the VOT continuum, which she represents in braces: {voiced}, {vl.unasp.}, and {vl.asp.}. These realizations would then be represented in 'pseudo-physical' representation to describe actual phonetic implementation. In this way, English and Polish share similar phonological rules by opposing [+voice] stops to [-voice] stops, unlike the different representations in SPE and Halle and Stevens. However, the phonetic differences are captured by having, e.g. Polish [-voice] represented as {vl.unasp.} and English [-voice] as {vl.asp.}. Keating thus claims that 'interesting and meaningful constraints exist on phonetic variation' (314).

Another approach to scalar features within the framework of feature geometry may be found, especially regarding vowel height. Clements (1989b, 1991) and Clements and Hume (1995) have proposed vowel aperture as a scalar feature. Parkinson (1996) proposed an Incremental Constriction Model in which vowel height is seen as a single phonetic scale, with contrasting heights distinguished by different 'stacked' occurrences of a monovalent feature [closed]. Low vowels have no specification for [closed]. In a three-height system, mid vowels have one occurrence of [closed] and high vowels have two, stacked occurrences; in a four-height system, each height above low adds one occurrence of [closed].

The equivalent of such a model for laryngeal features would take one end of a continuum as a monovalent property. For example, glottal aperture could be viewed as [glottal constriction], with voiceless aspirates containing no specification, and ejectives containing the most number of nested specifications. (This would fit one of Williamson's criteria for scalar features—when points on a scale cannot co-occur). The specification would be added along a scale something like:

(11) Scale of [glottal constriction]:
\[ t^h > t > d > d' > d'' > t' \]

For a sketch of this as it relates to ejectives in the strength hierarchy, see Tosco (1988), who bases his work on early proposals by Foley (1970). Tosco, however, places ejectives and implosives on opposite ends of the strength hierarchy and thus did not chose a scale based on glottal constriction, but rather perceived 'strength'.
Parkinson found that all partial height harmonies involve a one-step change and that such harmonies involve raising. However, there is no equivalent finding for glottal stricture. Sounds may undergo both lenition and fortition and so change goes along both directions of the scale. Furthermore, I know of no cases of incremental increase of glottal constriction of the type ejective becomes implosive adjacent to voiceless unaspirated stop, or voiceless aspirated becomes voiceless unaspirated because of a following voiced stop. (Lombardi 1991:16 argues in a similar way against Ladefoged's continuum).

In addition, the formal unity of glottalized sounds could not be represented except by a metric of counting a certain number of occurrences of a feature like [glottal constriction]; they would no longer share a simple feature like [constricted glottis]. Lastly, markedness could not be incorporated the same way as in a theory of privative features (discussed below), where laryngeal neutralization results in voiceless unaspirated stops (but plain voiced sonorants), since voiceless aspirated stops are presumably at an unmarked end of the [glottal constriction] scale. For these reasons, a scalar approach to laryngeal features is not adopted here.

In sum, advocates of multi-valued features have emphasized the scalar, incremental nature of articulation, particularly with respect to place of articulation, glottal state, and vowel height. Yet for such a major issue, relatively little phonological evidence has been put forward, a point noted by Creider (1986). Many of the differences between binary and scalar features seem to revolve around the purpose of features and the level at which their application is aimed: contrastive/phonological or allophonic/phonetic. Keating's proposal seems to be a moderate compromise between binarism, which is pervasive through language, and scalarism, which best describes levels of detail across languages. Recent research, however, has attacked binarism on other, strictly phonological grounds from the point of view that features may be privative.

2.3.3. Privative Features
Trubetzkoy (1939[1969]) defined relations between phonemes as a series of oppositions along various axes. 'Privative oppositions are oppositions in which one member is characterized by the presence, the other by the absence, of a mark' (1969:75). Trubetzkoy gave as examples the oppositions voiced/voiceless, nasal/oral, and round/unround. In part because such oppositions are now viewed in terms of features, the term 'privative' has been widely adopted to refer to the presence of a feature, and its absence as a lack of a
feature, as opposed to the binary view of one (specified) feature always being present, with either a plus or minus specification.

In his framework of stratificational phonology, Lamb (1962, 1966 [1972:619]) proposed that phonemic components, or phonons (roughly, distinctive features) are singulary, or unary. In Lockwood's words, 'a phonon is either present or absent' (1969[1972:649]). Regarding the laryngeal features, Lockwood states quite clearly that 'the voicelessness of obstruents will be treated as equivalent to the absence of a specification for voicing' (1972:659). The main justifications for unary features were to avoid 'the addition of some new ad hoc device to the system of graphic notation' which represented 'an additional type of conceptual equipment in a linguistic theory' (Lamb 1966[1972:619]). Also, Lamb tried to avoid a larger inventory of specified features and the redundancy rules which went with them in classical generative phonology. Lockwood (1969, 1972) directly incorporated notions of (language-specific) markedness and neutralization into the stratificational system of unary features, where the feature present was the marked member. Stratificational phonology never gained wide popularity and today its adherents could probably be counted on one hand; for summaries and reviews of the theory, see Fischer-Jørgensen (1975) and Sommerstein (1977); Postal (1968) is the most polemical and strident critic of the theory. It is interesting, however, to see that some of the constructs it proposed such as privative features, and a rejection of rule ordering, have become influential in current phonological thinking, though not directly through the stratificational theory.

Another early advocate of privative features, Wallace Chafe, wrote that

'I have always been fond of singulary features, and remain somewhat loath to give them up. It seems to me that glottalization, rounding, nasalization, and the absence of voicing are all in some sense intrinsically marked phonetic properties—properties which somehow involve a deviation from the normal state of vocal sound production. I therefore like to think of them as features which are either there or not there, not as features which are always there, with either a plus or minus value' (1970:119).

Chafe supports privative features on the grounds that they directly capture marking, and they are easier to describe since only those features which are present need be mentioned. Sanders (1972) was another relatively early proposal for privative features.
The earliest suggestion within the published generative literature that some features may be privative may be in the following often overlooked passage by Larry Hyman (1975:142):

'...the feature [+glottalic] may define a class of implosives in a language (for example, /b/ and /d/). While these segments do constitute a natural class and are expected to function together in phonological rules, the class of [-glottalic] segments, that is, all segments except the implosives, is not natural. This asymmetry in the feature specifications characterizes most oppositions which were defined as privative by Trubetzkoy'.

Sommerstein (1977:110) dismisses the idea behind feature privativity by saying that 'whenever we try to formalize a theory of singulary features, we seem to find that it emerges as a notational variant of a theory of binary (or multinary) features. As an example, he gives the hypothetical case of a language with both /b/ and /p/. If voice is marked only on /b/, and if a rule of the language changes only /p/ to /l/ (and not also /b/ to /v/), then there would be no way to formalize this change without also making it apply to /b/, since both labial stops would be specified as, roughly, [-cont, Labial]. If we were to refer to the absence of voice on /p/, then we would simply be reintroducing binarity through the back door. I know of no cases like this, but even in a privative theory, we could get around such a change if we could specify the voiceless features as [spread glottis], for example. Lombardi (1996), discussed in more detail below, allows binary features within a privative theory in certain instances.

In Dependency Phonology, features (called components) are unary, or single-valued (=privative). See Anderson and Jones (1974), Ewen (1980), Anderson and Ewen (1980, 1987), Durand (1986, 1990), and Lass (1984) for more on this theory. Van der Hulst and Smith (1985) and van der Hulst (1988, 1989) also work in a similar framework. One of the motivations for considering these 'features' to be privative is to be able to encode markedness considerations 'directly in the primitives and principles of the theory' (van der Hulst 1988:80). In addition, the proposal that vowels are made up of the features lill, lal and lul ties in with phonetic findings regarding quantal regions and with typologies of vowel inventories. Another similar approach is also taken by Kaye, Lowenstamm, and Vergnaud (1985). Sanford Schane has proposed Particle Phonology, in which features, especially for vowels, are viewed as atoms which combine to form components of segments. Although there have been proposals to view features as privative, they did not receive much attention in the United States until the mid to late 1980s, though they have
influenced such phonologists as Goldsmith and Mester and Itô. See the critical overview in den Dikken and van der Hulst (1988).

More recent discussion of privativity in autosegmental phonology dates to Goldsmith (1985). As Goldsmith explains:

‘A feature which is equipollent (in a given language) is always specified as either [+ ] or [- ]; a feature which is privative is specified only for the presence of the feature, and its absence is not marked; thus no plus or minus value is necessary or appropriate.’ (1985:255).

In Goldsmith’s view, features are specified as privative in a language-specific way. Thus in Finnish, for example, he claims [round] is equipollent (binary), while in Mongolian it is privative. Depending on the language involved, other privative features Goldsmith proposed include [front], and [low]. Archangeli (1988:190) terms this type of privativity ‘inherent monovalent underspecification’. She notes that segments with no underlying specification for privative features may remain unspecified or may acquire it during a derivation. ‘If there are monovalent features, then such features are in part inherently underspecified, that is underspecified due to the property of being monovalent’ (190).

Another precursor of privativity was the abolition of some binary features in the feature geometry of Sagey (1986) and the introduction of articulator nodes. As Sagey states in her discussion of this matter vis-à-vis complex articulations, 'what is required, therefore, is that the place of articulation features for an articulation must contain only positive specifications of articulation required and relevant to that articulation, and not features for what articulations are absent.' (65). She goes on to state that ‘labial, coronal, and dorsal are not features, which may be specified + or -, but are class nodes, which may only be either present or absent in underlying representation.’ (66). And further: ‘class nodes are either present (denoting active involvement of an articulator), or absent (denoting no active involvement by the articulator)’ (67). For Sagey, then, a bit of privativity was introduced through the articulator nodes. Terminal features (or features proper) were still binary, however. Archangeli (1988) terms this type of privativity ‘inherent node dependent underspecification’. An important prediction of this model is that if a segment is unspecified for an articulator node, e.g. [coronal], then the features which are dependent on this node, e.g. [anterior] and [distributed] must be unspecified as well.

Steriade (1987a) supports this view of articulator features as well. Following unpublished work by McCarthy, Steriade assumes that ‘notations such as [-coronal] or
[-labial] denote only the absence of an articulator node, not the presence of a negative …’ (599). Thus [round] is privative because [-round] never spreads in harmony rules, and [labial] is privative because of its ‘articulator disharmony’ in Semitic. However, Steriade believes that features such as [back] and [high] are binary because both values can spread. Steriade (1987b) mentions [round] and [voice] as privative features ‘perhaps on a language-specific basis’ (341).

Yip (1989) provides support for the Sageyian model of features as either present or absent by examining ‘identity classes’, which are ‘constituents…identified as units by rules which compute identity, such as the OCP’ (349). She supports articulator nodes over a theory with binary features.

Mester and Itô (1989) explicitly proposed privative features, particularly for [voice]. In Japanese native compounds (Rendaku), the initial voiceless segment of the second member of the compound is voiced:

(12) ori-kami → origami ‘origami paper’
onna-kokoro → onnagokoro ‘feminine feelings’

This is analyzed as the linking of an autosegmental [+voice] feature to the first voiceless segment of the second member of the compound. However, Rendaku is blocked by Lyman’s Law, which prohibits more than one voiced obstruent in a morpheme whenever the second compound member already contains a voiced obstruent.

(13) kita-kaze kita-kaze *kitagaze ‘(freezing) north wind’
doku-tokage dokutokage *dokudokage ‘poisonous lizard’

This is viewed as an OCP-driven rule which deletes the first of two [+voice] specifications within a morpheme.

Mester and Itô suggest that the privativity of voicing is a universal and not a language-specific property. Apparent cases of [-voice], disallowed in a privative theory, are treated either as aspirated ([+spread]), or as the delinking of [voice] due to syllable well-formedness, and not due to the spread of [-voice]. (See Lombardi 1995b).

Avery and Rice (1989:180) make the radical assumption that all features are monovalent, arguing that binarity is only the result of the presence vs. absence of a feature.
Lombardi (1991) has proposed that all three of her laryngeal features are privative. The following table shows Lombardi’s distinctions using the features [aspirated] ([asp]), [glottal] ([gl], which includes ejectives and implosives), and [voice] ([voi]). We can think of [asp] as a notational variant of [+spread glottis] and [glottal] as a variant of [+constricted glottis].

\[
\begin{array}{|c|c|c|}
\hline
\text{Voiceless} & \text{[voice]} & \text{[gl]} & \text{[asp]} \\
\hline
\text{Voiced} & + & & \\
\text{Voiceless aspirated} & & + & \\
\text{Voiced aspirate (‘murmured’)} & + & & \\
\text{Voiceless glottalized (usually ejective)} & & + & \\
\text{Voiced glottalized (usually implosive)} & + & + & \\
\hline
\end{array}
\]

Lombardi proposes that the combination [gl, asp] be judged impossible and must therefore invoke a universal constraint (though she does not formalize it):

\[
\text{*[gl, asp]}
\]

This constraint rules out the other two logical combinations not shown in the table above: [glottal, aspirated] and [glottal, aspirated, voiced]. This constraint makes good sense, since by definition [spread] and [constricted] ([asp] and [gl]) are logically mutually exclusive, and since no aspirated glottal stops are attested in the languages of the world (Maddieson 1984, Ladefoged and Maddieson 1996). See Bessell (1992) for allophonically aspirated glottal stops in Columbian Salish, however.

In Lombardi’s system, we have a maximum of six contrasts achieved through the use of three features; this is the maximum laryngeal/phonatory contrast attested in any language (Ladefoged 1971, Ladefoged and Maddieson 1996). Note that plain voiceless stops are not specified for any feature; their representation is literally unmarked. Thus with three features, and one constraint, we have the maximally constrained theory which accounts for the data.

In Lombardi’s system, however, what were formerly thought of as voiceless consonants must be designated either plain voiceless, and thus unmarked, or as aspirated consonants, and thus marked with the feature [asp]. The analyst must scrutinize the language to determine whether phonological rules refer to voiceless consonants as targets.
or triggers. If they do, and privativity is to be maintained, then those segments must be analyzed as aspirated phonologically. (Another case, which depends on Lombardi’s referral to sonority conditions, will be addressed in detail in Chapter Three). For example, in Modern South Arabian dialects (Johnstone 1975), the vowel initial prefix appears to delete before plain voiceless consonants. As example, consider the article in Mehri:

\[ \text{a-ge:d} \quad \text{a-k'a:b} \quad \text{kawb} \]

- 'the skin'
- 'the heart'
- 'a/the wolf'

The prefix to the intensive-conative verbal theme likewise gets deleted in the following examples:

\[ \text{agoaob} \quad \text{ak'oibal} \quad \text{kotram} \]

- 'to try'
- 'to point to; the qiblah'
- 'to be generous'

In a privative feature framework, there are two ways to handle this. The easiest is to assume that voiceless nonglottalic sounds are specified for [spread glottis], and posit a rule which deletes the article and verbal theme before such segments. The alternative is to assume that /k/ is unspecified for laryngeal features, and to require the insertion of the article only if there is a laryngeal node on the following stop.

Next we turn to works influenced by Lombardi’s proposals of privativity. Donnelly (1992), in a framework of privative features, tentatively represents ejectives in Xhosa as completely unspecified, with the feature [constricted glottis] filled in by redundancy rule in the phonetic output. They are opposed to aspirated stops, represented by the feature [asp], and breathy voiced consonants, represented by the feature [depressor], since the vocal folds are said to be depressed during their articulation. In an earlier account of Zulu (Khumalo 1987, cited by Donnelly 1992), ejectives were fully specified in a binary system as [-asp, -dep].

Rice (1994) gives an analysis of Athapaskan using privative laryngeal features. Lexically, only [voice] is active, despite the fact that there is another marked feature, [constricted glottis]. Buckley (1994) adopts privative features for his thorough analysis of Kashaya laryngeal phonology.

Steriade (1995:147) has argued that ‘in most cases where it is justified to omit a feature value from underlying structure there is also considerable evidence that the value is
permanently missing; the feature is privative'. One of the strongest arguments in favor of privativity is that no assimilatory or dissimilatory processes refer to [-constricted]. Aspiration and glottalization are subject to dissimilatory constraints (such as Grassmann's Law). Unglottalized stops are never prohibited from co-occurring. These facts suggest that it is the absence of laryngeal features, not the presence of a minus-value. Steriade (1994, 1995) speculates that some features like nasality may be privative because they deviate in only one way from 'neutral position' along certain articulatory dimensions; other features (e.g. advanced or retracted tongue position) can deviate in two ways from neutral position and hence are binary. Privative features are those which have a specified neutral position, allowing marked feature values to be encoded directly in representations.

Den Dikken and van der Hulst (1988:35) believe that 'strong privativeness' is desirable because it is theoretically the most restrictive view, and it avoids 'empirical overgeneralization, and it is tenable since most evidence pointing to binarism can be reanalyzed in a privative framework'.

Recently, Lombardi (1996) has retreated from strong privativeness and accepted binary features for Place and for voicing at the level of postlexical rules. For example, the rule of Canadian raising refers to the centralization of vowels before a final voiceless obstruent, as in [fajt] 'fight' vs. [bajd] 'bide'. The voiceless consonants must act therefore as a natural class, and this is one of the examples that forces Lombardi to admit binary values, though only at the postlexical level. Perhaps this is a necessary concession.

One prediction of the privative model is that ejectives and aspirated stops will not pattern together, since they do not share any laryngeal features. Formerly, one could capture these features together as [-voice]. However, I have not yet found convincing evidence that one needs to do this; there are no phonological rules (lexical or postlexical) in which aspirates and ejectives pattern to the exclusion of voiced stops. Of course voiced stops may undergo a process which other stops do not.

In sum, because it appears to be maximally constrained, and because it elegantly accounts for laryngeal neutralization, I will adopt Lombardi's proposal that laryngeal features are privative. The data from ejectives do not appear to me to require the use of binary features at the postlexical level. Next we turn to the structural representation of laryngeal features, particularly within feature geometry.
2.4. Representations

2.4.1. Linear Feature Matrices

Since Jakobson (1949), many phonologists have viewed segments as a matrix of binary distinctive features. Chomsky and Halle (1968) proposed that

\[ \text{each item in the lexicon be represented as a two-dimensional matrix in which the columns stand for consecutive units and the rows are labeled by the names of the individual phonetic features. We specifically allow the rules of the grammar to alter the matrix, by deleting or adding columns (units), by changing the specifications assigned to particular rows (features) in particular columns, or by interchanging the positions of columns} \] (296).

In explaining the features, Chomsky and Halle classify features into groups such as the major class features, cavity features, manner of articulation features, source features, and prosodic features. They note that these classifications are made primarily for purposes of exposition and that they 'have little theoretical basis at present.' However, they state that it seems likely that 'the features themselves will be seen to be organized in a hierarchical structure which may resemble the structure that we have imposed on them for purely expository reasons' (300), a quote frequently overlooked, even by Clements (1985), though it is cited in Clements and Hume (1995). Despite this suggestion for a research question, it was not until six years later when Anderson and Jones, in the manifesto of Dependency Phonology (1974), asserted that 'phonological representations are more highly structured than the standard theory would claim', and that certain segments are complex in that they can be decomposed into 'simultaneous complexes of more elementary elements that elsewhere occur as independent segments'. Eight years later (Lass 1976) made the first hierarchical cut between laryngeal and supralaryngeal feature groups, and seventeen years later, Clements (1985) first formalized a hierarchical arrangement of features.

2.4.2. Feature Geometry

2.4.2.1. The Development of Feature Geometry

Goldsmith (1976) changed the notion in classical generative phonology that segments are 'bundles' of features. Most of what he described involved tone. But in Chapter Four of his dissertation, Goldsmith also discussed the autosegmentalization of the feature [spr gl], suggesting that laryngeal features could operate independently or autosegmentally. However, Goldsmith did not propose putting features into groups. Instead, his work
forced phonologists to break away from the idea of matrices, which sped the development of feature grouping.

An early recognition of the behavior of groups of features comes from Lass (1976), who developed the idea from discussions with Charles Bird. Lass recognized that glottal stops are 'something very like the features of a voiceless stop, but minus supralaryngeal articulation' (153). He noted that every segment was 'bi-gestural', with one laryngeal and one supralaryngeal 'articulatory configuration'. The two gestures provide two phonological subcomponents: the categorial gesture (roughly, manner of articulation) and the locational or distinctive gesture (roughly, place). Lass notes that /h/ and /ʔ/ are defective in that they lack the intra-oral component of their features. Specifically, Lass proposes that phonological segments have two independent sub-matrices, [oral] and [laryngeal]. A similar view was sketched by Lass and Anderson (1975).

Although Halle and Stevens (1971) provided a set of laryngeal features with phonetically grounded descriptions, they did not offer much in the way of phonological evidence for these features. Some of that came from Thráinsson (1978), who analyzed Icelandic preaspiration using the Halle and Stevens features in an autosegmental way by recognizing that 'in some cases a certain subset of the phonological features composing a phoneme can behave as a unit' (35).

Goldsmith (1979, 1981) was inspired by Cressey's (1974) observation that certain subsets of features clustered together, and by his proposal for a 'place of articulation' quasi-feature. With his proposals for autosegmental phonology, he realized that the 'aspiration' (or debuccalization) of /s/ to [h] in Spanish dialects was a result of 'a rule deleting the oral gesture autosegment, but leaving behind untouched the laryngeal gesture of voicelessness' (1981:6).

Halle and Vergnaud (1980) vaguely hinted at grouping place and manner features in separate autosegmental tiers, but Steriade (1982) developed this, and proposed an additional aspiration tier.

Mohanon (1983), cited in Sagey (1986:25-6), proposed an early version of feature geometry. In this model, underneath a root node was a Phonation node, under which the phonation features [constr], [spread], [tense] and [lax] grouped. Sister nodes to the Phonation node were the Sonority and Place nodes, which have since radically changed. Mohanon's early insight was incorporated in Clements' (1985) model of feature geometry, which also drew upon Mascaró's (1983) proposal of laryngeal features dominated by a class node.
In Clements’ (1985) model, under the Root node were two main class tiers: the Laryngeal node and the Supralaryngeal node. Clements argued that laryngeal features pattern together and should therefore be organized into a node, Laryngeal, which is directly under the Root node. Clements believes that the Laryngeal node consists of the set: [spread], [constricted], and [voiced]. He assumes that tonal features are distinct from these laryngeal features, though he cites some interdependence in Thai (Yip 1982) and Zulu (Laughren 1984).

Clements (1985:235) cites as evidence for the laryngeal node the fact that in Thai (Noss 1964), voiced, voiceless unaspirated, and voiceless aspirated stops contrast initially, but only unreleased voiceless stops appear finally. The three-way contrast of voiced, voiceless, and ejective (glottalized) obstruents are neutralized before another stop in Klamath (Barker 1964). Proto-Indo-Iranian obstruents in prepausal clusters are devoiced or deaspirated, while Bartholomae’s Law (Schindler 1976) describes a ‘mirror image rule of voicing/aspiration…applied to non-aspirated obstruents adjacent to a voiced aspirate’ (Clements 1985:235).

Clements (1985) provides additional evidence for the Laryngeal node by showing processes which are said to affect the supralaryngeal features without affecting the laryngeal features. For example, he cites Lass’ (1976) work on reductions of consonants in English to glottals. He also reanalyzes Thráinsson’s (1978) work on Icelandic preaspiration within his feature geometric approach. And finally, he cites in Klamath (Barker 1964) the spreading of [lateral] and delinking of supralaryngeal features.

Sagey (1986:35) cites additional evidence for Laryngeal in Kinyarwanda, which, in my opinion, is unconvincing. These cases involve the aspiration of prenasalized stops, which Sagey analyzes as the merging of [+nasal] onto the following stop. She also discusses a case of a ‘prenasalized, labiovelarized, voiceless stop’ in which voicelessness and aspiration are spread over the whole segment. Her example of /ku-n-tua/ realized as [kuunwhaara] does not illustrate clearly the existence of the Laryngeal node.

McCarthy (1988:90) cites evidence for the Laryngeal node from Classical Greek, which had voiced, voiceless, and voiceless aspirated stops. The stops regressively assimilate both voice and aspiration, and since the laryngeal features assimilate as a group, we can treat this as the spreading of the Laryngeal node.

Citing the work of Marlett and Stemberger (1983), McCarthy follows Yip’s (1988) analysis of glottal stop dissimilation in Seri as the result of an OCP violation of the Laryngeal node. Two other cases are mentioned: Lyman’s Law in Japanese, and Harauti.
In Japanese native vocabulary, as we have seen, only one voiced obstruent is permitted in a root (Itô and Mester 1986). And in Harauti (Allen 1957), only one voiced or voiceless aspirated consonant is permitted in a word. However, these constraints could also be analyzed at the featural, rather than nodal, level, as McCarthy himself notes.

Yip (1989:365) argues that a morpheme structure constraint on Yucatec Mayan may be described at the level of the Laryngeal node. Identical consonants appear in Mayan roots only when both consonants are glottalized or neither one is. If both consonants in a CVC root are glottalized, then the consonants must be identical. Yip notes that unpublished work by McCarthy assumes a constraint:

(18) *[constricted glottis] [constricted glottis].

Yip suggests formulating the constraint on the Laryngeal node since [constricted glottis] is 'the only feature used distinctively in Yucatec. Together with a prohibition on double linking of [constricted glottis] (or Laryngeal) this will correctly capture the facts' (365).

Iverson (1989) provides additional evidence for the Laryngeal node, but argues against the structure of the Supralaryngeal node. Like the Thai data, Korean obstruents neutralize to plain, voiceless, unreleased stops in syllable-final position. In his analysis, 'all the tense and aspirated obstruents, including /h/, lose their distinctive laryngeal characteristics at the end of a syllable, where they are provided instead with the default laryngeal values of the lax series ([-constricted glottis, -spread glottis])' (289).

Despite all the different feature geometries proposed, the one aspect which achieves virtually unanimous consensus is the existence of a Laryngeal node. In this dissertation I assume that the correct representation for ejectives is the feature [constricted glottis] dependent under the Laryngeal node.

2.4.2.2. Recent Proposals

Despite near unanimity that a Laryngeal node exists, scholars have developed many proposals in an attempt to capture the complex interrelation between laryngeal features and such factors as tone and state of the pharynx.

Recall that in the Halle and Stevens system of features, laryngeal features directly encoded tonal features. Now that nonlinear representations are widely accepted, some researchers (e.g. Clark 1990) include a tonal node within the Laryngeal node:
One advantage of this system is that it directly incorporates the common observation that voiceless stops raise tone and voiced stops lower it, both historically and synchronically. Some consonants, for example, are called depressor consonants because of their effect in lowering tone or in blocking the spread of H tone. In Kingston's (1985a) phonetic study of ejectives, however, he found that ejectives elevated the pitch of the following vowel in Tigrinya, but lowered it in Quiche (though neither language has tone). (See §7.6 for more on the phonetic differences among ejectives, and see Kingston (1985b) for more on the role of ejectives in tonogenesis.) Bao (1990) suggests [stiff] and [slack] may be a constituent and [spread] and [constricted] another. Like Clark, he incorporates tone into laryngeal features.

Yip (1995), drawing on work by Bao and Duanmu (1990), proposes an explicit model of tone and laryngeal features. Her model is reproduced below:

\[
\begin{align*}
\text{Register} & \quad \text{Glottal Aperture} \\
(H/L; [\text{voice}]) & \quad [\text{c.g.}] \quad [\text{s.g.}] \\
\text{Pitch} (h/l) & \quad \text{Pitch} (h/l)
\end{align*}
\]

The Laryngeal node is divided into a Register node and a Glottal Aperture node. Register is 'variously realized as H/L tonal register or [voice]' (1995:484). The feature Pitch appears twice to allow for contour tones and contains specification for high or low pitch. The Glottal Aperture node contains the familiar laryngeal features [constricted] and [spread]. Yip is uncommitted whether the Laryngeal node attaches directly to the syllable (as shown above) or to the root node. And she suggests that the 'dependency relations between Register and Pitch might differ between Chinese and African languages' (487). The details of the interaction between tone and laryngeal quality are complex, and are worth
mentioning, but they are beyond the scope of this work. I refer the reader to Yip (1995) for a quick overview. Alternative solutions to subordinating tone to the Laryngeal node involve linking tones to moras, though other researchers propose the syllable (see Odden 1995 for an overview).

One problem with the proposal to include tonal features within the laryngeal node is that we lose the autonomy of tones (e.g. tonal stability), which originally motivated the tonal tier of autosegmental phonology (Goldsmith 1976). Another problem is that it is difficult to apply this geometry to languages in which moras appear to be the relevant tone bearing unit. Steriade (1987) acknowledges a Laryngeal node but proposes that it link directly to the prosodic tier, as we saw Yip suggest above. But as Hayes (1990) has pointed out, Steriade's theory cannot express rules of total assimilation. Once individual features (or class nodes) are associated with the prosodic tier, we begin to return to a bottlebrush theory of features.

A third problem is that the main criterion for constituency may not apply at all. Clements and Hume (1995:266) propose that ‘if a phonological rule can be shown to perform an operation (spreading, delinking, etc.) on a given set of features to the exclusion of others, we assume that the set forms a constituent in the feature hierarchy’. Although there is clearly interaction between tone and phonation, scholars have not provided convincing evidence that both nodes (or tone and glottal aperture) act as a unit. The models described above predict that delinking of the Laryngeal node will also result in deletion of tonal properties. Yip's model predicts that deletion of Register could leave Glottal Aperture features intact. It also suggests that if [voice] spreads, tone will too, since they are specified with the same node. The model also predicts that Glottal Aperture could spread independently of voice, but this is never the case with respect to ejectives (see Chapter 3 for examples). Unless these predictions can be verified, there is no basis for positing intermediate constituency.

Instead, researchers should examine some shared feature common to both voicing and tone. For example, it is often observed that pharyngeals lower adjacent vowels, so pharyngeals in SPE were represented as [+low]. More current frameworks (e.g. Clements and Hume 1995) suggest that low vowels and pharyngeals both share a feature [pharyngeal], though the feature has different structural dependencies for consonants and for vowels. Perhaps a similar arrangement could account for the interaction between tone and phonation.
Recently, Mary Bradshaw (forthcoming) has proposed a unified feature [voice/L], in which the feature refers to lead VOT ([voice/]) when it is dominated by the Laryngeal node, and to a Low tone when it is dominated by prosody (a mora). The feature thus occurs on the same tier but on different planes. (Compare the place features in Hume (1992) and Clements and Hume (1995), which are on the same tier but dominated by different structure). For Bradshaw, doubly linked structures account for the tonal depressor effect of voiced consonants.

We turn next to proposals for various organizations of laryngeal features independent of tone. Working within a Dependency Phonology framework, Anderson and Ewen (1987) suggest that the Halle-Stevens features 'should be assigned to different sub-gestures within the categorial gesture' (146). They propose that [voice] (or [stiff] and [slack]) are part of the phonatory sub-gesture, while [glottal stricture] (or [spread] and [constricted glottis]) are part of the initiatory sub-gesture. However, this proposal is simply asserted and not argued for.

Trigo (1991) has written on pharynx-larynx interactions, proposing two pharyngeal features [ATR/RTR], and [LL/RL] (Lowered Larynx/Raised Larynx). She notes that register distinctions may be made by either or both of these features. However, Trigo did not incorporate these into feature geometry and did not discuss their relation to the laryngeal features. Rose (1996), however, did tackle the issue of the influence of ejectives on vowel quality. In Tigre and Harsusi, ejectives lower vowels, and so Rose proposed that in these languages, ejectives are specified for [RTR] (1996:94), but this did not lead her to propose new laryngeal/pharyngeal constituents. Trigo's work, however, did inspire Halle's recent conceptions of feature geometry.

Halle (1992) groups the laryngeal features under a Glottis node, which is a sister with a Tongue Root node, a node whose features include [advanced tongue root] and [constricted pharynx]. The Glottis and Tongue Root nodes are daughters of the Laryngeal node. Halle's relevant geometry is as follows:

(21)

```
   Glottis
    /   \
   /     \ 
[spread] [c.g.] [stiff] [slack]   [ATR]   [Constr. Pharynx]
```


Halle’s brief article does not motivate this new conception of the Laryngeal node; what we have been calling the Laryngeal node is in this system only the features dominated by Glottis.

Halle’s 1995 hierarchy is essentially the same, but renamed as follows:

\[
\begin{align*}
\text{Guttural} & \\
\text{Larynx} & \quad \text{Tongue Root} \\
\text{[spread]} & \quad \text{[c.g.]} \quad \text{[stiff]} \quad \text{[slack]} & \quad \text{[ATR]} \quad \text{[RTR]}
\end{align*}
\]

Halle believes that the Tongue Root should be grouped with the Larynx node under a common Guttural node because articulators which they represent occur next to each other in the vocal tract. Both also involve glide-like behavior, but are considered 'articulator free'. Both uvulars and pharyngeals are produced with constriction in the pharynx ([+RTR]), while laryngeal consonants lack this ([−RTR]). Finally, in many languages there is modification of voice quality so that [−ATR] vowels are produced with creaky voice while [+ATR] tend to be breathy. There is also often a correlation between [ATR] and voicing. A node like Guttural which dominates Larynx and Tongue Root is an attempt to capture the fact that both articulators are interlinked phonetically (Halle 1995:17-18).

A problem with Halle’s proposal is that apparent interaction does not necessarily imply constituency. The feature [round], which often correlates with [+back] (or its equivalent) is grouped as a daughter of Labial, while [+back] is grouped under a Dorsal node in Halle’s system. Although Labial and Dorsal share being dominated by Place, Place was not proposed because [round] and [back] often correlate. For Guttural to be considered a constituent, we would expect the whole node to be deleted in some rules, and we would expect it to be the target of an assimilation in others. Halle did not provide evidence that this is the case. In sum, Halle’s arguments seem to me to be based more on phonetic facts than phonological processes.

Keyser and Stevens (1994) proposed a feature geometry based on acoustic considerations (with careful application of enhancement theory) and on anatomical organization, with four independently controlled regions: (1) adjustment of vocal fold stiffness, (2) ‘manipulation of the state and configuration of the surfaces of the airways in the laryngeal and pharyngeal regions’, (3) control of the soft palate, and (4) movement of articulators in the oral cavity. Their model is given below.
One unfortunate consequence of their almost exclusive focus on phonetic factors is that it undoes much of the progress based on study of phonological processes. For example, laryngeal neutralization (Clements 1985, Sagey 1986, Lombardi 1991) is no longer able to be expressed, since no node dominates the features [stiff] and [slack] (or [voice]) and [spread] and [constricted]. Indeed, in Stevens and Keyser (1989), [spread glottis] and [constricted glottis] are considered to be vocalic features ('represented in the sound while the vocal tract is relatively open', while [voice] is considered a nonvocalic features (represented when 'the vocal tract is more constricted') (83).

Agreement of laryngeal features would have to be expressed as two different rules. Bartholomae's Law, for example (Bartholomae 1882, Collinge 1985) is complex, but part of it involves the spread of both voice and aspiration onto an adjacent consonant, e.g. /bf+t/ → /bfδf/; this rule could not be expressed in a unified way in the Keyser and Stevens geometry.

Lombardi (1991:29) says that she has not found sufficient phonological evidence for structure or dependency within the Laryngeal node. She says that while ‘it is somewhat suggestive that I have found neutralization of aspiration without neutralization of voicing, I have not found neutralization of voicing without neutralization of aspiration’ (29). She says that this might suggest that [asp] is dependent upon [voice]. No one has pursued this line of inquiry, I believe, because most specifications for [asp] do not contain a specification for voice. See Chapter Three for more on this in relation to laryngeal spreading.

While tone and laryngeal/pharyngeal feature clearly provide a rich area of study, I must conclude that there is insufficient evidence for internal organization within the laryngeal node. Many alternatives suggest constituents based on phonetic facts and not phonological ones. While I do not rule out the possibility of internal constituents in the laryngeal node, I remain unconvinced so far. The final section below examines Steriade’s proposal for aperture nodes.
2.4.3. Closure and Release

In addition to there being questions about which features characterize ejectives and whether they are privative, Steriade (1993, 1994) has proposed changing some of the basic assumptions of the timing tier by proposing closure and release nodes. With these nodes she is able to capture details of the behavior of affricates and other contour-like segments, as well as closure and release. In her system, released stops have two aperture (A) positions. Ejectives are represented with the feature [constricted] associated with the release position of a stop or affricate. For example:

\[
\begin{array}{cccc}
  & \text{[constricted]} & \text{[constricted]} & \text{[constricted]} & \text{[constricted]} \\
A_0A_{\text{max}} & A_0A_{\text{max}} & A_0A_{\text{max}} & A_f & A_0A_{\text{max}} \\
\end{array}
\]

'preglottalized stop' \quad \text{'postglottalized stop'} \quad \text{'fully glottalized stop'} \quad \text{'glottalized continuant'} \quad \text{'plain released stop'}

Steriade’s proposal incorporates the insights of Kingston’s (1990) binding principle, in which glottal gestures are tied to the release portion of a stop. Kingston based his findings on the cross-linguistic phoneme inventory of Maddieson (1984) in which:

1. Stops are much more likely to contrast for glottal articulations than either fricatives or sonorants, and
2. Glottal articulations in stops are much more frequently realized as modifications of the release of the oral closure than of its onset’ (Kingston 1990:407).

Steriade has made a valuable contribution. As Kenstowicz (1993:503) realizes, ‘the ubiquitous processes of deglottalization and deaspiration in preconsonantal position now begin to make sense’ since the release position tends to get deleted before another consonant (see Chapter Four on deglottalization).

However, there appear to be at least five possible problems with Steriade’s representations. First, there is an explicit attempt to compare the release of an affricate with a simple continuant: both contain an \(A_f\) node. When the feature [constricted] is associated to the \(A_f\) node of an affricate, we get an ejective affricate; when it is associated to a bare \(A_f\) node, we get an ejective fricative. However, this formalization gives no indication that
glottalized fricatives are much rarer in language inventories, despite the representational similarity. [Constricted glottis] on an independent A_f node is more marked than an A_f node immediately after an A_o node. (In all fairness, even other theories must add specific marking statements.)

The second problem involves the distinction among preglottalized, postglottalized, and fully glottalized stops. Such distinctions may parallel to her treatment of nasals, where a prenasalized stop is [d], a postnasalized stop is [d̪], and a fully nasalized stop is simply [n]. If so, then what is a fully glottalized stop – glottal stop? If so, it would be represented as:

\((25) \) [constricted glottis]

\[
\hat{A}_o A_{\text{max}}
\]

This raises several questions, however, about the place features of a stop should the laryngeal feature anchor to both positions. Steriade’s aperture proposals also do not make clear the phonological difference between fully glottalized and postglottalized sounds. She cites unpublished work by Buckley (1991) on Kashaya, which is reported to have plain, preglottalized, postglottalized and fully glottalized plosives, although Buckley (1992/1994) does not make use of aperture notation. Steriade (1994) does however provide an overview. Compare a fully glottalized plosive [ʔt'] (an ejective with a laryngeal increment) vs. preglottalized [t] (voiceless stop with laryngeal increment) and postglottalized [t'] (an ejective), e.g. /-ʔt'ol-/ ‘make a smacking sound’ vs. /-ʔti-/ ‘roll up’ vs. /-t’an-/ ‘bruise’ (Buckley 1994:270-71). Buckley argues that these sounds are units, not clusters, since they would be the only case in which Kashaya had onset clusters, and they behave as units in reduplication.

The third problem has to do with possible locality violations. In the Mechaa variety of Western Oromo (Lloret 1993), an ejective /p’ t’ k’/ followed by a /t/ yields a cluster of two ejectives, suggesting that the feature [constricted] spreads onto the following stop. In Steriade’s framework, spreading would either have to skip the closure node A_o of the stop (which is unspecified), or this would later need to be repaired, since this language does not appear to have fully glottalized stops. Thus notions of locality (Odden 1994) would need to come into play, where A_{max} could skip over the A_o of the following stop and create ejection on the release node A_{max} of that stop:
Blevins uses Steriade’s analysis of aperture features in her analysis of Klamath. She notes that ‘while language-specific statements define docking sites for laryngeal features, docking sites are claimed to be non-distinctive in all languages (i.e. there is no language in which pre- and postaspirated stops are distinctive)’ (243). The same could apply to [constricted glottis]. If Blevins’ claims about docking sites being non-distinctive are correct, then strict locality could apply, with the A_max projected later in the derivation.

Another potential problem with Steriade’s system is the ‘preruptives’ in Caucasian languages (Catford 1977, 1991). Catford (1991:246) notes that in Avar and Akhwakh Andi, fortis stops have a long and strong affricated release. There are oppositions between [kʰ] and [kxx], [k′] and [kxx′], and [q′] or [qX′] and [qXX′]. These sounds pose a problem for any theory, but Steriade may need to invoke two release nodes to describe the sustained delayed release. It is unclear whether A_max A_max is a well-formed structure.

Another phonological question is which release node the glottalization attaches to. In a related phenomenon, Literary Avar has sounds like the fortis obstruent lateral [ɫ], which is a long fricative. Perhaps it could be represented as a sequence, but perhaps we again need two A_r nodes for certain rare types of fricatives. Since the aperture nodes act roughly as the Root node, it is unclear how her theory handles gemination, and whether it is done prosodically, via a mora or a timing slot, or by a proliferation of aperture nodes. Clearly, further investigation and more explicit formalism are called for.

A final question is how the aperture nodes are integrated into a feature geometry. Much of Steriade’s work begs the question, and manages quite nicely without feature geometry for the types of problems she analyzes. Some of the representations make use of feature geometric terms like Place, yet others treat individual features as if Steriade assumes the bottlebrush theory. Until this question of integration of aperture into a feature geometry is addressed, Steriade’s theory cannot reap the benefits of feature geometric structure.
2.5. Conclusion

As we have seen, questions of laryngeal representation have played an integral part of linguistic theory. And since ejectives provide a distinct aspect of laryngeal theory, their study can provide insights into phonological organization.

Of all the feature systems proposed, the most successful has recognized the similar patterning of various glottal and glottalic sounds through the feature [constricted glottis]. With insights from studies of Native American languages of the structural tradition, in combination with the generative feature tradition, Halle and Stevens' proposal of [c.g.] is a real advance for feature theory. Alternative feature theories, while perhaps descriptively adequate, have not held the appeal of [c.g.].

The dominant view of distinctive features has been that they are binary. Yet the failure of rules to refer to [-c.g.] is a serious inadequacy of binarism. Recognition that laryngeal features are privative, at least in underlying representation, is another recent advance, and there seems to be a growing consensus of this view, both in Dependency-influenced frameworks, as well as in North American generative linguistics. While various proposals for a scalar approach to laryngeal features have been put forward, the phonological behavior of these features does not lend itself to such an analysis.

The third main advance of laryngeal features came with the recognition that they form a constituent within a hierarchical arrangement of features into a feature geometry. From early recognition that laryngeal features pattern differently from supralaryngeal features, the Laryngeal node proposed by Clements has held its ground. Attempts to create additional structure within the Laryngeal node have not overwhelmed skeptics. Steriade's proposal for aperture nodes captures many insightful facts, yet the role of these nodes in relation to feature geometry remains unclear.

We now turn our focus to exploring the phonological patterning of ejectives in a wide variety of languages, using the Clements and Hume (1995) model of feature geometry.
CHAPTER 3
ASSIMILATION

3.1. Introduction
Clements (1985), citing work by Mohanan (1983), notes that in current phonological theory there should be 'three common types of assimilation processes in the world's languages': total assimilation, expressed as spreading of the Root node; partial assimilation in which a class node spreads; and single-feature assimilation in which a single feature spreads. This chapter tests these predictions against the laryngeal features, particularly for the feature [constricted glottis] ([c.g.]), which characterizes ejectives. Total assimilation of ejectives is confirmed in §3.8; class node assimilation, where the class node is the Laryngeal node, is confirmed in §§3.4 and 3.5, and for the place node in §3.7; and single-feature assimilation is confirmed for [voice] in §3.3. However, not all features appear to behave independently, since ejectives behave in a very asymmetrical way from how the theory predicts. I have found no evidence to show that ejectives spread [c.g.] phonologically, while other laryngeal features remain inert (thereby proving that only the single feature [c.g.] spreads and not the whole Laryngeal node). This raises the question whether the features are adequately characterized and organized, or whether this should be reconsidered.

This chapter is organized as follows: Section 3.1 examines the theoretical and empirical predictions of feature theory. Requirements of general feature theory are discussed in §3.1.1, while predictions of feature geometry are addressed in §3.1.2. The question of scalar questions is examined and rejected in §3.1.3. The theoretical formalization of assimilation as spreading is reviewed in §3.2. The next section examines the predicted independence among laryngeal features by documenting cases in Oromo and Northwest Caucasian in which [voice] spreads while [c.g.] does not. Cases where all laryngeal features spread are analyzed in §3.4. Section 3.5 first discusses some of the theoretical problems involved in certain types of complete assimilation and prepares the reader for the analysis of Mingrelian and Laz data. Other types of laryngeal spread are examined in §3.6. Place assimilation and complete assimilation which involve ejectives are
briefly discussed in §3.7 and §3.8. The conclusion delves into the question of why [e.g.] behaves in an asymmetric way from [voice].

3.1.1. Requirements of a Theory of Features
Before testing the predictions of a theory of feature organization, it is useful to review some of the goals of both feature theory and feature geometry. An empirically adequate feature theory must address (1a-c), and some phonologists would add (1d):

(1) a. Distinguish laryngeal features in underlying representation
    b. Allow for features to trigger processes
    c. Allow features to be the target of processes
    d. Allow for allophonic laryngeal specifications in phonetic representation

In this section and the following, I will provide cursory reference to processes in a variety of languages. I will not cite many examples so that the reader can follow the main thread of the discussion, particularly as it relates to the goal of this chapter: to test feature geometry and spreading against a pool of data involving ejectives.

All feature theories are capable of describing the underlyingly contrastive laryngeal features which characterize different segments (1a), though they differ with respect to the nature of features themselves (e.g. binary, privative, or multi-valued) and with respect to underspecification, as was reviewed in Chapter Two. For example, English can contrast /p t k/ from /b d g/ by using the feature [voice], and languages which add an ejective series /p' t' k'V also add the contrastive feature [constricted glottis].

We also expect some phonological rules to utilize features to trigger certain processes (1b). Allophonically in many languages such as Georgian (Robins 1957), Mayan Chontal (Keller 1958), and Eastern Pomo (McLendon 1975), ejectives (and often other glottalic sounds and glottal stop) cause adjacent vowels to be laryngealized, which we can view as the spread of the feature [e.g.]. At the contrastive phonemic level, the succession of the feature [voice] in Japanese may trigger Lyman’s Law, which deletes the first of two [voice] specifications in Rendaku compounds (see §2.3.3.).

Laryngeal features may also be the target of certain processes (1c). For example, as we will see in Chapter Four, ejectives are often targeted for deglottalization in preconsonantal position. Chapter Six explores dissimilations in which sequences of the same feature are not permitted, and resolution of this results in a change of one of these
features. In this case the same feature (on different segments) may be considered both target and trigger.

Different theories have different goals with respect to characterizing allophonic processes (1d), though not all theories are concerned with providing sufficient detail to permit cross-linguistic comparison. In English, for example, we can characterize aspiration as a low-level specification for [spread glottis] ([s.g.l]) for voiceless stops in certain positions ([pʰmA] ‘pin’ vs. [spmA] ‘spin’), and glottalization as the optional addition of [e.g.] in certain other positions ([bæʔk] ‘back’). The challenge for phonology is when to recognize that gradient phenomena are falsely categorized, leading to the proliferation of new features or feature values to describe minute allophonic differences. I believe that the most detailed allophonic distinctions which a phonologist would want to posit are those ‘necessary for the description of a particular language as opposed to all other languages’ (Ladefoged 1972). Thus a feature theory should be able to account for the English /t/ as alveolar and aspirated, while the French /t/ is dental and unaspirated, since these categories are contrastive in some languages. It may leave to phonetics, however, the exact amount of laryngealization on a vowel adjacent to a glottalized consonant in English.

Thus the basic predictions of current feature theory are on the whole confirmed.

3.1.2. Predictions of Feature Geometry

With the advent of feature geometry (Clements 1985, Sagey 1986, Clements and Hume 1995), laryngeal features are grouped together under the Laryngeal node (see the review of the literature in §2.4). A further prediction of this model is that if laryngeal features group together, we expect all laryngeal features to spread, and all laryngeal features to delete in some phonological rules. This chapter, particularly §3.4 and §3.5.4, focuses on the complete laryngeal assimilation rules in various languages with ejectives, a process due to the spreading of the Laryngeal node. (Detailed analyses of laryngeal spreading have been provided for Ancient Greek; see Steriade 1982, Kenstowicz 1993:156-7). Chapter Four examines cases of deglottalization, many of which involve delinking of the Laryngeal node. Lombardi (1991) has provided abundant evidence for Laryngeal neutralization in such languages as Thai and Sanskrit, which she expressed as the delinking of the whole Laryngeal node. And Buckley (1991) argues that Kashayan complex sonorants cannot bear a Laryngeal node in onset position and must therefore delete this node. (This process is described further in §3.6.1).
Although features are grouped together, feature theory predicts that individual features may still act independently. As such, features in phonological theory should be able to:

(2) a. Be licensed in certain positions
b. Change
c. Delete
d. Spread

As an example of (2a), Lombardi (1991) has argued that in languages such as Tol (Fleming and Dennis 1977), with voiceless, voiceless aspirated, and glottalized stops in onset position, but only glottalized and voiceless unaspirated in syllable-final position, the feature [asp] ([spread glottis]) is licensed only in onset position, since aspiration is not permitted in coda position, e.g. /sitʰin/ vs. [sit] ‘avocado’. She also argues that Bengali neutralizes [s.g.] word-finally, but permits [voice]; note that this is true of only some dialects—see the discussion below. In short, specific features and not simply the whole Laryngeal node must be referred to.

Individual laryngeal features should be able to change through one process or another (2b). For example, allophonically, syllable-final voiceless stops in English may be glottalized (or may undergo glottal reinforcement), while voiced stops are not (Gimson and Cruttenden 1994). Somali voiced stops can be allophonically realized as ejectives in word-final position (Armstrong 1934, Puglielli 1997). In Venda (Doke 1967, Poulos 1990) noun class 20 has aspirates which alternate with ejectives, indicating a change of laryngeal feature. Korean obstruents become glottalized (fortis, but not ejective, shown by the asterisk) after another obstruent, e.g. /apʰ/ → [ap] ‘front’ vs. /apʰ-to/ → [apʰ*o] ‘front also’ (Lombardi 1991:125-26, citing data from Kim-Reynaud 1986). These processes suggest that certain natural classes like voiceless stops may be changed to a certain feature like [e.g.], leaving voiceless aspirated stops unaffected, e.g. [faktʰo] ‘red dirt’. In contrast, Tahltan (Nater 1989) voiceless stops are voiced intervocally, while ejectives are not. Thus it seems clear that this prediction of the theory is borne out.

Individual features should also be able to delete, while other laryngeal features are preserved (2c). For example, Marathi (Houlihan and Iverson 1979:52) shows neutralization of aspiration, but not of voice:
Because [voice] is still preserved, but aspiration is not, the whole Laryngeal node cannot delink; thus [voice] and [spread] act independently. Furthermore, the last example above illustrates that the breathy voiced stops are best characterized phonologically as the union of two features: [voice] and [spread glottis], since loss of aspiration leaves the sound voiced. Implosive consonants are often characterized as being specified for both [voice] and [constricted glottis]. Evidence from S’aamakko (East Cushitic; Hayward 1989) is suggestive of this. The phonemic inventory of S’aamakko is /p t j k ? b d ? g, s j x h h, z, ð d ð[?], s’ ð’ q’, ð ð, m n (n) ng, 1 r w y/. Thus, although there are both ejectives and implosives, they do not contrast by place. Hayward notes that when the implosives occur preconsonantally, or perhaps syllable finally, the labial and velar are voiceless such that the labial is either ejective [p’] or a voiceless implosive [ç]; the voiced implosive /ç/ does not occur in this position, instead assimilating completely to a following consonant: /jë’ti/ ‘I dress (tr.)’ vs. /jë’tì/ → [jë’tì] ‘you dress’ (1989:6). There are alternations which show the allophonic alternation between voiced and voiceless glottalic consonants:

(4) Root 3m.sg. 3f.sg. 1pl. Gloss
dìill- dìi[l’]ì dìi[k’]ti dìi[k’]në ‘add to’
mìe[l’]ì mìe[k’]ìti mìe[k’]në ‘fetch water’
kàma[l’]ì kàma[ð]ìti kàma[ð]në ‘breed’
tù[l’]ì tù[ð]ìti tù[ð]në ‘pound’

(based on Hayward 1989:6).

Thus if we assume that implosives have two laryngeal features, we can account for the (allophonic) pronunciation of S’aamakko by positing the delinking of [voice] on implosives in syllable-final position. Simple [voice] however, not only remains in this position, but spreads rightward onto the suffix: /dìj’gì/ ‘he takes root’ vs. /dìj’gìtì/ → [dìj’gì] ‘she takes root’ (1989:6-7). Keller (1958:46) also reports implosive devoicing in the Mayan
Chontal of Allende, e.g. /seɓ/ → [sep']. The flip side of this specification, whereby ejectives acquire [voice] to become implosives, is examined in Chapter Seven on voicing.

Additional evidence for individual features deleting, while leaving other laryngeal features intact, includes Kashaya (Buckley 1994), which dissimilates through deletion the first of two aspirates, but leaves voiced and ejective sounds intact, e.g. /tʰeːtʰeːn/ → [tɛn] 'my mother' (1994:83). And Lezgian (Haspelmath 1993) deglottalizes the first of two ejectives in root, but leaves voiced and aspirates intact. It also deaspirates the second of two adjacent aspirated stops. Details of Lezgian will be presented in §4.4.2.

This chapter will focus on the assimilation of laryngeal features (2d), particularly [c.g.]. Section 3.3 will demonstrate that [voice] can spread to the exclusion of [c.g.]. However, one pattern which the theory predicts is not attested. I have found no evidence that [c.g.] alone can spread from ejectives onto other consonants. There is abundant evidence for this phenomenon, but only if other laryngeal features spread as well. That is, the whole Laryngeal node may spread, including Laryngeal nodes with specifications for [voice] and [c.g.], but there is no evidence for only [c.g.] to spread from ejectives. Once the data have been examined, this point will be discussed in the conclusion (§3.9). For now, however, the asymmetry between [voice] and [c.g.] calls into question the nature of these laryngeal features.

3.1.3. Scalar Features Revisited (and Rejected)
In light of this data gap, perhaps the multivalued features should be reconsidered since it was last discussed in §2.3.2. Gnanadesikan (1997), for example, proposes a series of ternary scales, including an Inherent Voicing Scale and a Consonantal Stricture scale, which she claims provide 'natural explanations for a number of phonological processes which are opaque in binary models' (vi). Unfortunately she does not address where ejectives would fall in such a scale, and it is unclear whether a ternary scale would be sufficient were we, like Ladefoged, to adopt a hypothetical laryngeal stricture scale. For example, while her system allows voiceless to assimilate to voiced consonants and vice versa, it fails to describe consonants which assimilate with respect to ejection; ample cases in §3.4 show that this is a serious inadequacy of the theory. While Gnanadesikan offers an original and unique explanation for such phenomena as chain shifts, as she admits, her system does not replace all binary or privative features. Furthermore, with her abolition of privative [voice] and its incorporation into the Inherent Voicing Scale, the relation of [voice] to other laryngeal features such as [constricted glottis] and [spread glottis] is
unknown. And it remains unclear whether the same features can participate in different ternary scales, e.g. both an Inherent Voicing Scale and a Glottal Stricture Scale. Because of these problems, we will turn elsewhere for a potential multivalued solution.

The strongest multivalued feature hypothesis I will dub the Unified Laryngeal Feature Hypothesis:

(5) The Unified Laryngeal Feature Hypothesis

The laryngeal ‘features’ are organized along a multi-valued scale based on laryngeal stricture. This entails that one laryngeal ‘feature’ cannot spread without spreading all, and one laryngeal ‘feature’ cannot delete without deleting all.

For example, one implementation of this scale would be to propose that features from [spread] to [constricted] are assigned a value, e.g. [1 glottal] = ejective, [2 glottal] = implosive, [3 glottal] = obstructive voice, [4 glottal] = sonorant voice, [5 glottal] = breathy voice, [6 glottal] = plain voiceless, and [7 glottal] = aspirated. The absolute numbers would have to be adjusted to account for languages with no sounds like implosives or breathy-voiced consonants, but the relative values would remain. In favor of this proposal is the theoretical impossibility of simultaneous [constricted] and [spread glottis], one of the clues that Williamson (1977) believed may indicate a multivalued feature (but see §5.7).

As a multivalued scale, however, the laryngeal features would not be cross-classifying, compositional features. Thus individual features such as [voice] and [constricted glottis] could not combine to form the implosive specified for both [voice] and [constricted glottis]. Similarly, breathy voiced consonants could not be specified for both [voice] and [spread glottis]. However, as we have seen in Marathi (in (3) above), these features do seem to cross-classify the voiced and the aspirate sounds. To express aspiration neutralization using the scale above, one simply subtracts one from the input, but one cannot unite the targets: [7 glottal] → [6 glottal] and [5 glottal] → [4 glottal]. In S’aamakko ((4) above), the implosives show allophonic variants as ejectives which can easily be analyzed as the delinking of the [voice] component of the implosives, a relatively natural process which may be seen as final devoicing. In the scalar theory, this is

1 I am grateful to David Odden for comments and discussion on the nature of multivalued features. Of course, I am responsible for the ideas presented here.
expressed as [2 glottal] → [1 glottal], a change which could imply increase in glottal constriction as the explanation, rather than devoicing.

Recall from §2.2.4.3 that in Burmese (Ladefoged and Maddieson 1996:69), alternations between the simplex and causative forms vary according to aspiration for stops, and for voicelessness for nasals and laterals. For example, /páu?/ ‘be pierced’ alternates in the causative /pʰáu?/ ‘pierce’, while a form like /nōu/ ‘be awake’ alternates with /nōu/ ‘waken’. This strongly suggests the cross-classification of ‘voiceless’ sonorants with aspirated consonants by means of the feature [spread glottis]. Lombardi (1991:203-204), citing Chang (1968), notes a similar pattern in Tibetan causatives. If we accept (5), then these patterns cannot be captured in an elegant way. For example, in the Burmese case, a scale of glottal stricture might be ordered from 1-5: b > m > p > m > pʰ, in which case one would need to add 2 to get the output: [2 gl] → [4 gl], [3 gl] → [5 gl]. If the scale is correct, then if one can skip over items in the scale, the question is what prevents one from adding three or more to the values? Even if the scale is changed, one could not assign one value on the scale as a floating morpheme to account for the Burmese data. With the independent laryngeal feature hypothesis, one need only posit the feature [spread glottis] as the causative morpheme, and accept the hypothesis that laryngeal features may be compositional: [nasal] + [s.g.] → [N], and, assuming privative features, 0 + [s.g.] → [Th].

Another prediction of the Unified Laryngeal Feature Hypothesis is that features may not act independently of one another; they either all spread or all delete. However, as I demonstrate in §3.3, there are a few cases in which [voice] spreads without [e.g.] also spreading. The Marathi data suggest that [spread] may delink independently of [voice]; this is not predicted by (5). As David Odden (p.c.) observes, the Unified Laryngeal Feature Hypothesis could specify range variables for certain of its processes. To show that (5) is still untenable, I will explore Bengali in more detail.

Kenstowicz (1994:193-4) mentions two dialects of Bengali. The first does not have word-final laryngeal neutralization; the second neutralizes the feature of [spread glottis] so that /b, bʰ/ → [b] and /p, pʰ/ → [p], for example. Lombardi (1991), as mentioned above, must have been referring to this dialect. Ray, Hai, and Ray (1966) describe the first dialect. Kenstowicz notes that both dialects display the following alternations (in the gloss I simply conjoin the meanings of the individual elements—the compound may have a better translation, but Kenstowicz does not supply it):
I propose that syllable-finally and preconsonantly, all laryngeal features undergo Laryngeal neutralization such that all four phonation types result in a plain voiceless stop. The occurrence of voiced stops word-finally (e.g. /bag/ ‘tiger’) is accounted for by appealing to word-final extrametricality (Lombardi 1991). I also propose a rule of regressive [voice] assimilation. Thus in the second dialect, in which aspiration but not voice is neutralized, voice spreads onto the preceding stop (as in (6a-c), (6e)). Note, however, that the aspiration of voiced aspirates does not also spread ((6b, 6e), thereby showing the independence of these two features; the Laryngeal node as a whole does not spread. Thus /pʰ bʰ/ act together in undergoing deaspiration word-finally in the second dialect, and /b bʰ/ act together in spreading voice onto the preceding stop. An alternative account, in which the whole Laryngeal node of the first consonant of the second element of the compound spreads onto the final consonant of the first element of the compound would also need to specify that [spread] could not be licensed pre-consonantly, a logical assumption given facts of the release of aspiration. However, the devoicing of voiced stops (as in [6d, f, g]) would not be predicted, and so one would need to account for this by another process. Occam’s Razor would favor the analysis in which the Laryngeal node delinks and [voice] spreads. Thus this example is another blow to the hypothesis in (5).

In conclusion, I do not believe that a single multivalued feature is empirically adequate. Therefore, I will continue to assume that the laryngeal features [e.g., [s.g.], and [voice] are (1) compositional and cross-classifying; (2) may act independently in a variety of phonological situations; and (3) may act jointly as constituents of the Laryngeal node. Before examining the data to prove points (2) and (3), we review in the next section the formalization of assimilation as spreading.

2 I assume Kenstowicz (1994) has a typographic error since the nasalized vowel is missing in the compound; I have added it here.
3.2. The Formalization of Assimilation as Spreading

Clements and Hume (1995:257) claim that 'perhaps the most widely recurrent type of phonological rule is assimilation'. Assimilation, according to McCarthy, 'is the spreading of the assimilating feature over a wider domain' (1988:86); Clements first formalized this as 'the spreading of an element of one tier to a new position on an adjacent tier' (1985:231). In autosegmental phonology, assimilation is expressed by one of the elementary operations of nonlinear phonology: the addition of an association line from one feature or node to the appropriate node of another segment (Halle and Vergnaud 1980, Steriade 1982, Clements 1985, Hayes 1986). The addition of an association line either from application of the Well-formedness Condition or of a phonological rule is indicated by dashed lines (Goldsmith 1976 [1979:25], Clements 1976:114). Rightward spreading is known as progressive or perseverative assimilation. Leftward spreading is known as regressive or anticipatory assimilation. In the unmarked or default mode of assimilation, a spreading rule spreads features which are not specified in the target, in a feature-filling manner. A feature-changing assimilation rule spreads to a target already specified for a feature or node, whose original values are delinked and then replaced by the linked structure of the assimilating feature. Examples of these processes are shown in (7).

(7) a. Progressive feature-changing assimilation

\[
\begin{array}{c|c|c|c}
X & Y & | & \\
A & B & & \\
\end{array} \rightarrow \begin{array}{c|c|c|c}
X & \dagger & | & \\
A & B & & \\
\end{array} \rightarrow \begin{array}{c|c|c|c}
& & & \\
& & & \\
\end{array}
\]

b. Regressive feature-filling assimilation

\[
\begin{array}{c|c|c|c}
X & Y & | & \\
A & & & \\
\end{array} \rightarrow \begin{array}{c|c|c|c}
X & \dagger & | & \\
A & & & \\
\end{array} \rightarrow \begin{array}{c|c|c|c}
& & & \\
& & & \\
\end{array}
\]

Assimilation across a segment already specified for the assimilating feature is prohibited because of a well-formedness constraint, the Line-Crossing Prohibition (No-Crossing Condition), which states that association lines between the same autosegmental tiers may not cross.

Autosegmental theory was originally proposed for tone, and sketched for vowel harmony (Goldsmith 1976a). Vowel harmony and spreading were developed in Clements (1976, 1980 [1976]), and later work applied the theory to segmental phenomena (e.g. Goldsmith 1976b, 1981, and Hayes 1986 inter al.). Specific analyses involving the spread of laryngeal features include Steriade (1982), Hayes (1984), Itô and Mester (1986), Mester and Itô (1989), and Lombardi (1991, 1995a).
With the advent of feature geometry, the laryngeal features [voice], [spread glottis], and [constricted glottis] are grouped together under a Laryngeal (Lar) node (Clements 1985). As we noted above, phonological theory predicts that laryngeal features should pattern together in similar ways as various phonological rules affect representations with (or without) a Laryngeal node. Rules which involve spreading of the Laryngeal node predict that all laryngeal features should spread. However, individual laryngeal features may also spread. As McCarthy (1988:90) notes, the spread of [voice] (or any laryngeal feature) could in principle be regarded as the spreading of the whole Laryngeal node, shown in (8a), which illustrates this process with a voiced segment, or as the spreading of the individual laryngeal feature (8b), depending on how the other laryngeal features behave. The exact determination is impossible, Lombardi (1991:41) notes, when only one dependent feature, say [voice], is phonologically active in the language. (Rt below indicates a segment’s Root node, the highest level of featural cohesion, roughly equal to the idea of a segment).

(8) a. Spreading of the Laryngeal node

\[
\begin{array}{c}
\text{Rt} \\
\text{Lar} \\
\text{[voice]}
\end{array}
\]

b. Spreading of the feature [voice]

\[
\begin{array}{c}
\text{Rt} \\
\text{Lar} \\
\text{[voice]}
\end{array}
\]

Which feature values can spread has been called into question with the proposal that laryngeal features are privative (see §2.3.3). The most comprehensive presentation of assimilation using privative laryngeal features is Lombardi (1991). The basic points in Lombardi’s analysis of privative features and assimilation are summarized in (9a - f):

(9) a. Laryngeal features [voice] [spread glottis] and [constricted glottis] ([voice], [asp], and [gl], respectively) are privative.3

b. Plain voiceless consonants are unmarked and therefore bear no Laryngeal node. Laryngeal neutralization is usually delinking of the Laryngeal node, which results in plain voiceless obstruents.

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3 Lombardi (1996) argues that laryngeal features may be binary at the postlexical level.
c. Languages with neutralization have positive licensing constraints which specify the features which can appear before [+son], i.e. very roughly, in onset position. Neutralization of only one feature in a language with two or more marked laryngeal series is specified with reference to that feature in a licensing constraint; otherwise the constraint applies to the Laryngeal node as a whole.

d. Languages may have specific rules of spreading laryngeal features or the Laryngeal node.

e. Final consonant exceptionality is used to account for languages with word-internal but not word-final neutralization.

f. The Universal Sonority Constraint does not permit the following configurations, since voiced obstruents are more sonorous than voiceless ones:

*syllable nucleus-voiceless obstruent-voiced obstruent
  e.g. Vsd

*voiced obstruent-voiceless obstruent-syllable nucleus
  e.g. sdV^4

(Adapted from Lombardi 1991:36-42)

In Lombardi's analysis, voicing assimilation is two different processes consisting of (1) neutralization of [voice] by delinking (voicelessness assimilation); and (2) spreading of [voice] (voiced assimilation). The 'assimilation' of voiceless consonants is simply a result of the first process of neutralization (1991:34), while assimilation which causes segments to become voiced is the result of the spreading of [voice]. Since there is no feature specification [-voice] in a privative theory, what is apparently spreading of voicelessness must be described as neutralization (delinking), which is governed by prosodic licensing conditions. The two processes are shown below:

---

^ Apparently a typo for dsV or ztV.
Lombardi has demonstrated that the laryngeal features of glottalization and aspiration show the same neutralization behavior as voicing, with similar constraints of both individual features and the Laryngeal node as a whole. Kenstowicz (1993:157-8) claims that 'we expect languages with glottalized consonants to spread [constr gl] along with features of aspiration and voicing — a prediction that is well supported on cross-linguistic grounds.' However Kenstowicz does not cite such cases. Kenstowicz is apparently referring to spreading of the Laryngeal node as a whole, even for those segments which bear a [c.g.] specification.

Lombardi has observed an interesting asymmetry: 'while spreading of [voice] is quite common, spreading of the other laryngeal features is much less common' (1991:74). When Lombardi claims that 'voice very commonly spreads in clusters, while spreading of glottalization and aspiration is extremely rare' (1991:183; see also 1991:102), she must be referring to evidence not from the Laryngeal node, but from individual features. Not only is individual feature spreading of [s.g.] or [c.g.] rare in her view, she reports that 'I have not found spreading of aspiration (or glottalization) without spreading of voice' (1991:29). Lombardi notes that Ancient Greek had clusters that agree in aspiration, but it is otherwise rare. She argues that phonological double linking of [asp] does exist in other languages like Sanskrit. And she predicts that [c.g.] can spread individually, but had no examples of multiply-linked [c.g.] at the time she wrote her dissertation (1991:102).

In this chapter, I will document in §3.4 and §3.5 what Kenstowicz has claimed: the complete laryngeal assimilation of segments, including ejectives. I will also report that I cannot confirm what Lombardi predicts: segments which spread only the feature

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5 Cf Greenberg's (1978c:270) universal that 'In terms of dissimilation, sequences which differ only in glottal adjustment are disfavored...': This implies laryngeal agreement and hence either assimilation of [c.g.] or deglottalization.
3.3. Cases of Laryngeal Independence: [voice] Spreads Without Ejection

In order to prove that laryngeal features are independent (and further disprove the Unified Laryngeal Theory of (5)), we need to examine whether Laryngeal features may act independently of one another; otherwise, if they all behave in the same way, the Laryngeal node and not individual laryngeal features would be at work. In this section we observe instances of [voice] spreading to the exclusion of [constricted glottis]. The first is in Waata Oromo, an Omotic language with a rich set of assimilations. The second set of observations come from three varieties in the Northwest Caucasian (NWC) family: Kabardian, Bzhedukh, and Abzakh. All of the languages in this section have related dialects in which complete laryngeal assimilation occurs, which provides an interesting typological contrast. The other varieties of Oromo are discussed in §3.4.1, and complete assimilation in NWC will be discussed in §3.4.2.

3.3.1. Waata Oromo

One language which appears to permit the spread of voice but which does not have active ejection spread is the Oromo dialect of Waata (Omotic; Heine 1981 and Stroomer 1987). Heine's (1981) consultants were from Gede (Gedi) and Arabuko in eastern Kenya; Stroomer's (1987) fieldwork seems to have been done primarily in Malindi, slightly to the north, and in surrounding villages. The phonemic inventory of consonants which Heine provides is as follows:

6 Heine notes that [v, z, η] also occur, but only in loanwords from Swahili and Mijikenda. /f/ has been found in one word only, and is not even mentioned in Stroomer. Stroomer mentions the occurrence of [p] in loanwords only.

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Oromo has a complex set of morphophonemic changes, and details of these vary from dialect to dialect; this section will focus on those changes found in the Waata dialect. In general terms, there are (1) progressive assimilations among plain obstruents and sonorants; (2) regressive assimilation of implosives to pulmonic coronals, and of some sounds to nasal /n/; and (3) a type of fusional palatalization when a velar and a coronal are in contact. Stroomer (1987) notes that consonant clusters across morpheme boundaries often arise from the last consonant of the stem in contact with the following: person markers beginning in /-t/, the negative suffix /-ne/, the causative suffix in /-s-, the nomen agentis suffix /-tuu/, and initial consonants can be preceded by preverbal elements in /(h)in-/ or /(h)in-. In nouns, the initial subject markers begin in /t/ and /n/, and in adjectives, the feminine gender suffix is /-tuu/. Thus there are no suffixes which begin with a voiced obstruent.

First we will examine the cases of progressive assimilation in which voice of the first member appears to spread onto a following suffixal /l/. Forms which establish the underlying representation of the suffix are also provided. Because Heine provides only a few examples, I have searched the index of roots to provide additional forms which follow the pattern; I assume these are regular and have marked these cases with a postposed asterisk.

(12) a. /did-te/ [didde] ‘she has refused’ (cf. /mur-te/ ‘she has cut’)
/k’ood-te/* [k’oodde] ‘she has divided’
/gaad-te/* [gaadde] ‘she has herded’

b. /k’aw-ti/ [k’abdj] ‘she has, owns’ (cf. /mur-ti/ ‘she cuts’)
/guw-ti/* [gubdij] ‘she burns up’

In the examples above, the root-final voiced consonant spreads the feature [voice] rightward onto the voiceless prefixal consonant.

Heine analyzes the forms in (12b) as deriving from an underlying /w/, as shown by its existence in forms like /k’aw-q/ ‘I have’ (cf. [k’abdj] ‘she has’). Thus in his analysis the labiovelar glide undergoes fortition before plosives and then triggers progressive voicing assimilation. (Stroomer’s analysis also involves fortition, though to /l/, in his dialect, not /b/). However, he acknowledges that this sound derives historically from *b. Given that /t, d/ spirantize to [θ, ð] in vocalic environments, it is plausible that the labial glide lenites to [β], which has weakened further to [w]. If the underlying form does end in
a voiced bilabial stop, an extra rule of fortition is avoided, and the lenition rule patterns similarly to other non-velar stops. Nothing particularly crucial hinges on this, as long as it is acknowledged that at some point, the labial segment induces voicing on the following coronal suffix. The rule thus spreads voice from /d, b/ onto a following voiceless suffix. (As mentioned above, the velar stop is involved in palatalization, and will be examined in more detail below).

The other type of progressive assimilation involves complete assimilation of coronal sonorants. A sequence of liquid plus nasal is completely assimilated to the liquid, the result of the whole Root node spreading.

(13) /déger-nè/ → [dégerre] ‘we have seen’ (cf. /dun-nè/ ‘we have come’)  
/kofol-nè/ [kofolle] ‘we have laughed’

Implosives followed by /t/ or /n/ yield a pulmonic geminate voiceless oral or voiced nasal coronal:

(14) a. /dub-ad-tè/ [dub-at-tè] ‘she has talked’ (cf. /dub-ad-è/* ‘I have talked’, and forms like /deer-ad-è/ ‘I have become tall’)  
/deer-ad-tä/ [deer-at-ta] ‘you (sg.) become tall’  
(cf. /deer-ad-ä/ ‘I become tall’)  
/sodaad-tu?/ [sodáát-tu?] ‘coward’ (< ‘to be afraid + agentive suffix’)  

b. /dub-ad-nè/ [dub-an-nè] ‘we have talked’  
/deer-ad-nä/ [deer-an-nä] ‘we become tall’  
(cf. /deer-ad-ä/ ‘I become tall’)

This change could be accounted for in a few ways. First, the coronal /t/ or /n/ could spread their Root nodes onto a preceding implosive, creating complete regressive assimilation. Or, perhaps due to phonotactics, the implosive could delete (as a result of not being licensed in coda position) and then the coronals spread due to compensatory lengthening. Another possibility in (14a) is for the Laryngeal node of the suffixal /t/ to spread leftward. However, given the assumption that plain voiceless consonants are unspecified for a Laryngeal node, this would be formally impossible. Furthermore, there could not be a unified account with the process in (14b) involving the nasal. I therefore believe that the whole Root node spreads leftwards in this process.
Evidence for regressive assimilation is seen in the two sequences /w-n/ → /mn/ and
/tn/ → /nn/, where nasality spreads leftward:

(15) /k'aw-nç/ [k'amnç] ‘we have seized’
/hîn kut-nâ/ [hîn kunnâ] ‘we shall cut’ (cf. /hâ kut-anj/ ‘has been cut’ and
/k'am-nâ/ ‘we (shall) have’ )

Next, to understand the behavior of ejectives, we must observe their patterning with
other velar stops in biconsonantal clusters. According to Heine (1981), when velar and
dental phonemes meet across a morpheme boundary, a palatal or palatalized consonant
results?, apparently in a type of fusion:

(16) a. /dug-tç/ [dû-dʒç] ‘she has drunk’ (cf. /dûûg-áân/ ‘drinking’
and /mur-te/ ‘she has cut’) /dek'-tç/ [de-ʃe] ‘she has gone’ (cf. /dek'-é/ ‘going’)
b. /dug-nç/ [dû-nç] ‘we have drunk’ (cf. /k'aw-nç/ →
/k'am-nç/ ‘we have seized’) /dek'-nç/ [de-ŋç] ‘we have gone’ (1981:22)

Where the second consonant is nasal, as in (16b) above, the result will be a palatal nasal.
With the obstruent clusters in (16a), the voicing of the first consonant appears to determine
the voicing of the alveopalatal. One exception is that the ejectives fail to create a palatal
ejective as we might expect. Thus only [voice] but not [e.g.] is preserved under fusion.

There are many cases of what appear to be monomorphemic /tʃ/ in Waata, e.g.

7 Palatalization is also triggered when the stem ends in /u/:

/hâ matʃ'au-tç/ → [hâ matʃ'oo-tʃç] ‘she has been drunk’
(cf. /déger-te/ ‘she has seen’) /hâ matʃ'au-nç/ → [hâ matʃ'oo-nç] ‘we have been drunk’ (1981:22)
(cf. /k'am-nç/ ‘we have seized’)

One other idiosyncratic case of palatalization occurs when the implosive is
followed by the sibilant fricative, e.g. /naad-sis/ → [naa-tʃis-] ‘to feed’ (i.e. ‘to cause to
eat’; /naad-/ ‘eat’ + /-sis-/ ‘causative suffix’. Apparently the only place this occurs is
with the causative.

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Therefore the failure to create a palatal ejective cannot be attributed to structure preservation.

In short, although there are cases of voicing spread (e.g. /wt/ or /bt/ → [bd]), there are no cases of the spread of ejection, e.g. */k't/ → *[k't']). Instead, a plain voiceless alveopalatal is created. Thus in Waata Oromo, [voice] is phonologically active—the subject of phonological rules, while ejection is not. And this shows the independence of the laryngeal features, since individual laryngeal features may act independently of the Laryngeal node as a whole.

Stroomer's (1987) study of Waata Oromo leads us largely to the same conclusion, although the details include more free variation for various morphophonemic combinations. Additional evidence for the rule of progressive assimilation is found in the combination /b-t/, which has three optional realizations: no change: [bt]; voicing assimilation: [bd]; and either fusion or progressive voicing assimilation followed by regressive Place/Root assimilation: [dd]. The examples which support voicing assimilation are given below:

(18)  a. /arrab-ta/ [arrabda] 'you lick'
      /gawaab-tuu/ [gawaabduu] 'short' (f)
  b. /did-ta/ [didda] 'you refuse'

Complete progressive assimilation of liquids in liquid-nasal sequences also occurs.

The status of the implosive is questionable in Southern Oromo, according to Stroomer. Although he symbolizes it /d/ (and /d'/), and labels it a dental/alveolar implosive, he later notes that 'this sound has the properties of a retroflexed voiced alveolar stop and it may have a flap pronunciation between vowels. It is doubtful whether it is glottalized in BOW' the Boraana, Orma, and Waata dialects he studied (1987:15). The implosive does not survive contact with other phonemes:
As in Heine's dialect, velar plus coronal yields an alveopalatal. Usually the voicing of the first member is preserved, except for cases influence by analogy. The ejective, however, does not survive this combination.

What makes the Waata dialect unique is that it spreads voice but not ejection. Other Oromo dialects like Boraana and Orma both spread ejection (or at least preserve it in fusion). Take, for example the Boraana forms:

(21) /riik'-ta/ \(\rightarrow\) [riit't'a] 'you grind' (/riik'aa/ 'stones for grinding cereal')
\(\rightarrow\) [sup't'i] 'she molds a pot' (/sup'a/ 'to mold a pot')

These closely related dialects which spread the Laryngeal node as a whole are discussed in §3.4.1. In the next section, we will see additional evidence for [voice] spreading without ejection.

3.3.2. Northwest Caucasian

We now turn to the Northwest Caucasian languages, all of which have an ejective series, a voiced series, and a voiceless series; the voiceless series is either aspirated or unaspirated,

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8 Stroomer believes this change can be explained in terms of analogy to other verb paradigms.
and some dialects have a phonemic distinction between the two⁹. This family of languages is usually divided into three branches: (1) the almost extinct Ubykh; (2) Abkhaz-Abaza, which branches into Abkhaz dialects and into Abaza; and (3) Circassian, which itself is divided into East Circassian (including Kabardian), and West Circassian (Adyghe), which includes Shupsegh, and Bzhedukh. Colarusso (p.c.) observes that in West Circassian and in most Kabardian dialects, voicing spreads but not glottalization. He notes that 'this is hard to hear and many workers have reported full Laryngeal node spreading when in fact only some features appear to spread' (Colarusso p.c. 3 Dec. 1997). We begin with Kabardian, a language which is amply documented.

3.3.2.1. Kabardian

The Kabardian language (East Circassian; Colarusso 1989, 1992) has the following consonant inventory:

<table>
<thead>
<tr>
<th>Phoneme</th>
<th>Transcription</th>
</tr>
</thead>
<tbody>
<tr>
<td>p b p' f f' m</td>
<td>p b f f' m</td>
</tr>
<tr>
<td>t d t' s z</td>
<td>t d s z</td>
</tr>
<tr>
<td>ts dz ts'</td>
<td>ts dz</td>
</tr>
<tr>
<td>c z c'</td>
<td>c z c'</td>
</tr>
<tr>
<td>k g k' x j y</td>
<td>k g k' x j y</td>
</tr>
<tr>
<td>k' g' k' x' j' y'</td>
<td>k' g' k' x' j' y'</td>
</tr>
<tr>
<td>q q' x y</td>
<td>q q' x y</td>
</tr>
<tr>
<td>q' x' j y'</td>
<td>q' x' j y'</td>
</tr>
<tr>
<td>h</td>
<td>h</td>
</tr>
<tr>
<td>?</td>
<td>?</td>
</tr>
</tbody>
</table>

Kabardian has a rule of voice assimilation of verbal indices¹⁰. Colarusso (1992:132) gives

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⁹ According to Colarusso (1988), these include the West Circassian varieties Bzhedukh, Shapsegh, Kirova Shapsegh, Hakuchi, and Armavir Temirgoy.

¹⁰ Colarusso's (1992) transcriptions have been modified in the following way to conform to the IPA (see 1.5): Colarusso's [c, ç, ç'] → [ts, dz, ts']; the laterals [l, f, i']'; the (laminal) alveolo/palatalals [s, z, s'] → [c, ç, ç']; or, more precisely [ç, ç, ç']; the palato-alveolars [f, f] → [l, l]; the palatalals [k, g, k'] → [k, g, k'] and [k, g, y] → [ç, j, j]; the labialized velars [k', x', k'] → [k', x', x']; the uvular ejective [q', q'] → [q', q']; the uvular fricatives [x, y, x', y'] → [x, y, x', y'] and pharyngeal [h] → [h].

Colarusso's (1989) transcriptions follow the same changes as above, except for his notational differences: /g'/ etc. is /g/; labialization, which he marked with a raised circle ['], is marked here with [ʷ]; the voiced fricative [L] is [l]; and the lamino
the underlying forms of the personal verbal indices as follows. (For typographic reasons, the zero morpheme $\emptyset$ will be transcribed as $\phi$).

(23) \hspace{1cm} a. For nouns in the absolutive:

<table>
<thead>
<tr>
<th></th>
<th>Singular</th>
<th>Plural</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>$\mathbf{s}$-</td>
<td>$\mathbf{d}$-</td>
</tr>
<tr>
<td>2.</td>
<td>$\mathbf{w}$-</td>
<td>$\mathbf{f}$-</td>
</tr>
<tr>
<td>3.</td>
<td>$\phi$-</td>
<td>$\phi$- (ma-/ma- in intransitive dynamic present)</td>
</tr>
</tbody>
</table>

b. For nouns in the oblique of ergative subjects:

1. -s- -d-
2. -b-/w- -f-
3. -j- -j-ha-

c. For nouns in the oblique of other grammatical roles (indirect object, etc.):

1. -s- -d-
2. -w- -f-
3. $\phi$- $\phi$-ha

The alternation of the second person singular between /w/ ~ /b/ is due (in part) to the optional dissimilation of the labial glide before the present progressive: /-a-w-/ (e.g. /$\emptyset$-w-a-w-c' / $\rightarrow$ /$\emptyset$-b-a-w-c' / $\rightarrow$ [b'ox'] $\rightarrow$ [w'ox'] 'you are doing it' (3-you-pres-prog-do) (1992:44). Other factors include fortition, discussed below. The complex phonetic realizations of the underlying forms are detailed in Colarusso (1989) and (1992); many of the changes in the examples presented here involve vowels fusing with glides or taking on place features of adjacent consonants.

Voicing assimilation of the affix occurs when it is "surrounded by voiced segments" (Colarusso 1992:133), though since this occurs even in initial position as in (27ciii) below, perhaps an adjacent voiced segment is a sufficient trigger. We begin with the first person singular, where (24a) illustrates the underlying form, and the forms in (24b) show the effects of index voicing:

(24) First person singular

a.(i) /$\emptyset$-s-a-w-ta-ar-c/ $\rightarrow$ [so:ta:c]  
3-me-dat-you-give-past-aff  
'You gave it to me' (1992:133)

alveolopalatals [$s$, $z$, $s'$] are [c, z, c'].

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(ii) /Ø-q′ɔ-s-aʔa-sl-c/ → [q′isæʔæc]  
3-hor-I-dat-belong-aff  
'I have (the money)' (1992:179)

b. (i) /Ø-q′a-s-bqaka-lata-as-c/ → [q′izbketaq]  
3-hor-me-past-rush-past-aff  
'He rushed past me' (1992:99)

(ii) /Ø-c′-jɔ-s-dz-a-as-q/ → [c′izdæq]  
3-interior-dir-I-throw-in-past-aff  
'I started' (the business) (1992:102)

(iii) /Ø-q′a-w-a-s-ya-a-ta-as-c/ → [q′uwotæq]  
3-hor-you-dat-I-caus-give-past-aff  
'I made (you) give it' (1992:107)

(iv) /Ø — q′-s-dz-as — q/ → [q′azdaq]  
3-hor-paradox-II-aff  
'It is paradox that' (Colarusso p.c.)

(v) /Ø-q′a-s-a-w-ta-as-c/ → [q′izotæq]  
3-hor-me-dat-you-give-past-aff  
'You loaned it to me' (1992:133)

(25) Second person plural index
a. /Ø-f-a-s-ta-as-c/ → [festæq]  
3-you (pl)-dat-I-give-past-aff  
'I gave it to you (pl)' (1992:133)

b. /Ø-q′a-f-a-s-ta-as-c/ → [q′evfstæq]  
3-hor-you (pl)-dat-I-give-past-aff  
'I loaned it to you (pl)' (1992:133)

Forms for alternations involving the second person singular index will be given below shortly.

It is unclear why this form does not undergo voicing, since it meets the structural description of the rule. This morpheme in another word also does not: /Ø-q′a-s-aʔaʔa-n-w-c/ → [q′esøʔænæq] 'I shall hear (his/her voice)' (179), making it less likely that they are typographic errors.
Colarusso (1992:45) formalized this rule using Greek-letter notation and dependent variables as follows:

\[(26) \text{Voice Assimilation of Kabardian Verbal Indices}\]

\[
\begin{align*}
\text{[+consonantal]} & \rightarrow \begin{bmatrix}
\alpha & \text{stiff glottis} \\
\alpha & \text{laxed glottis} \\
(\alpha & \text{closed glottis})
\end{bmatrix} & \% & \begin{bmatrix}
\alpha & \text{stiff glottis} \\
\alpha & \text{laxed glottis} \\
(\alpha & \text{closed glottis})
\end{bmatrix}
\end{align*}
\]

The ejectives in Kabardian are described as creaky voiced, which Colarusso represents as [+[closed glottis, -stiff glottis, -lax glottis]]. Only the two glottal stops (/ʔ, ʔʔ/) are considered [+stiff glottis], 'with distinct glottal closure' (1992:10). In Halle and Stevens' (1971) featural system, [+stiff] describes voiceless and ejective consonants (though as mentioned above, Colarusso treats ejectives as [-stiff]). The feature [+slack vocal cords] (Colarusso's [laxed glottis]) describes voiced consonants. The feature [constricted glottis] (Colarusso's [closed glottis]) describes ejectives and glottal stop. So Colarusso's rule states that voicing features assimilate, except that ejectives usually don't (hence the parentheses, which Colarusso added, since his 'informant did not show a great tendency' to assimilate ejection (1992:45). The point to be made for Kabardian is that there is assimilation only of the feature [voice] but specifically not for [e.g.]. Therefore, in feature geometric terms, the rule spreads the feature [voice] but not the whole Laryngeal node. Before examining data which show the failure of ejection to spread, we should study the phonological behavior of the second person singular index.

A rule of glide strengthening changes the second person index /w/ to a bilabial stop when followed by an obstruent, including glottal stops. (Following sonorants /m, w, j/ trigger epenthesis, thus bleeding fortition). I assume this fortition involves a change of specification in the features [sonorant] and [approximant]. Since the glide is unspecified for a Laryngeal node, the strengthened segment also bears no Laryngeal node. This bilabial stop, through the rule of verbal index voice assimilation, which spreads [voice] leftward from an obstruent to the verbal index, will agree with the voicing of the following obstruent. The following voiceless obstruents have no feature to spread, so the strengthened segments with no Laryngeal node are interpreted as voiceless; aspiration shown below is not phonologically contrastive. The data illustrate the assimilation of the second person verbal index /w/:
(27)

a. Underlying glide

(i) /θ-w-a-s-ɔ-t/ → [wozit] 3-you-dat-I-give 'May (might) I give it to you!' (1992:111)

(ii) /θ-q'ə-w-d-ka-a-laaw^w-ak-c/ → [q'uwedbe:la:w^wa:ci] 3-hor-you-dat-we-caus-conn-see-past-aff 'We showed it to you' (1992:139)

b. Glide becomes voiceless

(i) /θ-q'ə-w-t-j-a-s-ɔ-ak-c/ → 3-hor-you-surface-dir-dat-I-take-past-affir 'I stole it from you'

(ii) /θ-q'ə-p-t-j-a-s-ɔ-ak-c/ → 'You saw him/her/it' (1989:287)

(iii) /wa sa ə-q'ə-w-t-j-a-x^x+a-ak-wa/ → you (obl) 3-hor-you-surf-dir-dat-fall+dat-past-pred 'that I fell on you' (1992:135)

(iv) /θ-wə-la-k'ə-ka-ma-əj/ → [plekJ'armi:] 'Even if you could do it...' (1992:87)

(v) /θ-q'ə-w-cha-pə-ək-ə-ak-c/ → 3-hor-you-head-tip-distr-exit-past-aff 'It went over your head' (1992:103)

(vi) /θ-q'ə-w-ʔ^w-ə-a-w-ha/ → 3-hor-you-edge-pres-prog-enter 'he is approaching you'

\[q'ep^wʔ:ɔ õ:hwæ\] (1989:287-8)\(^{13}\)

\(\text{12 According to Colarusso (1989:268) medial syllables are closed, either by a true coda, or 'by utilizing the following onset as a coda...to produce a slight gemination'. Presumably the unreleased diacritic in (27ci) indicates a phonological ejective which is slightly lengthened in medial position, but with only one ejective release. The voiceless stops are 'facultatively aspirated', which Colarusso indicates with a superscript.\)

\(\text{13 This form shows that the glottal stop acts as an obstruent, not a glide, since it triggers glide strengthening just like the other obstruents. It also shows that glottal stop does not spread [e.g.] onto the preceding consonant. This issue will be discussed at greater length in §5.3.4 on debuccalization.}\)
c. Glide becomes voiced

(i) /sə-q‘ə-w-da-kw‘-a-n-c/ →
   [səq‘q‘ɛb.dokw‘.kw‘ɛnc]  
   ‘I shall go with him (sometime)’ (1989:287)

(ii) /sə-w-da-gwə-jəq<aak-c/ →
    [səbdogw‘ifɛθɛk]  
    ‘I was joking with you’ (1992:116)

(iii) /φ-w-3ə-j-a-s-əa-a-ʔa-3ə-fə-n-w-c/ →
    ↓
    [b3e:zəθɛe3ɛfɛnɛk]  
    ‘I shall be able to make him retell it to you (at some definite time)’

(iv) /φ-q‘-w-da-gha-c/ →
    [q‘ɛbdɒkɛ]  
    ‘you sewed it’ (Colarusso p.c.)

The failure to undergo fortition before sonorants may be seen in forms like /w-j-aɑ-c/ →
   [wujdɔk] ‘you plastered it’ (Colarusso p.c.); for additional examples, see §5.3.4.

Now that we have seen how voice spreads, and how the index /-w/- undergoes fortition and participates in voicing agreement, we will now examine how the indices do not also undergo spread of [e.g.]. Examples (28a) to (28c) below show the occurrence of the personal index in pulmonic form despite occurrence before ejectives in the appropriate environment. Examples (28d)-(g) illustrate the failure of the glottal stops to trigger the spread of the feature [constricted glottis].

(28) Failure of [e.g.] spread to indices:

a. /pcaaca-r ə-q‘ə-w-f‘a-s-jə-aɑ-c/ → [q‘ɛpf‘ɛsθɛk]
   girl-abs 3-hor-you-despite-I-carry off-past-aff
   ‘I carried off (=married) the girl despite you’ (1992:97)

b. /sə-w-k‘a-qəha-aɑ-c/ → [səp‘ɛkɛθɛθɛk]
   I-you-behind-catch up-past-aff
   ‘I caught up with you’ (1992:100)

c. /jə-žə-da-w-c‘a-ɾ/ → [(ji)zɨdæpɛɾɛ]
   (what-)recip-com-you-do-ger
   ‘What you do together is done’ (quickly) (1992:97)
d. \( /\phi-\text{q}^\prime-\text{s-}^\circ\text{-w-}^\prime\text{-a-va-c/} \rightarrow [q^\prime\text{az}^\prime\text{ep}\text{ax}] \)

‘You said it to me.’ (Colarusso p.c.)

e. \( /\phi-\text{q}^\prime-\text{a-w-}^\circ\text{-s-}^\prime\text{-a-va-c/} \rightarrow [q^\prime\text{ab}^\prime\text{as}\text{ax}] (*[q^\prime\text{ab}^\prime\text{as}\text{ax}]) \)

it-hor-you-back-I-say-past-affirmative

‘I said it to you’ (Colarusso p.c.)

f. \( /\phi-\text{q}^\prime-\text{w-a-s-}^\prime\text{a-ka/} \rightarrow [q\text{was}^\prime\text{ak}] (*[q\text{was}^\prime\text{ak}]) \)

it-hor-you-to-I-say-past

‘I said it to you’ (Colarusso p.c.)

g. \( /\phi-\text{q}^\prime-\text{s-a-w-}^\prime\text{ka/} \rightarrow [q^\prime\text{asap}\text{ak}] (*[q^\prime\text{asap}\text{ak}]) \)

‘You said it to me.’ (Colarusso p.c.)

The cluster \([p^\prime f^\prime]\) is not attested, and thus the lack of spreading in (a) might be attributed to phonotactic constraints. The cluster \([p^\prime k^\prime]\) is attested (Colarusso 1992:13; cf. Kuipers 1975:53 /p^\prime k^\prime-a-la^\prime j/ ‘ladder, stairs’), and thus the failure of (b) to spread shows that [e.g.] does not trigger assimilation. The data in (g) show the failure of glottal stop to spread ejection. This is not due to phonotactic constraints, since the language also permits ejectives before glottal stop, e.g. /t^\prime w/ ‘two’ (though /p^\prime w/ is not attested).

One additional example illustrates that there is no ejection spread. Although complete laryngeal spread has been reported (e.g. Şagirov 1967:173), Colarusso’s informants did not display obvious ejection spread. He indicates both forms in his reports:

\( /f-f^\prime-a-d-a-w-tc-a/ \rightarrow /f^\prime.\text{ed}^\prime.\text{d}^\prime\text{t}c/ \) (possibly \([f^\prime.\text{ed}^\prime.\text{d}^\prime\text{t}c]\))

3-you(pl)-despite-we-pres-prog-write-tr

‘We are writing it despite you (pl)’ (1989:288, 1992:46)

Colarusso (1992:45) observes that ‘most accounts of Kabardian also represent the indices as assimilating in glottalisation ([+closed glottis, +laxed glottis]) and I have included this for such dialects, even though my informant did not show a great tendency in this direction’ (hence the parentheses around this change in the rule output). In a personal communication, Colarusso elaborated that ‘my informant was a woman who was also fluent in Bzhedukh... I now feel that she rarely carries glottalization over’.

At best, then, ejective laryngeal agreement is optional, though quite rare, in the Baksan dialect of Kabardian described by Colarusso. In the usual case, [voice] spreads without the concomitant spread of ejection. Therefore the individual laryngeal features may
indeed act independently of other laryngeal features and hence the whole Laryngeal node, as feature geometry predicts.

3.3.2.2. Bzhedukh

The West Circassian (Adyghé) dialect Bzhedukh has a similar rule of personal index assimilation. Recall that Bzhedukh has four contrastive source features, including aspirated and unaspirated voiceless stops. Colarusso describes the rule in general terms as follows:

‘Like inalienable possession, this takes a personal index, occurring right before the verbal root or the verbal root prefixed by the causative or negative particles, and deletes a /l/. A later assimilation rule, the same one that operates upon inalienable possession prefixes, assimilates the remaining consonant to the voicing, in some dialects also the aspiration and glottal ejection, of the root initial consonant. There is some evidence that this assimilation may take place even though a causative or negative (sometimes both), prefix may intervene between the verbal index and the verbal root.’ (1988:415, fn 21)

When asked for clarification on the dialects that assimilate only some of the laryngeal features, Colarusso responded that ‘the assimilatory dialects to which I refer were those reported by workers who had had difficulties with hearing what was going on. I would now claim that assimilation is only to voicing and that it must be adjacent’ (p.c.).

As in Kabardian, the schwa of indices before verb roots is absent, the second person index strengthens to a stop before an obstruent, and agrees with it for voice:

(30) /wə+χʷə/ → w+χʷə → p+χʷə → [pχʷɪ] 'your manhood' (Colarusso 1988:374)

Bzhedukh also has voicing assimilation, as the following forms show:

(31) /ø+sə+də+n/ → [zdɪn] 'I am sewing (trans.)' (1988:111)

The following examples were kindly provided by Colarusso (p.c.). First, the failure of aspiration to spread is illustrated:
Colarusso reports a slight release but no real aspiration in the above forms. The first form shows that sequences of aspirated obstruents (at least stop-fricative combinations) are permitted, and so the failure of aspiration is not due to an OCP violation.

The indices fail to assimilate ejection from glottal stops:

(33) /c^w?o/ → [c^w?o] ‘your hands’  (cf. /c^w?a/ → [c^w?o] ‘liver’)

Finally, failure of true ejectives to spread [c.g.] is shown in the following data:

(34) /φ-w-c‘a-ra/ → [pc‘a-ra] ‘you made something’ (*p‘c‘a-ra/

The initial cluster [p‘c‘] is attested (Colarusso 1988:103; Kuipers 1975:28 /p‘c‘(a)/ ‘ten (times)’).

Therefore Bzhedukh, with its four types of laryngeal specifications, clearly spreads only [voice], and [c.g.] does not spread. The failure of ejection to spread is not due to phonotactic constraints; the language does allow sequences such as initial /p’t’s‘-, p‘c‘-, p‘t‘j‘-, p‘t‘j‘-, t‘k‘w‘-, etc. Therefore West Circassian Bzhedukh, like East Circassian Kabardian, does not spread ejection but does spread [voice]. We turn to one more example from the sister Adyghe language, Abzakh.
3.3.2.3. Abzakh

Paris (1989) describes the Adyghe dialect Abzakh, which has voiceless (aspirated), voiced, and ejective plosives. She writes that ‘The trait of glottalization is not assimilatory in Abzakh’ (162). However, the language does include rules of voicing assimilation.

In Abzakh, the verbal personal indices in certain tenses, as well as the inalienable possessive indices of the first and second persons, assimilate to the voicing of the initial consonant of the item that follows them (with the familiar rule of glide fortition for the labiovelar glide):

\[(35)\]

<table>
<thead>
<tr>
<th></th>
<th></th>
<th>→</th>
</tr>
</thead>
<tbody>
<tr>
<td>1sg.</td>
<td>s[ə]-</td>
<td>s/z</td>
</tr>
<tr>
<td>2sg.</td>
<td>w[ə]-</td>
<td>p/b</td>
</tr>
<tr>
<td>1pl.</td>
<td>t[ə]-</td>
<td>t/d</td>
</tr>
<tr>
<td>2pl.</td>
<td>sʷ[ə]-</td>
<td>sʷ/zʷ</td>
</tr>
</tbody>
</table>

(\(sʷ/\) is a labialized voiceless ‘predorso-postalveolar fricative’, which Colarusso 1989 describes in related Kabardian as an alveolo-palatal, i.e. /cʷ/). The same indices keep their vowel and thus do not assimilate before the negative prefix /mə-/ . Before glides, the assimilated form is preferred but optional (36a-b), below, unless the glide is in phonetic initial position, in which case the nonassimilated form is preferred (36c):

\[(36)\]

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>a.</td>
<td>/ə-ə-jaʃ/</td>
<td>~</td>
<td>[z-ə-ke]</td>
</tr>
<tr>
<td>b.</td>
<td>/ə-wə-wəberedʒə-n/</td>
<td>[səwuw*beredʒən]</td>
<td>~</td>
</tr>
<tr>
<td>c.</td>
<td>/ə-wə-wəberedʒə-n/</td>
<td>[wu*beredʒən]</td>
<td>‘it -you-beat up-PAST; you beat it up’</td>
</tr>
</tbody>
</table>

Paris does not provide specific examples to show that the indices do not assimilate to ejectives, though as mentioned above, she asserts that they do not. It is conceivable that there is ejective spread in Abzakh, followed immediately by deglottalization in pre-consonantal position—ejectives seem not to appear pre-consonantly in morphemes—but without proof of this, I prefer an Occam’s Razor approach. In addition, there are forms

---

14 Abzakh (or Abadzekh) is one of the eastern dialects of Adyghe, a West Circassian language of the North West Caucasus. It is not to be confused with Abkhaz, a representative of the Abkhazian (or Abkhaz-Abaza) languages of the North West Caucasus.
such as /t' e+kʷ-t e+kʷ' a-ze/ ‘little by little’ (Paris 1989:192) which show sequences of adjacent ejectives, and there is no remark on deglottalization in such an environment.

The language could make a contrast between two strings of ejectives with separate Laryngeal nodes and two Root nodes which share the same specification for [c.g.], as in:

\[
\begin{aligned}
\text{(37) } & \text{ a. } \text{C} & \quad \text{b. } \text{C} \\
& \text{Lar} & \quad \text{Lar} \\
& [\text{c.g.}] & \quad [\text{c.g.}]
\end{aligned}
\]

Such a contrast was proposed to describe Georgian non-harmonic vs. harmonic clusters, which are said to be complex segments (Deprez 1987, and Padgett 1995 for Kabardian). It is also possible that the above example could involve postlexical spreading, or the phonotactics may be slightly different in different morphological domains.

Evidence that ejection does not assimilate is confirmed by John Colarusso, who notes that ‘Abdzakh is just like Bzhedukh in this regard. Abdzakh simply lacks unaspirated voiceless stops’ (p.c.). He offers the following examples, where (38a) shows the failure to assimilate ejection, while (b) shows voicing assimilation:

\[
\begin{aligned}
\text{(38) a. } & /\theta-t-c'\text{-}e\text{-}\text{ba}/ \rightarrow [\text{tc'\text{-}e\text{-}ba}] (*[t'c'\text{-}e\text{-}ba]) \text{ ‘we made something’} \\
& /\theta-w-c'\text{-}e\text{-}\text{ba}/ \rightarrow [\text{pc'\text{-}e\text{-}ba}] \text{ ‘you made something’} \\
\text{b. } & /\theta-s-k\text{-}w\text{a}t\text{-}s\text{-}\text{ba}/ \rightarrow [\text{kwat\text{-}s\text{-}ba}] \text{ ‘I found something’ (it-I-find-past)} \\
& /\theta-t-k\text{-}w\text{a}t\text{-}s\text{-}\text{ba}/ \rightarrow [\text{kwat\text{-}s\text{-}ba}] \text{ ‘we found something’}
\end{aligned}
\]

Again, Abzakh is one more example of the independence of ejection from voicing, as our theory predicts.

3.3.3. Conclusion
We have seen the independence of [voice] in spreading, and ejection remaining inert in the Northwest Caucasian languages Abzakh, Bzhedukh, and Kabardian. And we have seen the independence of these same features in Waata Oromo, a Cushitic language. These examples have been important because they illustrate that not all laryngeal features must agree; they need not all spread at once. However, it is true that quite often they do act as a whole and each of the languages above has related dialects or languages in which the whole...
Laryngeal node spreads, not just [voice]. In the next section, we will explore various instances of complete Laryngeal node assimilation.

3.4. Complete Laryngeal Assimilation

In this section, I will demonstrate the ability of the whole Laryngeal node to assimilate in a variety of languages, showing that laryngeal features may act jointly in processes involving their common organizing node, the Laryngeal node. Oromo will be analyzed in §3.4.1, where I also argue against Lloret’s representation of ejectives. The Northwest Caucasian languages are discussed in §3.4.2. Other instances of complete assimilation are covered briefly in §3.4.3. Sporadic changes are discussed in §3.4.4, and in the final section, I provide a brief conclusion.

3.4.1. Oromo

Bender, Eteffa, and Stinson (1976:132-3) provide a cursory description of laryngeal assimilation in Galla (now called Oromo), a Cushitic language. A more complete description is provided for Harar Oromo, a northeastern dialect spoken in Ethiopia (Owens 1985). Here it is evident that the whole Laryngeal node spreads since ejective-final stems spread onto voiceless-initial suffixes (except where structure preservation prevents the creation of ejective fricatives, as in the last form in (39a) below). Voiced-final stems do likewise. Stem-final voiceless sounds already agree with voiceless-initial suffixes. Therefore, the phenomena above can be seen as the rightward spreading of the Laryngeal node.  

In the assimilation rules, Owens mentions that the sound, symbolized as <d'>, but never described, ‘behaves like a voiceless consonant’ in not being a trigger for voicing assimilation, e.g. /fed-ta/ \(\rightarrow\) [fetta] ‘you want’ (cited in Lloret 1995:260). Owens notes that ‘the assimilation is sensitive to the voiceless glottal element of the sound’ (23). Apparently, then, this stop is voiceless and glottal, suggesting an ejective (but it does not spread as do the ejectives in (38a)). It was previously noted as retroflex. It seems, from the scanty data, to be: (1) a voiced implosive which does not trigger voicing assimilation; (2) a voiceless implosive /\(\tilde{d}\)/; or (3) a voiceless retroflex ejective /\(\tilde{h}'\)/. According to Ali and Zaborski, the sound is slightly implosive, while Stroomer (1987) calls the sound retroflex and doubts that it is glottalic. The question, then, is how to represent the sound, which is lexically distinct from /\(t\)/, /\(t'\)/ and /\(d\)/? Since it does not participate in laryngeal assimilation, I will assume it has no laryngeal node, at least at the time it takes place. This makes its representation distinct from /\(t\)'/ and /\(d\)/, which have laryngeal features. I make it distinct from /\(t\)/ by adding under the coronal node the traditional specification for retroflex, [-anterior, -distributed]. The phonologically voiceless retroflex may become voiced/implosive by a late rule of phonetic implementation which is apparently only in certain dialects. The alternative would be to stipulate an ad hoc exception to the otherwise
(39) a. /ʌ̃t̥'ap'-ti/ [t̥'ap'ti] ‘it(f.) breaks’
    /meek'-te/ [meet'te] ‘you turned’
    /meek'-ta/ [meet'ta] ‘you turn’
    /ʌ̃t̥'ap'-s-ta/ [t̥'ap'sita] ‘you break something’

    b. /did-te/ [didde] ‘you refused’
    /k'ab-ta/ [k'abda] ‘you have’
    /gub-tan/ [gubdan] ‘you pl. burn something’
    /fiig-te/ [fiijdde] ‘you escaped’

Such spreading of the Laryngeal node creates a multiply-linked Laryngeal node, shared across two roots:

(40) p' + t

\[
\begin{array}{c}
\text{Rt} \\
\text{OC} \\
\text{Lar} \\
\text{C-Place [labial]}
\end{array} \quad \text{p' t'}
\begin{array}{c}
\text{Rt} \\
\text{OC} \\
\text{Lar} \\
\text{C-Place [coronal]}
\end{array}
\]

The reason there are two releases with a shared Laryngeal node is because the Laryngeal node is shared by two different root nodes, with two different place specifications. I suspect that forms such as [meet’t’a] are actually pronounced [meett’a]. Since both the Laryngeal node and Place features are identical, the segments fuse to form a true geminate—one root with two timing slots—and thus have only one release.

A similar rule of laryngeal assimilation is found in the Oromo of Wellegga, a northwestern dialect of Ethiopia (Gragg 1976:176). The essentials are the same as in Harar Oromo, though there are minor differences, such as the spread of ejection onto sibilants to form an ejective, e.g. /lit'-siis-uu/ → [litj’tj’iisuu] ‘to make enter’. (The coronals /t, l/ always undergo palatalization preceding the sibilant /s/, and there is only one ejective and regular process of laryngeal assimilation. (Lloret 1995 proposes representing this sound simply as a coronal stop with [c.g.] under the Laryngeal node, but this forces her to develop a more complicated representation for ejectives, which bear a Pharyngeal node in addition to their primary Place node, but are not specified underlingly for [c.g.]. See also Lloret 1992, 1994, 1995).
fricative release, e.g. [l̥t̊j’iisuu] is actually [l̥t̊j’iisuu]. In Harar Oromo ejectives delete before the causative suffix, e.g. underlying /t’uut’-siis/ → [t’usiis] ‘make suck’.

We have already seen in §3.3.1 that not all the laryngeal features of Waata Oromo spread. However, the other two Southern Oromo dialects studied by Stroomer (1987), Boraana and Orma, do have Laryngeal node spread, though there is some free variation. Boraana Oromo stops generally spread laryngeal features rightward. The data in (41a) below show that sequences of voiced plus voiceless stops usually yield homogenous voiced clusters; the exception is the problematic retroflex/implosive, discussed in footnote 15. The data in (41b) show clear evidence of the spread of [e.g.] rightwards onto the voiceless consonant of the suffix (though geminate ejectives usually have only one release—see Lloret 1995: 277 fn 5). The data in (c) show stems ending in voiceless consonants, which undergo no change, and (d) shows the behavior of voiceless fricative plus stop sequences, in which voicing does not change. (Recall there are no suffixes with initial voiced obstruents).

(41) Boraana dialect obstruent + /t/ clusters

<table>
<thead>
<tr>
<th>UR</th>
<th>PR</th>
<th>Gloss</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. b + t = bt, bd</td>
<td>arraab-ta arrabta, arrabda</td>
<td>‘you lick’</td>
</tr>
<tr>
<td></td>
<td>did-ta didda</td>
<td>‘you refuse’</td>
</tr>
<tr>
<td></td>
<td>haad-tii haattii</td>
<td>‘mother + subj.’</td>
</tr>
<tr>
<td></td>
<td>d̥q-ta d̥qutta</td>
<td>‘you drink’</td>
</tr>
<tr>
<td></td>
<td>c̥q-t = c̥q-ta c̥qutta</td>
<td>‘you cut’</td>
</tr>
<tr>
<td></td>
<td>4ug-ta 4ug-ta</td>
<td>‘you drink’</td>
</tr>
<tr>
<td></td>
<td>4uug-ta 4uug-ta</td>
<td>‘you know’</td>
</tr>
<tr>
<td></td>
<td>tuf-ta tufta</td>
<td>‘you spit’</td>
</tr>
<tr>
<td></td>
<td>t̥d̥3ee-ta t̥d̥3eehta</td>
<td>‘you kill’</td>
</tr>
</tbody>
</table>

Final /tJ, t̥J, t’/ ‘are treated as a double consonant, an epenthetic vowel being inserted between a verbal, nominal, or adjectival stem ending in /tJ, t̥J, t’/ and a consonant initial suffix’ (1987:39). For example, /booj'-ta/ → [booj’ita] ‘you carve wood’, /t’uut’-na/ → [t’uut’ina] ‘we suck a liquid’. There were no examples in Stroomer’s data of /d̥3-t/ and /f-t/. In Boraana Oromo, any stop before a nasal /n/ is assimilated with respect to nasality and except for /b/, to place as well.

100
The behavior of obstruent clusters with /s/ as a second member have a slightly different set of assimilatory principles. Generally, the labial does not assimilate, the coronals become affricated postalveolars, and the velar stops assimilate completely. Some sort of voiceless sibilant is always in the output; only the voiced bilabial stop preserves its distinct laryngeal features. The velar ejective is assimilated completely to the following /s/.

(42) Boraana dialect obstruent plus /s/ clusters

<table>
<thead>
<tr>
<th>Final C+/s/</th>
<th>UR</th>
<th>PR</th>
<th>Gloss</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. b + s = bs</td>
<td>tʃ'ab-s-a</td>
<td>tʃ'absa</td>
<td>'I break s.t.; he breaks s.t.'</td>
</tr>
<tr>
<td>d + s = tʃ</td>
<td>duud-s-a</td>
<td>duuiʃa</td>
<td>'I/he fill s.t.'</td>
</tr>
<tr>
<td>q + s = tʃ, s</td>
<td>naaq-sis-a</td>
<td>naatʃisa</td>
<td>'I/he feeds s.o.'</td>
</tr>
<tr>
<td>g + s = s(s)</td>
<td>fuud-sis-a</td>
<td>fuusisa</td>
<td>'I/he make s.o take'</td>
</tr>
<tr>
<td>b. k' + s + ss</td>
<td>dik'-sis-a</td>
<td>diissiisa</td>
<td>'I make s.o. wash'</td>
</tr>
<tr>
<td>c. t + s = tʃ</td>
<td>hat-sis-a</td>
<td>hatʃisa</td>
<td>'I make s.o. steal'</td>
</tr>
<tr>
<td>k + s = ss</td>
<td>tik-s-a</td>
<td>tissa</td>
<td>'I herd cattle'</td>
</tr>
<tr>
<td>d. f + s = fs</td>
<td>af-sis-a</td>
<td>aʃisiisa</td>
<td>'I make s.o. spread s.t.'</td>
</tr>
</tbody>
</table>

/m, n, r/ do not change, while stem-final /l-/ plus /-s/ yield [ltʃ]. Stroomer found no tokens of /ʃ-s, tiʃ-s, dʒ-s, p'-s, s-s, t'-s/.

In sum, Boraana has several types of assimilation, depending on various combinations of place and manner of articulation. Of greatest interest here is the fact that all laryngeal features generally spread rightward onto an adjacent stop. Next we will look at assimilatory phenomena of the Orma dialect.

The Orma dialect has quite similar patterns of assimilation, though there are minor variations compared with Boraana. The differences include additional possibilities for the /g-t/ cluster as [gd] or [tt] or [dd]; no tokens of /p'-t/; the bilabial ejective is preserved in clusters before /s/ (e.g. /tʃ'ap'-sa/ → /tʃ'ap'sa/ 'I break s.t.'); and some instances of /k-t/ occur as [dd] (perhaps due to morphological reanalysis or analogy with /gt/ → [dd]; only one such example is provided, and that is in free variation with [tt]).

In Southern Oromo, no sequences of three consonants can occur; they are broken up by epenthesis between C₂ and C₃. Stems ending in a long consonant, a consonant

\[16\] Some verbs always have tʃ, others have s; the conditioning is unclear.
cluster, or in /tʃ', ʃ, t'/ have epenthetic /-i-/ if a consonant initial suffix is added. Thus the rule of epenthesis effectively bleeds several potential assimilations of ejectives to the following consonant. Epenthesis may also occur if the verb stem ends in /d/. The abbreviations B, O, W stand for the Boraana, Orma, and Waata dialects. The data in (43a) show epenthesis in triconsonantal sequences, while (b) shows the epenthesis patterns for stems ending in ejectives which act as if they were two consonants, and (c) shows the 'implosive' in apparently irregular behavior, given that Orma /d-t/ usually yields /-tt-/ (Stroomer 1987:41).

(43) Dialect | UR | PR | Gloss
--- | --- | --- | ---
a. BOW araar-s-ta araarsita 'you reconcile'
   B bak'-s-ta bassita 'you melt s.t.'
   BO duud-s-ta duutjita 'you fill up a hole'
   B elm-ta elmita 'you are milking'

b. BOW boq'-ta boq'ita 'you carve wood'
   (BOW) fit'-ta fit'ita 'you finish' (Lloret 1995:270)
   BOW t'uut'-na t'uut'ina 'we suck up a liquid'
c. O hooq'-s-a hootjisa 'I cook s.t.'
   BOW hooq'-s-a hooq'isa 'I make s.o. suck'
   O hooq'-t uu hooq'ituu 'hot, warm' (1987:54-5)

Lloret (1995) used these facts to argue that epenthesis is sensitive to the complex nature of palatals and ejectives. Following ideas in McCarthy (1989), Lloret proposes that ejectives should be represented with a branching place specification:

(44) Ejective /t'/

Place

Coronal / Pharyngeal

[glottal]

The bilabial ejective /p'/ has branching Labial, and Pharyngeal (which is claimed to be not underlying present), and the velar ejective /k'/ has branching Dorsal and Pharyngeal.
Because epenthesis is claimed to operate on Place nodes, and since palatals and ejectives have branching Place specifications, epenthesis is triggered, just as it is for /-rst-/ or /-lmt-/ sequences. The bilabial does not trigger epenthesis (e.g. /tʃap'-ta/ → [tʃap'ta] 'we break' (Lloret 1995:270) since Oromo has no /p/ and therefore /p'/ is only redundantly specified for branching Pharyngeal, leaving no trigger for the epenthesis rule. The velar ejective /k'/ does not trigger epenthesis due to a process of Dorsal Delinking, which triggers a following consonant to spread place leftwards.

Lloret's other piece of evidence comes from the behavior of coronal plus nasal sequences. Thus in Oromo /t-n/ → [nn], as in /bit-na/ → [binna] 'we buy', yet the ejective triggers epenthesis, e.g. /fit'-na/ → [fit'ina] 'we finish'. She claims that the relevant trigger for nasal assimilation is homorganicity, and so since the ejective with its two place specifications is not homorganic, it does not undergo assimilation, helps trigger epenthesis to avoid the Oromo ban against *t's. First, if we must stipulate constraints against *t's, why not simply stipulate other constraints as well, e.g. *t't? Second, the relevant trigger for assimilation is not homorganicity, since other places of articulation undergo assimilation as well, e.g. /arrab-na/ → [arramna] 'we lick'.

Thus Lloret's analysis of ejectives, which characterizes them with branching place, is based only on the facts from one place of articulation; the other two places are accounted for, but show no empirical evidence of branching structure. Furthermore, her account does not explain the behavior of the implosive in (43c), though presumably it could also stipulate its branching structure. I am skeptical that ejectives have branching place, and believe that just because the affricates /tʃ, tʃ'/ and the ejective /t'/ trigger epenthesis, they do not necessarily form a natural class (other than shared coronal place, [-sonorant], etc.). We could simply attribute this to a phonotactic constraint or constraints against /tʃ+C/ without restructuring the standard representation of ejectives.

In sum, Oromo shows a complex set of alternations, though the laryngeal patterning is fairly straightforward. Boraana showed signs of rightward spread of the Laryngeal node as a whole, since voiced stops and ejectives assimilated following consonants to their respective laryngeal features; the retroflex was an exception, which patterned like a voiceless consonant. Orma was similar, though it showed more variation in its voicing assimilation; ejection spread as well. In contrast, in the Waata dialect, ejection did not spread, but voicing did, providing evidence for the independence of laryngeal features.
3.4.2. Northwest Caucasian

Complete laryngeal assimilation has been reported in the languages of the Northwest Caucasus. Kumanov (1967:146-8) notes the following alternations in literary Adyghe (West Circassian), which is based on the Termirgoj dialect. The underlyingly voiceless forms may be found in the personal pronouns, /sa/ ‘I’, /ta/ ‘we’, and /c=a/ ‘you (pl.)’ (152).

(45) (a) Voicing assimilation

\[ /s-\text{sek}^{w}\text{'as}/ \rightarrow [z\text{sek}^{w}\text{'as}] \quad \text{‘I forced to go’} \]
\[ /t-\text{sek}^{w}\text{'as}/ \rightarrow [d\text{sek}^{w}\text{'as}] \quad \text{‘we forced to go’} \]
\[ /c^{w}-\text{sek}^{w}\text{'as}/ \rightarrow [z\text{sek}^{w}\text{'as}] \quad \text{‘you (pl.) forced to go’} \]

(b) Ejection assimilation

\[ /p'-\text{f'are}/ \rightarrow [p'f'are] \quad \text{‘you made’} \]
\[ /t'-\text{f'are}/ \rightarrow [t'f'are] \quad \text{‘we made’} \]

Thus literary Adyghe, with its voiced, voiceless and ejective obstruents, assimilates all three laryngeal features, showing that the Laryngeal node as a whole spreads. This possibility is predicted by all versions of feature geometry and so it is not surprising to find it occur.

In Besleney (West Circassian; Alparslan and Dumézil 1963), /w/ assimilates to glottal stop (and perhaps ejectives as well), e.g. /dj'wo-p'a/ \[ \rightarrow [d'j'p'a] \quad \text{‘you say’} \] (cited in Colarusso 1988:116 n. 14, 117 n. 17). This index, like the other dialects, also displays laryngeal agreement before other phonation types.

3.4.3. Other Instances of Complete Laryngeal Assimilation

Yurok (Robins 1958) has a plain and a glottalized series of plosives. The third person singular is a glottal stop which makes the final stem plosive ejective, e.g. /(jo?) ma?epet-?/ \[ \rightarrow [(jo?) ma?epet'] \quad \text{‘he ties up’} \] (see also §8.4.1.3). In e-class verbs whose stems end in a cluster of two stops or affricates, both become glottalized, indicating spread of ejection (most likely the Laryngeal node spreads). For example, /ho:k'\text{t'}-?/ \[ \rightarrow [hok'\text{'t'}] \quad \text{‘to gamble’} \] and /noj'k'-?/ \[ \rightarrow [noj'k'] \quad \text{‘to eat as a guest’} \]. Thus in Yurok, final clusters of stops or affricates share Laryngeal features, which have transferred by spreading.

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Complete laryngeal assimilation has also been reported for the following languages, though some of the sources listed below do not provide sufficient evidence to motivate underlying forms, and do not include alternations\textsuperscript{17}:

(46) Complete Laryngeal Node Spreading

<table>
<thead>
<tr>
<th>Language</th>
<th>Family</th>
<th>Source and Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Harari</td>
<td>Ethiopian Semitic</td>
<td>Leslau (1965)</td>
</tr>
<tr>
<td>Dime</td>
<td>South Omotic</td>
<td>Fleming (1990); some processes are fusion</td>
</tr>
<tr>
<td>Avar</td>
<td>Avar (NEC)</td>
<td>Charachidze (1981:27, 45)</td>
</tr>
<tr>
<td>Rutul</td>
<td>Lezgian (NEC)</td>
<td>Alekseev (1994a:217), Dirr (1928:313)</td>
</tr>
<tr>
<td>Budukh</td>
<td>Lezgian (NEC)</td>
<td>Alekseev (1994b:263)</td>
</tr>
<tr>
<td>Tsova-Tush (Bats)</td>
<td>Nakh (NCC)</td>
<td>Holisky (1994: 150-151, 160) and (Dešeriev 1953:159-160) - not synchronic</td>
</tr>
</tbody>
</table>

There are thus a number of examples which suggest the commonality of complete laryngeal spreading. However, we need better descriptions of these phenomena.

3.4.4. Conclusion

In this section, I have demonstrated that complete laryngeal assimilation exists for such languages as most dialects of Oromo, in some Northwest Caucasian languages, and

\textsuperscript{17} There is one spurious report of ejection spread in Afro-Asiatic. Pam (1973) has reported in Tigrinya a rule of glottalization assimilation. In linear phonological terms, he writes the rule as:

Glottalization assimilation

\[ C \rightarrow [\text{aglot}] / \quad [\text{aglot}] \]

and illustrates it only with the following example: \( /\text{sarık}^-\text{a}/ \rightarrow /\text{sarıká}/ 'you stole'. In this unusual example, there has been deglottalization of the stem-final ejective, and its subsequent deletion. According to the rule, Pam predicts that ejectives should also be able to spread leftwards, but I have not been able to locate examples or other sources to verify this. Gene Buckley (p.c.), who has conducted fieldwork on Tigrinya, believes that Pam's report is in error in this regard. Tigrinya has been widely cited in the literature on geminates (e.g. Schein and Steriade 1986; Hayes 1986:336-7; Kenstowicz 1993:420-1), but such laryngeal assimilation has not been reported. I know of no ejective-initial suffixes on which to test the plus value of the alpha in Pam's rule above. Therefore, the possibility of ejective assimilation in Tigrinya should be discounted.
possibly in several other languages. This occurs just as feature theory predicts. And as Kenstowicz had mentioned, ejectives do participate in laryngeal spreading.

3.5. Theoretical and Empirical Problems of Complete Assimilation
This section will discuss three of the theoretical issues involved in certain types of Laryngeal node assimilation, which will be important in the analysis of the Zan languages, discussed later in §3.5.4.3. First, I will point out an asymmetry in the way Lombardi must describe types of laryngeal assimilation. Her theory of laryngeal neutralization makes use not only of delinking, but also of a Sonority Constraint, which will be reviewed in detail. Second, her theory of privative [voice] prevents reference to [-voice], so what appears to be voiceless assimilation must be expressed by other means. Finally, I will examine the role that medial sonorants can play in clusters which display laryngeal agreement, and review how analysts have proposed them to be underspecified and sometimes extraprosodic.

3.5.1. Laryngeal Node Spreading and the Sonority Constraint
Lombardi’s theory of laryngeal assimilation displays a fundamental asymmetry. In coda position, Lombardi handles a change like [p+z] → [b+z] by a rule of leftward spreading, but a change like [b+s] → [p+s] is handled by delinking the [voice] specification, in non-pre-sonorant position, where certain features like [voice] may not be prosodically licensed by the Laryngeal Constraint. This delinking is necessary since in her privative analysis, voiceless consonants do not have a Laryngeal node or any daughter features to spread. In onset position, the analysis of [voice] spread still holds, but the Laryngeal Licensing Constraint does not, since syllable-final neutralization is inapplicable in syllable-onset position. Therefore Lombardi has to appeal to a Universal Sonority Constraint (90), repeated below, which does not permit sequences of voiced-voiceless in onset position, or voiceless-voiced in coda position.

(47) Lombardi’s Universal Sonority Constraint
Voiced obstruents are more sonorous than voiceless, therefore the following configurations are impossible within a syllable:
*syllable nucleus–voiceless obstruent–voiced obstruent (e.g. *[-Vsd])
*voiced obstruent–voiceless obstruent–syllable nucleus (e.g. *[dsV-])

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Violations of the Sonority Constraint are (often) universally repaired by delinking, so voiced obstruents are forced to delink their Laryngeal node before voiceless obstruents in onset position. Lombardi formalized her Sonority Constraint only as in (47). Technically speaking, the constraint cannot refer to voiceless consonants since they have no Laryngeal node, but instead must presumably scan the next obstruent’s Root node to see whether it is [-sonorant]. If the following consonant is [-sonorant], then the voiced consonant might have to check that following Laryngeal node to see whether it is voiced, in which case it can remain, or whether there is no such node, in which case the first consonant must delink.

Although the Sonority Constraint is in Lombardi’s view ‘an absolute universal that no language can violate’, Clements (1990) gives a very detailed overview of the Sonority Sequencing Principle and explicitly notes that there are exceptions to an otherwise robust generalization. Furthermore, he discusses sonority plateaus, in which ‘adjacent consonants at the beginning or end of a word have the same sonority rank’ (287). Blevins (1995:210-3) adopts a ‘working universal sonority scale’ in which voiceless noncontinuants are clearly less sonorous than voiced noncontinuants. However, there are abundant exceptions to this alleged universal, so that it has come to be viewed as ‘a preference condition, a determinant of syllable markedness, or as a constraint on initial syllabification, which can later be violated by language-particular rules and/or constraints’ (Blevins 1995:211). One of the contributions of Optimality Theory (e.g. McCarthy and Prince 1993, Prince and Smolensky 1993, Archangeli and Langedoen 1997) has been the recognition of the violable nature of constraints. It is therefore best to view the Sonority Constraint, not as an absolute universal, but as one which may be violated. In the analysis of Kartvelian languages presented in §3.5.4, we will see numerous violations of this constraint.

In short, in Lombardi’s system, agreement with respect to [voice] is summarized as follows:

\[
\begin{align*}
\text{Onset:} & \quad \text{Spread [voice]} & \text{Delink Lar?} & \text{Son. Constr.} & \text{Spread [voice]} \\
\text{Coda:} & \quad \text{Spread [voice]} & \text{Delink Lar} & \text{Delink Lar} & \text{Spread [voice]}
\end{align*}
\]

For the theoretical change from \(sd \rightarrow st\) in onset position, the Sonority Constraint cannot apply since voiced consonants are more sonorous than voiced consonants. Therefore such a change would have to be expressed as delinking the Laryngeal node. While Lombardi’s
theory nicely captures the unmarked nature of laryngeal neutralization, it is less than elegant to account for one general process, laryngeal assimilations, in three different ways—two for the same type of change according to the position in the syllable.

3.5.2. The Privativity of [voice] and Laryngeal Node Spreading

Another fact in the privative feature theory is that reference cannot be made to voiceless consonants, since they bear no Laryngeal node. In the cases of apparent voicelessness assimilation like [sd] → [st] and [ds] → [ts], one might wish to spread the Laryngeal node, just as one can for voicedness assimilation, but this would not be theoretically possible. How then do initial obstruent Laryngeal nodes agree if some of the segments involved have no Laryngeal node? As we have seen, Lombardi would invoke the Sonority Constraint for [ds] → [ts] in onset position, and would have to posit a rule of laryngeal delinking for cases like [sd] → [st]. But are there other accounts? In this section, I will explore three possibilities.

The strongest position would be to abandon the privativity of [voice] and readmit the binary [-voice] to the ranks. There are a plethora of rules which refer to [-voice], and some scholars like Rubach (1996) have argued that the feature is binary. Even Lombardi (1996) admits that the feature is binary, but only in postlexical rules. However, there is still no good evidence to show that other laryngeal features are binary (see §2.3.3), which would leave a strange asymmetry, and thus should probably not be accepted.

Another position is to reconsider some commonly-held claims about phonological structure. Lombardi (1991:38), for example, has claimed that 'there is no phonological contrast between a representation with a bare Laryngeal node and no Laryngeal node at all. Therefore any theory should allow only one representation' in order to be maximally constrained. Archangeli and Pulleyblank (1994:21) also object to representations with only a bare Laryngeal node on the grounds that there is no inherent phonetic content in bare nodes. They propose that 'the Laryngeal node, which dominates feature like [±voiced] and [±constricted glottis] that define the laryngeal configuration, cannot appear terminally since it does not define a particular configuration in and of itself'. Recall that in Lombardi's framework, a plain voiceless consonant is represented with no Laryngeal node at all. This view achieves a true generalization in the context of laryngeal neutralization, analyzed as the delinking of the Laryngeal node, since the result is a voiceless consonant. However, absent Laryngeal nodes cannot spread since they are not specified.
An alternative solution would be to allow languages to specify voiceless consonants with a bare Laryngeal node so that voiceless consonants would bear a Laryngeal node but with no dependent features like [-voice]. In a rule of complete laryngeal assimilation, the whole Laryngeal node spreads. If the Laryngeal node is specified for [voice] or [c.g.], then assimilation takes place in the usual manner. If no dependent feature is specified, the bare Laryngeal node still spreads. Rice and Avery (1990) permit such structures as a Root with a blank Laryngeal node. Their exact proposal also includes a Spontaneous Voice feature and a Laryngeal Voice feature, and the authors believe all features are privative. Their leading idea has here been adapted to fit Lombardi's framework. The figure below represents different types of obstruents:

<table>
<thead>
<tr>
<th>Voiced</th>
<th>Ejective</th>
<th>Voiceless</th>
</tr>
</thead>
<tbody>
<tr>
<td>Root</td>
<td>Root</td>
<td>Root</td>
</tr>
<tr>
<td>Lar</td>
<td>Lar</td>
<td>Lar</td>
</tr>
<tr>
<td>[voice]</td>
<td>[c.g.]</td>
<td></td>
</tr>
</tbody>
</table>

This approach would be a weakening of Lombardi's more restrictive claim; it would call into question the nature of representations and the role of their phonetic implementation; and it would raise the possibility of languages contrasting voiceless consonants on the basis of presence or absence of a Laryngeal node. For these reasons, it has not been accepted by most researchers.

Another way to solve the problem of onset voiceless agreement (recall that in coda position, there is either [voice] spread or syllable-final delinking) is to assume that all (or most) voiceless sounds are really specified for [spread glottis]. In this way, laryngeal agreement could be expressed as a spreading of the whole Laryngeal node. This option allows us to capture the unity of laryngeal agreement as a spreading process. We therefore avoid the asymmetric behavior of ejectives and voiced segments which spread, versus voiceless sounds, which would have to trigger delinking on a preceding obstruent on the basis of a sonority constraint. Although the stops and affricates are phonetically aspirated, the fricatives are not reported to be aspirated. Nevertheless, it is a common assumption that fricatives are specified phonetically for [spread] (e.g. Kenstowicz 1993:489, citing Clements 1985 and McCarthy 1988; see also Rice 1994, Steriade 1994, Vaux 1996).
If the voiceless sounds in a language like Mingrelian (discussed below) are specified for the feature \([\text{spread glottis}]\), then the underlying inventory, at least for the stops, would include a three-way marked series of \([\text{constricted glottis}]\) ejectives, \([\text{spread glottis}]\) aspirates, and \([\text{voiced}]\) consonants. A potential drawback to this approach is that any language which has voiceless assimilation in onset position and which has sonorant transparency would have to have its voiceless consonants specified as \([\text{spread}]\) for this insight to work. But in so doing, one loses the cross-linguistic generalizations that voiceless stops are unmarked, that they occur in all languages of the world, and that the presence of voiceless stops implies the presence of aspirates. (For statistical frequencies of stop types, see Maddieson (1984), Henton, Ladefoged and Maddieson (1992:95), and Laver (1994:587), who uses Maddieson’s data to calculate that 95.3% of the 317 language sample have voiceless stops, while only 29% have voiceless aspirated stops.) This is clearly a heavy price to pay to express what is intuitively a simple process of laryngeal assimilation. However, as David Odden (p.c.) reminds me, linguists tend to mark aspirates only where there is a contrast, and so the typological assumption of aspirates being more marked may not be as robust as often assumed, despite Maddieson’s (1984) attempts at consistently categorizing the phonological inventories.

In sum, there are various alternatives to the asymmetry of Laryngeal node spreading, but each has a drawback. In the next section, we explore a theoretical feature which will play an important role in deciding whether these solutions need to be adopted for Kartvelian.

### 3.5.3. Sonorant Transparency and Extraprosodic Consonants

The phenomenon of sonorant transparency is found in Russian voicing assimilation (Hayes 1984; Kiparsky 1985). In Russian, sonorants are transparent to a rule of voicing assimilation so that underlying \(/{\text{i}}\z\text{mts}\text{ensk}+\text{a/} \rightarrow {\text{i}[s m}\text{s}\text{enska} ‘\text{from Mceesk}’\) and \(/{\text{o}}\text{t}\text{mdzi/} \rightarrow {\text{o[d mzd}{\text{ji ‘from the bribe’}} (Kiparsky 1985:104). Data such as these have played a large role in the literature on underspecification, so all the details will not be repeated here. (A similar phenomenon is found in Polish; see Rubach (1996, 1997).

Lombardi’s Voice Constraint (or, if all laryngeal features are involved, the Laryngeal constraint) permits the feature [voice] (or Laryngeal nodes in general) only before a tautosyllabic sonorant, as shown below:
In her discussion of Polish consonant clusters, Lombardi (1991:58-65) notes the problem that medial sonorants pose to onset clusters such as [krt-] and [grd-]. She notes that 'if [voice] is truly licensed before a sonorant consonant, as well as before a vowel, we would expect that initial clusters such as [grt] would be possible: [voice] in [g] would be licensed before [r], which is [+son].' (59). In Polish, however, obstruents must agree in voicing despite an intervening sonorant. 'This means that the impossibility of clusters like [#grt] is ruled out by the Universal Sonority constraint, which does not allow a voiceless obstruent to intervene between a voiced obstruent and a syllable nucleus.'

Another technique Lombardi uses to account for problems in Polish laryngeal agreement is to appeal to Gussman's (1992 [then ms]) and Bethin's (1989) analysis of Polish clusters in which some sonorant consonants are not in syllable-onsets phonologically (e.g. piosnka, in which /s/ is in the coda of the first syllable and the /k/ is in the onset of the second, but /n/ is adjoined to the word, not the syllable).

Of course such consonants are realized phonetically, but their inconvenient appearance is explained by relegating them outside the usual phonological structure. Lombardi also uses this to account for sequences of final voiceless (but not voiced) obstruent-sonorant clusters. Her crucial point is that 'these segments do not receive the normal syllabification, and thus will not conform to the Constraint, since the obstruent precedes the sonorant but is not tautosyllabic with it' (1991:63).
Rubach (1997) provides a similar account of Polish in derivational terms (which he later recasts in an Optimality Theory framework). Compare the following underlying forms, in which a word-internal cluster with an intervening sonorant undergoes Final Devoicing:

(52) /mendrek/ → [mendrek] ‘crafty person’
/mendrek-a/ → [mentrka] ‘crafty person (gen. sg.)’

Rubach offers the following analysis:

(53) PW

In his derivational account, [-voice] spreads regressively from the /k/ in the onset of the second syllable to the /d/. The /l/ is transparent because it is not specified for [voice] on the Laryngeal tier and because the /l/ is not included in the prosodic structure. The /r/ is later pronounced through a rule of Default Adjunction, which links such unsyllabified consonants directly to the prosodic word.

Extraprosodic consonants have been utilized in the analyses of other languages. Bagemihl (1991) has proposed that the Salish language Bella Coola, renowned for its vowel-less words and complex consonant clusters, has syllables of the ordinary type in which sonorant segments occupy the nucleus and up to two consonants occupy the onset. However, to achieve this simple generalization, Bagemihl’s analysis requires many segments to ‘remain unsyllabified...if they do not fit into the canonical syllable shape’ (590). Obstruent-only words are, in this analysis, phonologically syllable-less. Bagemihl provides a wealth of data based on reduplication which give credence to his proposal. The majority of obstruent-only words do not have reduplicative forms, but those that do are reduplicated only if a coronal sonorant is inserted into the base prior to reduplication. Thus /Iq’/- ‘slap’ is reduplicated in the continuative form as /Iŋq’/- (1991:607), and the base
/t'χt/ ‘stone’ is augmented and pluralized as /t'iχt'iχt/ ‘large stones’\(^{18}\). This suggests that syllabic obstruents do not exist at the phonological level. Bagemihl provides much additional evidence from phonological facts which show that obstruents may remain unsyllabified in Bella Coola. He proposes that their phonetic implementation occurs because of their affiliation with the mora; this prevents their deletion due to stray erasure, since only those segments unlinked to a mora are deleted.

The Kartvelian languages discussed in §3.5.4 provide new data for sonorant transparency and for extraprosodic consonants.

### 3.5.4. Kartvelian Language Data and Analysis

In this section, we will first analyze the data of two Kartvelian languages, Mingrelian and Laz. All Kartvelian languages, spoken primarily in the area in and around the Georgian Republic, have a three-way series of stops and affricates: ejectives, voiced stops, and a set of phonetically aspirated voiceless plosives. The two languages which we will examine have a complex set of morphophonemic alternations of laryngeal features, some of which are in free variation with other allomorphs. But the data will shed light on sonorant transparency, laryngeal agreement, and extraprosodic consonants. After reviewing the facts of Mingrelian (§3.5.4.1) and Laz (§3.5.4.2), I will provide a brief analysis and theoretical discussion of the data in §3.5.4.3.

#### 3.5.4.1. Mingrelian

The Mingrelian inventory is given below (Harris 1989:317):

\[(54)\]

\[
\begin{array}{llllllll}
\text{b} & \text{d} & \text{dz} & \text{d}\text{3} & \text{g} \\
\text{p} & \text{t} & \text{t}s & \text{t}\text{j} & \text{k} & \text{?} \\
\text{p'} & \text{t'} & \text{t's} & \text{t'j} & \text{k'} & \text{q'} \\
& & \text{z} & \text{3} & \text{γ} \\
& & \text{s} & \text{ʃ} & \text{x} & \text{h} \\
\text{m} & \text{n} & \text{r} & \text{l}/\text{ɻ} & \text{w}/\text{v} \\
\end{array}
\]

\(^{18}\) Bagemihl has /t'iχt'iχt/, which I assume is a typographical error, with the velar fricative, since the previous example permits the uvular fricative (/sɪχsχ/- ‘peel-continuative’).
The sister language, Laz, has the same inventory except it has /f/ in loanwords and it lacks a phonemic glottal stop. The dorsal fricatives are realized as uvulars in Laz, the lateral is apical, and /r/ is more of an approximant and not a trill, as in Mingrelian.

Harris (1991c) provides an overview of Mingrelian, a language which permits morpheme-internal clusters, which obey what she terms the General Consonant Sequence Schema; a maximal cluster consists of: sonorant consonant (/r/ or /n/) + coronal obstruent + dorsal obstruent + /v/. Bilabial clusters, however, are acanonical in that they participate in other clusters. But all clusters, both hetero- and monomorphemic, must conform to what Harris terms the Homogeneity Principle:

(55) The Homogeneity Principle
‘obstruents in a cluster must both be voiced, or both ejectives, or both non-ejective voiceless consonants. That is, adjacent obstruents must be of the same phonation type’ (Harris 1991c:317).

One exception is with cluster-final /v/, which is also freely pronounced as a labiovelar glide and thus may not be an obstruent. There are also co-occurrence restrictions on clusters re-occurring in the word as a whole, but these are not relevant to the following discussion.

Clusters which involve prefixes may contain up to five consonants. Harris reports that such clusters tend to obey the principles of co-occurrence, and while the underlying consonants in these clusters are generally retained, the Homogeneity Principle does apply.

Word-initially, there is evidence of laryngeal alternations in Mingrelian between variant forms of the prefix markers. Some of these variants include an optional fortition process from glide (or fricative) to stop before obstruents; in other cases, some of which involve the output of the fortion process, the laryngeal agreement itself appears to be optional.

The first person subject prefix, which marks the verb in agreement with the subject, shows an interesting but complex array of allomorphs. I analyze the underlying form of the prefix as /v/ since it has the widest distribution, though nothing particularly crucial rides on this assumption. The prefix form /v/ occurs before vowels (except when it is deleted before the high back round vowel /u/, probably due to an OCP-motivated rule). It also occurs before all labial consonants, and in free variation in all other environments. The variant /b/ is found before nonlabial voiced consonants and it appears to be in the process of generalization over the remaining allomorphs, where it, too, can optionally appear. It is apparently the result of a rule of fortition which optionally changes the segment to
[-continuant] before obstruents. The allomorph /p'/ appears before nonlabial sounds specified for [c.g.] (i.e. ejectives and glottal stop), while the plain variant /p/ appears before voiceless consonants (see also Dirr 1928:95-6 and Kiziria 1967). This information is summarized below:

(56) Distribution of the Mingrelian first person subject prefix

\[
\begin{array}{c|c}
\emptyset & /___u \\
v & /___i, e, a, (a), o \\
& /___p, p', b, m; \text{in free variation with other allomorphs} \\
b & /___\text{nonlabial voiced consonants}\textsuperscript{19} \\
p' & /___\text{nonlabial ejective consonants and } \eta/ \\
p & /___\text{nonlabial voiceless consonants} \\
\end{array}
\]

Examples given by Harris include the following variants: /v-tasunk ~ p-tasunk ~ b-tasunk/ ‘I sow it’ (1991c:337). The /v/ and /b/ variants are in free variation, and the /p/ allomorph shows application of the assimilation rule. Not only is the rule of fortition optional, but the last form, [btasunk], shows that laryngeal agreement is also optional. This last form appears to contradict Harris’ statement of the Homogeneity Principle in which ‘adjacent obstruents must be of the same phonation type’ (318). However, in discussing heteromorphemic clusters, Harris states that the Homogeneity Principle ‘may apply’, which implies the optionality of laryngeal agreement in this context. When a stem begins with glottal stop, the first person subject marker is /p'/ and the glottal stop then deletes: /v-?idulenk/ \(\Rightarrow [p'idulenk] \) ‘I buy it’ (337). The feature [c.g.] seems to have spread from the root consonant glottal stop onto the prefix, and subsequently, the glottal stop is deleted (or there is a process of fusion—see Chapter Eight). Additional examples provided by Kiziria (1967:68)\textsuperscript{20} are as follows:

\textsuperscript{19} /b/ is often in other environments, since it is in free variation with /v/. See text below.

\textsuperscript{20} Because Kiziria groups Mingrelian and Laz (or Čan) as the Zan languages in his article, it is not always clear which language he is referring to, though mostly it is Mingrelian.
(57)a. /v-/ before vowels and labial consonants

\[\text{v-} \text{or} \text{i}s' \text{zek} \quad \text{I see}\
\[\text{v-} \text{p}' \text{ut' unk} \quad \text{I pinch}\
\[\text{v-} \text{pulunk} \quad \text{I hide}\

(58) Laryngeal agreement before obstruents

a. \text{b-gorup} \quad \text{I search}\
\text{b-gibup} \quad \text{I boil, cook}\
b. \text{p-} \text{xor} \text{xunk} \quad \text{I saw (with a saw)}\
\text{p-} \text{xafk' um} \quad \text{I dig}\
\text{p-tasum} \quad \text{I sow}\
c. \text{p'-} \text{t} \text{j} \text{'arunk} \quad \text{I write}\
\text{p'-} \text{t} \text{axum} \quad \text{I break}\
\text{p'-} \text{t} \text{j} \text{'opi} \quad \text{I caught}\

The first person subject marker behaves the same way even when prefixes such as /l/ are added (Kiziria 1967:68) (cf. Harris 1991c:338). The /v-/ prefix optionally undergoes metathesis before a bilabial consonant followed by a vowel, or before the verbal /i/ prefix, in which case laryngeal agreement takes place with the following obstruent. In the last variant form in (a) below, we can observe laryngeal agreement (as well as glide/fricative fortition) across the intervening /r/: the last form of (b) also shows voicing agreement across the intervening vowel, which has metathesized. In both of these examples, the change from glide (or fricative) to bilabial stop makes the previously redundant feature [voice] contrastive. In (c), ejection spreads leftward onto the person prefix, showing true assimilation.

(59) a. \text{v-i-rduk} \sim \text{i-v-rduk} \sim \text{i-b-rduk} \quad \text{I grow (up)}\
b. \text{v-i-birk} \sim \text{i-bibrk} \quad \text{I water}\
c. \text{v-i-} \text{tj}' \text{ank} \sim \text{i-p'-} \text{tj}' \text{ank} \quad \text{I sew for myself}\

While I do not have spectrographic data to prove there are two ejective releases, the different place of articulation in forms such as /p'-} \text{tj}' \text{arunk/} and in forms with affricate release like the postposition /t's/k'uma/ "with", as in /t'sima-t's/k'uma/ "with brother" show
that there are probably two ejective releases. Fleming, Ladefoged and Thomason (1994) note that bursts provide crucial cues to the identity of a stop, and find that in Montana Salish, the strong realization of stops and affricates in clusters 'aids considerably in maintaining the perceptibility of all the consonants in a cluster. For example, see their spectrogram of /tʃˈʃɛn/ 'where to' (19), and Colarusso's (1988:170) spectrogram of Ubykh [tʼqʷ*ədʷ*ama] for an example of two clear ejective releases. Further evidence comes from ejective clusters with an intervening sonorant (e.g. /pʼntsʼqʼunk/ 'you release me; ruin me'), where the ejective releases are clearer than before another obstruent due to the increased sonority of the nasal.

In sum, the first person /v-/ usually appears before vowels and labials; (I have no specific information on its occurrence before /vZ-initial verbs). Before nonlabial consonants, the prefix will be realized as a stop whose laryngeal features may agree with the following obstruent.

Another interesting fact about this agreement is what happens when the prefix is added to a sonorant + obstruent cluster. In Mingrelian when a verb stem begins with a prevocalic sonorant /n, l, r/, the first person subject marker is /v/ or /b/, in free variation. However, when the stem begins with a cluster of sonorant /n, l, r/ followed by an obstruent, the first person subject marker is determined by the following obstruent such that it is /b/ if the obstruent is voiced, /p'/ if ejective, and /p/ if voiceless, although each variant is in free variation with /v/, and /m/ is occasionally found before /n/. We have already seen one example of trans-sonorant agreement (and fortition) in (59a) above: [ibrduk] 'I grow up'. Additional examples may be found from the first person direct object marker.

The Mingrelian first person direct object marker shows partial syncrretism with the first person subject marker. The /m/ allomorph occurs prevocally, with the allomorphs /b, p, p'/ distributed according to the phonation type of the following consonant (Harris 1991c:339), although /m/ and /b/ appear to be in the process of generalization and may appear before any plosive. Such free variation between /m/ and /b/ also occurs before single sonorants (/r, l, m, n/). A list of the distribution and examples are given below (examples taken from Harris 1991c:339 unless otherwise indicated):
Mingrelian first-person object marker allomorphy

<table>
<thead>
<tr>
<th>m/ __V</th>
<th>m-/tʃ'aruns</th>
<th>'s/he writes it for me'</th>
</tr>
</thead>
<tbody>
<tr>
<td>_ any plosive (optional)</td>
<td>m-poruns</td>
<td>'it covers me'</td>
</tr>
<tr>
<td>m/ __ bilabials</td>
<td>m-poruns</td>
<td>'it covers me'</td>
</tr>
<tr>
<td>_ sonorants (~ b)</td>
<td>p-tʃoruns</td>
<td>'he buries me'</td>
</tr>
<tr>
<td>b/ _ any plosive (optional; in process of generalization)</td>
<td>b-goruns/ʃs</td>
<td>'he looks for me'</td>
</tr>
<tr>
<td>_ sonorants (~ m)</td>
<td>b-laχuns</td>
<td>'s/he hits me'</td>
</tr>
<tr>
<td>p'/ _ ejectives</td>
<td>p'-tʃ'k'uns/ʃs</td>
<td>'it eats me'</td>
</tr>
<tr>
<td>p/ _ voiceless consonants</td>
<td>(no specific examples, but cited in text)</td>
<td></td>
</tr>
</tbody>
</table>

My sources do not provide specific examples of /m/- or /v/-initial roots.

Gudava and Gamqrelidze (1981:220) cite the following examples (see also Cikobava 1936), in which laryngeal agreement across a sonorant is clearly seen (though /m/ is a free variant before sonorant or sonorant + obstruent clusters, e.g. /m-rtʃ'xunk ~ p-rtʃ'xunk/ 'you wash me' (Harris 1991c:339)):

(61)  
| b-rdunk    | 'you raise me'          |
| p-rtʃ'xunk | 'you wash me' ( ~ /m-rtʃ'xunk/) |
| p'-rts' q'unk | 'you water, irrigate me' |
| p'-ntʃ's' q'unk | 'you release; ruin me' |

Thus although there are some slight differences in realization between the subject and object markers, we can maintain the generalization that at least optionally, the prefixes

---

21 Due to optional metathesis with a root beginning with a bilabial consonant and vowel, the object marker may be realized as follows: m-poruns ~ po-b-runs ~ po-v-runs 'it covers me' (Harris 1991c:339).

22 Thanks to Kevin Tuite for translating the Georgian glosses.
become stops which assimilate to the laryngeal features of the following consonant, or to
the first obstruent in a cluster.

Deprez (1987) argued that one property of the harmonic clusters in Georgian is that
they could not be broken up by /r/ and thus this was taken as evidence that Georgian
‘clusters’ were really complex monosegments. Compare the data above, however, which
shows that morpheme-initial sonorants may occur between the prefix and the first obstruent
of the root, making it less likely that the laryngeal agreement may be attributed to the
creation of a harmonic cluster. Furthermore, while it may be possible to confuse ejective
release within obstruent clusters, the fact that a sonorant intervenes makes it much less
likely one could confuse ejective release. Therefore, this is additional evidence that
spreading takes place.

Also in Mingrelian, Harris (1991c:339-40) reports on variation involving the
second person object marker. Prevocally, this morpheme is realized as /g-/ ((62a)
below), and therefore this seems to be the basic alternant, but it becomes /r-/ before single
obstruents (62b). Harris explains that ‘this is an example of a rule that makes an
underlying noncanonical cluster accord with the General Consonant Sequence Schema’
(339). Before a root beginning with /r-/ , the second person marker may be realized as /g-/,
/r-/ or 0 (no examples shown). Before other sonorants, the prefix is /r/ (62c). Before a
cluster of /r/ and a following obstruent, /g-/ may optionally assimilate to the laryngeal
features of the following obstruent (62d-f). Examples are from Harris (1991c:339-40)
unless otherwise noted.

(62) Mingrelian Second Person Object Marker

a. g-eti"eibun  ‘s/he converses with you’
g-iirn’s’e(n)  ‘s/he sees you’  (Kiziria 1967:69)
b. r-itu’uns  ‘s/he burns you’  (Kiziria 1967:69)
r-bons  ‘s/he bakes you’
c. r-laxuns  ‘s/he hits you’
d. g-rduns  ‘s/he raises you’
e. k-rito'uns ~ g-rito'uns  ‘s/he washes you’
f. k'-rito'ip’uns ~ g-rito'ip’uns  ‘s/he stretches you’

As we can see clearly from (62d-f), laryngeal assimilation, although optional, is clearly
applied in a feature-changing manner, since the [voice] specification of /g/ is apparently
deleted before voiceless consonants in (e) and changed to [c.g.] before ejectives in (f).

Recall that forms such as /btasunk/ ‘I sow it’ show that fortition can apply but laryngeal agreement is also optional in obstruent clusters. Next we will examine a similar process in the sister language Laz, and then go on to examine the theoretical implications of such processes.

3.5.2.2. Laz

Holisky (1991) analyzes the grammar of closely related Laz, (sometimes called Čan), with which Mingrelian forms the Zan group of Kartvelian. (See also Anderson 1963, and Kutscher, Mattissen, and Wodarg 1995). The first person indicative subject marker /v/ behaves in a similar way as Mingrelian. The underlying form /v/ is seen in prevocalic position in (61a), below, though in the Vitse-Arkabe dialect and in some Atina subdialects, /v/ is replaced by /b/, as it appears to be in Mut'afi dialect (Kutscher et al. 1995). If the verb begins with a bilabial, the prefix is often zero (b), and it is almost always /m/ before nasals, where the marker causes place assimilation and usually undergoes subsequent deletion before the alveolar nasal, as seen in (c). The remaining allomorphs undergo a process of Laryngeal agreement in which the prefix turns to /b/ before voiced sounds (d) and /p/ before voiceless fricatives and stops (e), and /p'/ before ejectives (f).

(63) a. v-id-i ‘I left’
   b. berg-um ‘I’m plowing’ (root /berg/)
   c. m-ntsor-um ‘I’m sifting’ (root /ntsor/)
   d. b-dzir-i ‘I saw it’
   e. p-tkv-i ‘I said it’
   f. p'-f'k'om-i ‘I ate it’ (Holisky 1991:424)

Additional examples may be found in Mattissen (1995:54-5). In that work, there is an example of a sequence of bilabial ejective followed by velar ejective: /p'k'vatum/ ‘I cut it’.23

---

23 In Stathi’s treatment of phonotactics in that work, the cluster [p/k'] is listed (1995:17), but not *[p'k']. This must be a typographic error, since the ejective allomorph [p'] before [k'] is mentioned on the next page (18), and there are not otherwise contrasts between voiceless consonant followed by ejective vs. ejective-ejective clusters.
In the Findikli dialect of Laz studied by Ralph Anderson (1963), the glottalized prefix in /p/ is apparently basic, since it occurs before roots beginning with a vowel, as in /p'-ôrom/ 'I like' and /p'-âre/ 'we'll do, make (something)' (52). The glottalic variant also occurs before glottalic consonants, as in /p'-k'ôrtsxum/ 'I'm counting'. The allomorph /p/ occurs before voiceless consonants other than /p/, as in /p-jûm/ 'I drink'. /b/ occurs before voiced consonants other than nasals, and before vowels that are not part of the root, e.g. /b-gûbom/ 'I'm cooking' and /b-t-daten/ 'we'll go'.

In a similar way as Mingrelian, the second person pronoun marker in Laz alternates between velar voiced, voiceless, and ejective, where again the ejective also appears prevocally. For example:

(64)  
- k'-ôroms  ‘he likes you’
- me-k-tji  ‘I gave you (something)’
- k'-t'sópxi  ‘I fashioned you, made you what you are’
- g-dzôroms  ‘he sees you’ (Anderson 1963: 53-54; affirmed in Holisky 1991:424)

The voiced allomorph appears to be basic in the Mut’afi dialect, as the following data from Kutscher et al. (1995:55) show:

(65)  
- g-îram  ‘I bring you’
- g-gorum  ‘I look for you’
- me-ktjam  ‘I give you’
- e-k'-t'opum  ‘I pick you up’

Thus there is a general process of regressive assimilation for phonation type in Laz. Holisky reports that it is mostly voicing of voiceless sounds, though there are also examples of glottalization and devoicing, as we have seen. Also interesting is the fact that some of this assimilation may take place post-lexically, i.e. across clitic and word boundaries. I do not have enough data to propose an analysis of this, but here are the examples I have, in which there is apparently regressive Laryngeal node spread of [voice] (from a nasal), and [c.g.] from an ejective:
Also in Laz, the Series I imperfect stem is formed with /-t'/, which triggers regressive assimilation in the Khopa dialect Series Markers, which end in /-p/. Thus 
/b-gor-up-t'-i-t/ 'we were looking for it' is realized as [bgorup't'ita] (Holisky 1991:429). Unfortunately, this is the only example provided.

In Mingrelian and Laz we have seen several instances of alternations due to laryngeal agreement processes. In all cases, assimilation was regressive, or leftward-spreadling. In the person markers, there were some additional complications: (1) the allomorphy was governed by additional factors other than solely laryngeal type such as labiality of the root-initial consonant; and (2) laryngeal agreement appeared to be optional. Nevertheless, the variable application or 'free variation' which results in phonological alternations is something which phonological theory can account for (in conjunction with a theory of sociolinguistic variation).

3.5.4.3. Analysis and Discussion
The problems mentioned as background in sections 3.5.1-3.5.3 will now come into play in the analysis of the Zan languages.

First, we must assume a rule of fortition in Mingrelian and Laz which makes the prefix /v/ become a stop before another obstruent. Second, we must formalize the process of adjacent laryngeal agreement. Recall the forms like [b-gorup] 'I search', [p'-t'axum] 'I break' and [p-tasum] 'I sow', all with an underlying first person subject prefix of /v/, which may also be analyzed as /w/, with which it does not contrast and with which it is often in free variation. In Lombardi's system, the voiced consonant- and the ejective-initial roots bear Laryngeal nodes, which they spread onto a preceding Root node in word-initial position. This process must take place after fortition. Because the prefix does not contrast with an /f/, it is not necessarily specified for [voice], if we view it as /v/; if we treat it as the sonorant /w/, [voice] is still underspecified. Therefore for those forms which become [b-] and [p'-], the Laryngeal features spread leftward in a feature-filling manner.
In the case of voiceless consonants, which cause the prefix to become [p-], there is no laryngeal assimilation because voiceless consonants have no Laryngeal node to spread. Therefore, after fortition, the prefix becomes the unmarked stop, a voiceless stop, and does not receive a Laryngeal node. If for some reason, [voice] had to be specified on the prefix, through the Sonority Constraint, the Laryngeal node would be deleted.

The next issue is how to handle sonorant transparency. Recall that Mingrelian obstruents still agree, even if there is an intervening sonorant, as the following examples with the first person object marker show: [b-rdunk] ‘you raise me’, [p'-nts'q'unk] ‘you release; ruin me’, and [p'-rts'q'unk] ‘you wash me’. We can assume, following Hayes (1984) and many others, that sonorants are not specified for [voice]. This is shown in the diagram below:

The trans-sonorant spreading poses interesting challenges for Locality Theory. As we have seen, the laryngeal features of the first obstruent of the root spread onto the prefixal consonant, whether that consonant is immediately adjacent, as in Mingrelian /p'-tJ'arunk/ ‘I write’, or whether a sonorant intervenes, as in /p'-nts'q'unk/ ‘you water, irrigate me’. Yet there is no spreading across a vowel: /v-orts'3ek/, not */p'-orts'3ek/ ‘I see’, or /m-iJ'aruns/ ‘s/he writes it for me’, not */p'-iJ'aruns/. One explanation is that, using the framework of Odden’s (1994) Adjacency Parameters, we might impose a root-node adjacency on the rule. This approach would require the intervening sonorant to be phonetically glottalized. I have not seen this commented on, though since the glottalized sonorant would be simply allophonic and not phonemic, it is possible it has escaped notice.
Instrumental investigation would reveal whether this approach is correct. Syllable-adjacency states that the target and the trigger must be in adjacent syllables; in the Mingrelian cases, the target and trigger are within the onset, a parameter covered neither by root-node nor by syllable adjacency. Odden’s theory could simply specify no adjacency conditions in Mingrelian, but set the direction of the rule to leftward spread, and specify the target to be a [-cont] obstruent. This would account for the alternations above while preserving the theory of Locality and its Adjacency Parameters.

As we saw in §3.5.3, consonants which violate the Sonority Sequencing Generalization (Clements 1990) are often viewed as extraprosodic. Since a sonorant followed by an obstruent before a syllable nucleus violates the tendency to increase sonority towards the syllable peak, one might view the Mingrelian words with an initial sonorant as extraprosodic—that is, linked not to the syllable, but to the prosodic word. I do not know of evidence based on reduplication which could help determine this, and I am unaware of phonological arguments which would apply to Mingrelian. In addition, the laryngeal agreement would still occur across an unspecified sonorant. Therefore, because of insufficient support, I prefer the simpler analysis involving sonorant transparency.

In Mingrelian, the second person object marker is /g-/ as seen in the prevocalic form [g-ıɾıɾ’s’q’e(n)] ‘s/he sees you’. Although this marker has the variant /r-/ before single obstruents ([r-bons] ‘s/he bashes you’), in roots with initial sonorant-obstruent clusters, the /g-/ optionally assimilates to the laryngeal features of the following obstruent, e.g. [grduns] ‘s/he raises you’, [k’ɾɾ’t]’ip’uns] ‘s/he stretches you’, and [kɾtʃuns] ‘s/he washes you’. Since the prefix must be specified for [voice], any laryngeal spreading from roots with [voice] on the first obstruent (in sonorant-obstruent clusters) would spread vacuously. Roots with [c.g.], as in ‘stretch’ /ɾtʃ’ip’/- spread in a feature-changing manner, delinking the /g-’s Laryngeal node. However, why should the voiced prefix devoice as in [kɾtʃuns]?

The sources I have used do not directly attest whether the intervening /ɾ/ is syllabic or not. The related Kartvelian language, Georgian, is well known for its complex clusters, and many sources suggest that similar clusters in Georgian are monosyllabic. Vogt (1958:10), for example, notes that the Georgian syllable is determined by the number of vowels in the word. Anderson (1978:47) notes that Georgian /priskvni/ ‘you peel it’ is monosyllabic, and Catford (1977:292) affirms that the initial Georgian clusters are all syllable-initial clusters. Robins and Waterson (1952) note that ‘the substitution of a short “neutral vowel” (ə) was never accepted by our informant’ for interconsonantal /ɾ/, showing
a syllabic pronunciation of the /r/ is unacceptable. In short, though I do not have direct data for Mingrelian, Caucasologists commonly assume the monosyllabicity of such clusters.

Lombardi’s Laryngeal Constraint licenses the laryngeal features of obstruents within the same syllable before segments specified for [+son]. Thus in Mingrelian, [voice] would be licensed in this position. Lombardi’s Sonority Constraint does not directly apply, since it simply forbids sequences of voiced obstruent–voiceless obstruent–syllable nucleus. Since the sequence voiced obstruent–voiced sonorant–voiceless obstruent–syllable nucleus does not fit this constraint, the constraint does not apply. We have two options. One is to rephrase the Sonority Constraint so that no voiceless consonant may intervene between a voiced consonant and the nucleus, a point which Lombardi implicitly adopts in her explanation of Polish clusters. The other option is to let the constraint stand, but view the /r/ as an extraprosodic consonant not affiliated with the syllable, but with the prosodic word. In this case, because the [+son] /r/ is not affiliated with the same syllable as the following voiceless obstruent, the Sonority Constraint may indeed apply. The unsyllabified sonorant will at some late point in the derivation be adjoined to the prosodic word. Syllabification of only the onset is shown for ease of typography.

\[(69)\] Syllabification \quad Sonority Constraint \quad Adjunction

\[
\begin{array}{ccc}
\sigma & \sigma & \sigma \\
g-\pi\lambda' \chi u n s & \rightarrow & k-\pi\lambda' \chi u n s \\
\arrowvert & \rightarrow & \arrowvert \\
\end{array}
\]

One problem with proposing extrametricality is that, while the /r/ is peripheral within the morpheme, it is not peripheral within the syllable. If /k/ is within the syllable, then so must /r/. Thus it is preferable to revise Lombardi’s Sonority Constraint to prohibit the intervention of voiceless consonants between a voiced consonant and the nucleus. The resolution in Mingrelian involves delinking the [voice] specification of the offending prefix.

Finally, it is interesting to note that there appears to be a separate, postlexical rule of spreading the Laryngeal node, in Laz, as evidenced in (66) above. Laz appears not to have trans-sonorant harmony since the grammars do not report it, since the phonotactics as described by Anderson (1963), Holisky (1989), and Kutscher et al. (1995) do not seem to permit triconsonantal clusters with medial /r/, and since such clusters are not listed in
Kutscher et al.'s (1995) table of phonotactics, which includes heteromorphemic clusters (17-18).

### 3.5.5. Spreading of [c.g.] and its Phonetic Implementation

Since Goldsmith’s (1976) application of Hockett’s analogy of the orchestral score to autosegmental theory, it has been commonly viewed that the autosegmental association of features correlates with their duration in the time domain. Thus in voicing assimilation, the association of [voice] with more than one segment extends its domain, lengthening its duration and maintaining vocal fold vibration in a longer span. The articulators associated with [voice] are commanded to continue their work to produce vocal fold vibration. The spread of a feature like [nasal] is realized physically as a lowering of the velum and an extension of the time that it is lowered.

The spread of ejectives, however, is somewhat different from this notion. The feature [c.g.], when spread to vowels, as in Hausa, produces laryngealized vowels, and thus the domain of [c.g.] is increased, just like [nasal]. On obstruents, however, the spread of ejection has an explicit sequence of events which must take place to produce an ejective. The feature is not implemented simply as a constriction of the glottis, but also with larynx raising, necessary to create the compression required for the glottalic airstream mechanism. Thus two consonants which share ejection, as in Mingrelian /p’t’ɑχum/ do not simply continue implementing a phonetic motor command, but instead implement it twice. That is, unlike continuing vocal fold vibration, the spread of ejection involves two separate tightenings of the glottis and raisings of the larynx, and two releases.

Because this view is incompatible with the view of the phonetic implementation of other features, it deserves further investigation. However, this is hampered by a lack of available phonetic and phonological studies which show conclusively that what is transcribed as two ejectives, e.g. in Oromo, Northwest Caucasian, Mingrelian etc. is phonetically two ejectives with release. If the phonetic facts support the transcriptions and [c.g.] spread to a stop truly involves ejection, then this requires a rethinking of common assumptions regarding the phonetic implementation of phonological features and representations.

### 3.6. Other Types of Glottal Spread

So far, the examples of laryngeal agreement which we have seen have resulted from spreading. In this section, I first review the process of glottal transfer in Kashaya, and
then in §3.6.2, I discuss Bella Coola and Quileute. In §3.6.3, I examine sporadic assimilations of various types.

3.6.1. Glottal Transfer in Kashaya

Buckley (1994:81) discusses cases of consonants which precede glottalized sonorants and become glottalized in Kashaya (Northern Hokan); this is essentially the spreading of [e.g.]. In Buckley’s analysis, sonorants (as well as obstruents) can bear laryngeal features such as [spread glottis] ([asp]) and [constricted glottis] ([gl]); this differs from the traditional view that such sounds formed sequences of consonant followed by /h/ or /ʔ/. He argues that sonorants can bear these laryngeal features on the basis of phonetic plausibility, since a sound like /nʔ/ is pronounced phonetically as [nʔ], that is, with normal voice onset and creaky voice at the end of the sound, sometimes with a glottal stop. Phonologically, a glottalized sonorant is most likely a single segment because of the phonotactic pattern of monosyllabic verbal roots. Those alleged exceptions to the pattern all involve the glottalized sonorants. There are additional arguments based on syllable structure involving vowel length and epenthesis, as well as typological reasons, which will not be detailed here.

In Kashaya, the glottalized nasals are in complementary distribution with voiced stops; voiced stops occur only in onset position, and glottalized nasals occur only in coda position, e.g. /məh sə dʊn/ ‘while taking it away’ vs. /məh sən-q*/* ‘must have taken it away’ (1994:48). To account for this, Buckley 1994:78) proposes a rule of Desonorization, which he formalizes as follows, in which RC indicates the Root node of a consonant:

\[
\begin{align*}
\text{(70) Kashaya Desonorization} \\
\text{[σ RC} \\
\text{ [+son] → [-son]} \\
\text{Lar [+nas]} \\
\text{[c.e.g.]} \\
\end{align*}
\]

This rule basically makes glottalized nasals obstruents; a repair deletes the feature [+nasal] from the ill-formed representation. More complicated subsequent adjustments add [voice] to the segment in question, which then becomes a voiced stop. Desonorization also
interacts where appropriate with the following rule of Onset Simplification, which applies independently (while Desonorization does not). See Buckley (1994:80) for more details.

Onset Simplification delinks the Laryngeal node from a sonorant. In Buckley’s analysis, the delinking of the Laryngeal node results in a floating Laryngeal node (roughly a glottal stop), which, through a rule of Glottal Transfer, causes the floating Laryngeal node to dock onto a preceding obstruent, thereby glottalizing it (see also the chapter on fusion). For example:

(71) Onset Simplification/Desonorization → Glottal Merger


I will now detail and formalize these processes in turn, following Buckley’s analysis.

A rule of Onset Simplification, which ‘expresses the generalization that complex sonorants are not permitted in onsets’ (1994:78), delinks the Laryngeal node of sonorants. For example, compare the underlying /man=?-e: mu/ → [mané: mu] ‘that’s her’ (1994:77). Desonorization does not apply because the nasal is underlyingly in the coda (though it resyllabifies later). The rule is formalized as follows, where RS is the Root node of a sonorant:

(72) Kashaya Onset Simplification


Thus by Onset Simplification, complex sonorants lose their Laryngeal nodes. The Laryngeal node, however, is set afloat and by Glottal Transfer, links and glottalizes or aspirates a preceding consonant. Buckley formalizes this rule as follows:
The Glottal Merger and Glottal Transfer rules are discussed in more detail in my Chapter 8 on the laryngeal fusion and fission of segments. In short, the rule simply merges a plain stop and following glottal sound to an ejective.

In sum, in Kashaya we have seen the leftward spread of a Laryngeal node (bearing the feature [c.g.]) onto a laryngeal-less obstruent to form an ejective. The feature [voice] does not spread since it is not active in underlying representations and is only inserted post-lexically. The other laryngeal feature, [spread glottis], participates in Glottal Merger to form aspirated segments, so it, too, spreads, e.g. /huʔuj hku/ → [huʔújʰ ku] ‘one eye’, (Buckley 1994:70). Therefore Kashaya does not provide evidence for [e.g.] spread without other laryngeal features spreading as well.

3.6.2. Bella Coola and Quileute

Nater (1984:19), in his grammar of Bella Coola (Salishan), observes that ‘sonants are automatically glottalized in the surrounding T' ___V when no shwa intervenes…; this is merely a matter of delayed release of the glottal closure in T’. (Nater uses T' as the cover symbol for ejective stops). This spreading creates new segments in the language since no resonants are glottalized underlyingly. Nater gives the following examples:

(74) ̨l’s’ḻ’āl   ‘basket’
      l’t’el   ‘dog salmon’
      l’t’mej̱’x̱’l   ‘stump of tree’

Nater gives no independent evidence for this phenomenon in terms of alternations. However, if it does express a generalization that sonorants are glottalized after glottalized consonants, it could well be a process of laryngeal spread. If we accept Nater’s observations, then the feature [c.g.] spreads from an obstruent to an adjacent sonorant consonant, whether liquid or nasal. However, since Bella Coola has only two series of stops, plain and glottalized, it does not provide evidence for [c.g.] spread to the exclusion of other laryngeal features. Moreover, as David Odden (p.c.) points out, it is possible that
this is 'overhearing' of an oral sonorant gesture and a late glottal gesture, since there's no contrast – something along the lines of Ohala's (1993) observations on perception.

Quileute (Chimakuan; Andrade 1933 and Powell 1975) has the following phonemic inventory:

(75) p t t's ð ñ k k' q q''
p' t' t's' ð' ñ' k' k'' q' q''
b d (g)
s i j x x'' χ χ'' h
l j w

There are two processes which suggest the spread of the feature [e.g.]. First, the initial consonant of the causative suffix /-t's-is/ becomes glottalized after a glottal stop, as shown in the following examples (from Andrade 1933:177):

(76) té:kwa? 'rope' té:kwa?-t's'is 'he made a rope'
tjatjí? 'it flew' tjatjí?-t's'is 'he made it fly'

Powell (1975:129) lists the causal as /s/ for Chimakum, but /s/ for Quileute (128). The morpheme /-ats/ indicates 'action upon a particular object', and the lexical suffix /-tis/ indicates 'to do, make'. However, these sources unfortunately do not offer clear evidence that the underlying form is not glottalized. This process suggests that the feature [e.g.] from the glottal stop may spread rightward to a following obstruent. Andrade specifies only the causative suffix, so I am unsure if this is morpheme-specific or whether there are not other suffixes to which the glottal [e.g.] feature can spread to. (Powell (p.c.) notes that this suffix is not always glottalized in glottal environments, indicating some optionality to the process.)

Second, Powell (1975:24) notes that plain voiceless stops are optionally glottalized when followed by a glottal stop or a glottalized consonant, or in word final position when followed by a word beginning with glottal stop. Powell does not provide an example of such glottalization which is triggered by an ejective.

(77) /kiq?áts/ [keq?áts] ~ [keq’áts] 'to scrape something'
This small amount of Quileute data suggests leftward spreading from a glottal stop, even across word boundaries, indicating that this is a postlexical process whose assimilation is anticipatory, while the type involving the causative is perseveratory\(^{24}\). (See also Chapter Eight on fusion and fission). Powell (p.c. 30 March 1998) describes an old informant 'who made it a point of personal expressive style to glottalize all voiceless stops and affricates occurring with adjacent glottal stops (either preceding or following) and following ejectives'. Ejectivization in other informants appeared to be 'random and unpredictable'.

Another type of glottal spreading might be seen in the epenthetic glottal stop (often with echo vowel) which results from anticipating the glottal closure of ejectives. Powell (1975:27-28) includes examples such as the following:

\[(78) \quad \begin{align*}
/ˈháːʔʃ/ & \rightarrow [ˈháːʔʃ] - [ˈháʔʃ] - [ˈháʔʃ]\,' good, pretty, tasty' \\
/ˈpiːʔa/ & \rightarrow [ˈpɛːʔa] - [ˈpɛʔa] - [ˈpɛʔa\,ˈa] \quad \text{‘a fart'}
\end{align*}\]

Through insertion of a C-slot, the [c.g.] feature may spread to create a glottal stop, though further investigation is required to determine whether [ʔ] is epenthetic in other contexts.

In short, Quileute appears to have two processes of spreading [c.g.], one from glottal stops onto the causative suffix, and one leftward spread from a glottal stop and possibly ejective. Another type may be the epenthetic glottal stop. Note that these processes seem to be postlexical. What is interesting about Quileute is that there is apparently no other laryngeal assimilation. Powell gives examples of mixed-voiced obstruents, e.g. /t̜eʔikbaj/ 'type of basket' (152), /t̜is-d-o-qʷá-lakš/ 'she urinates too often' (160) and /lab-xaj-i-qʷá-li/ 'I drank too much', and in a p.c. emphasizes that voice 'definitely does NOT spread, even randomly'. However, I have not found alternations or lack of them to be entirely sure of this. Although [voice] is apparently needed to

\[^{24}\text{There is a possible third type of spread of [c.g.]}\text{ in plural infix harmony. If the initial stem begins with a stop, then the infix is the affricate /-ts-/}, \text{ e.g. /póʔa/ ‘Indian (human)’}, /póʔaʔq/ \text{(id. pl.)}; \text{Powell (1975:143) includes a few examples from fricative-initial stems. If the initial consonant of the root is ejective, then the affricate infix will also be ejective /-ts/, e.g. /t̜eʔilá/:̜ ‘vulva’, /t̜eʔs̜ě-\,lā/:̜ ‘id. pl.’}. \text{Unfortunately, Andrade (1933) provides only this one key example of ejective harmony and that involves a taboo word, and one with a medial glottal stop, which could have caused fusion with the infix. [Powell (p.c.) provides two additional examples, and one form without the glottalization in the infix, but believes that these ‘are just idiosyncratic forms that derive from historically variant forms’].}\]
distinguish voiced consonants from the other stop series, it does not seem to be active phonologically. We should also leave open the possibility that phonologically the voiced stops may have not a Laryngeal node and the voiceless stops may phonologically be [spread glottis]. Some support for this notion comes from the fact that the few voiced stops in Quileute developed from desonorized nasals; the language has no native nasals. Furthermore, in reduplicated CVC syllables, the voiced stops have non-contrastive prenasalized allophones (Powell 1975:23). This very tentative analysis would be in accord with the observation that [c.e.g.] spreads only when voice does as well. Clearly, Quileute deserves more investigation into this matter.

3.6.3. Sporadic Changes

In addition to the regular (and fairly regular) phonological processes discussed above, there are numerous instances in the literature in which there is sporadic glottalization of a sound in the environment of another ejective, sometimes from a distance.

Leslau (1956:27) notes sporadic instances of ejective spread in Gafat, now observed in the results of a presumed sound change inferred from comparison with related languages. He gives the example of ‘to laugh’, which is /shk'V in Northern Ethiopic and /sak'a/ in Southern Ethiopic, but /ts'ak'ä/ in Gafat, in which the initial consonant probably became ejective due to the following velar ejective. In Amharic, Leslau (1995:23-4, 1997) notes that in some instances a root-final ejective spreads onto the initial /u/ of the gerund, as in /mät'-to/ → [mät't'o] ‘he coming’, and /wät'-ta/ → [wät't'a] ‘she going’. However, these forms optionally undergo devoicing as well, so that [mätto] and [wätta] are heard as well; in this last case voiced stops also devoice, as in /nąd-to/ → [nättö] ‘he driving’. A few noncontiguous examples are listed as well, e.g. from the Arabic loan /ḫārīta/ ‘pocket’, there is variation between /kārät'it/ and /k'ārät'it/.

Georgian assimilations may be found in Neisser (1953:16-17), though it is unclear from his data whether they are historical changes or synchronic alternations or free variants. Some representative examples are shown in (79) in which (a) and (b) show progressive and regressive assimilation as the result of contact with an ejective, while examples (c) and (d) show spreading from a distance.

(79) a. Contact Assimilation, Progressive/Rightward

/ʧ'manva/ → [ʧ'p'änva] ‘fill in cracks’
/mok'vda/ → [mok't'a] ‘he died’
b. Contact Assimilation, Regressive/Leftward
/kvit’k’iri/ → [kvit’k’iri] ‘wall’ (Instrumental case, from /kva/ ‘stone’ + /k’iri/ ‘lime’)
Old Georgian /vab’aq’o/ < /vab’adq’o/ ‘he makes a big fuss’ /vab’adi/ ‘fuss’.
/q’opa/ ‘do’

c. Distant Assimilation, Progressive/Rightward
/k’u-r-t’umi/ ‘tail of a bird’ < /k’udi/ ‘bird’
Mtiulian dialect /ts’ip’i/ = /ts’its’ibo/ ‘beechnuts’ from /ts’ipeli/ ‘beech’
/t’q’ubi/ → Gurian dialect /t’q’up’i/ ‘twin’

d. Distant Assimilation, Regressive/Leftward
/tjik’ora/ → [tj’i-n-k’ora] ‘small, miserable’
/bort’qva/ → [p’ort’q’va] ‘crawl’
/bert’qa/ ‘to hit’ → [p’art’q’a-p’urt’q’i] ‘fight’

The above examples have been both feature-filling and feature changing. I should also note that Neisser provides a number of cases of voicing assimilation as well, but they will not be discussed here. Fahnrich (1991:137) offers a few additional examples of sporadic assimilations, including only one involving ejective spread at a distance.

Job (1984) notes that the Lezgian Migragh dialects show evidence of ejective spreading regressively across a vowel. Compare the conservative literary /get’e/ vs. the innovative spoken form /k’et’e/ ‘pot’. Job unfortunately does not indicate how regular this process may be.

Džeranišvili (1967:582) notes the following example of long-distance ejective spreading in Rutul (Northeast Caucasian), e.g. /sibq’An/ → [sip’q’An] ‘to clean’.

There is some evidence of ejective spread diachronically in the Northwest Caucasian languages, as reconstructed by Colarusso (1989b). In the following data, PNWC is Proto-Northwest Caucasian, PAA = Proto-Abkhaz-Abaza, C = Circassian, U = Ubykh, Abx = Abkhaz, and WC = West Circassian.
However, there is no systematic data, and assimilations seem to be both progressive and regressive.

Golla (1964) observes that in Yokuts (Penutian) 'there is evidence that in many cases glottalization is “infectious” – that is, if one consonant of a word is glottalized, the glottalization tends to shift or spread to other consonants.' In the word for ‘treat’, *tajim the Chukchansi reflex is the unexpected /t'ajim/, where the ejective can only be explained ‘by assuming an influence from the following /l/’ (57). There are other examples of glottalization, which do not appear to result from ‘infectious glottalization’, including Chukchansi /tj'ijuk'aj/ ‘green’ from *t|ijukaj; and Chukchansi /katj'ap/ ‘niece’ from reconstructed *katjap.

In sum, there are several interesting types of ejective assimilation, both regressive and progressive, and both contact and distant assimilation. However, all of it appears irregular and none of it appears to be rule-governed. It is therefore of relatively little theoretical interest, but is included here because this chapter aims at presenting a comprehensive survey of ejective assimilations.

3.7. Place Assimilation with Laryngeal Preservation

Feature geometry predicts that place and laryngeal features are independent, since they fall under different class nodes. Indeed, Clements' (1985) model of feature geometry predicted the ‘highest degree of independence between the laryngeal features and all others’ (230), since these are the highest-level branches in the model. Therefore it should come as no surprise to see ejectives change place of articulation while preserving their ejection.

Clements also noted that though it is less frequently commented on, ‘processes may affect supralaryngeal features while not affecting laryngeal features’ (230). This section provides empirical confirmation of this aspect of the model.

Shaw (1980) describes a process of velar palatalization in Dakota, in which /k kʰ k'/ → [tʃ tʃʰ tʃʰ] / i. e. _ V. Some examples follow, where (81a) shows the preservation
of aspiration and (b), of ejection. The percentage sign indicates a type of morphological boundary.

(81) a. \( ma+k^h\text{ûte} \) 'he shoots at me'
    \( ni+tj^h\text{ûte} \) 'he shoots at you'
b. \( û+k^\text{a} \) 'we dig it'
    \( mni%tj^\text{á+pi} \) 'well' (water\%=dig=PSV) (Shaw 1980:193)

Grover Hudson (1980) discusses the morphological conditioning of palatalization in Amharic in imperatives, e.g. /rut'/ 'run! (m.)' vs. /rutj'i/ ‘run! (f.)’.

In addition to synchronic processes, there are many diachronic examples. Holisky (1991:397) reports some reflexes of Common Kartvelian *q’ in clusters. In the Khopa and Vitse-Arkabe dialects *q’ > k’, while in Atina the uvular has been lost:

(82) Georgian  ts’q’ali ‘water’
    Khopa/Vitse-Arkabe  ts’k’ari
    Atina  ts’ari

Testen (1997:719) examines the palatalization of Iron Ossetic velars. Anderson (1997:985, 988) discusses velar palatalization in Proto-Daghestanian and alveolar palatalization in Lak dialects. Thompson, Thompson, and Efrat (1974) observe that Proto-Salish *k’ became /ts’/ in Cowichan Halkomelem. Velars palatalize in Sahaptin, producing alternations (Rigsby and Silverstein 1969, Rigsby and Rude 1996). Place shift may be found in Berta (Central Sudanic; Andersen 1993). Sasse (1979) notes that Burji and Galla (Oromo) palatalize Proto-East Cushitic *k’ to tj’, and Hayward (1989:27-8) reports on this similar phenomenon in some East Cushitic dialects, where Gollango or Gawwada usually preserve velar place, while Dullay dialects usually palatalize. One could easily amass dozens more examples, but since the point is relatively uninteresting from a theoretical point of view, a few examples have been given here for the sake of completeness.

3.8. Complete Assimilation

Feature geometry also predicts complete assimilation if one Root node spreads to another. Such a phenomenon is well documented (see Clements 1985, McCarthy 1988, and Clements and Hume (1995) for details). Because complete assimilation does not directly
involve the laryngeal features of ejectives, but the Root nodes of ejectives and other sounds, and because it does not distinguish them from other consonants since they are merely a subclass of sounds participating in a phonological rule, they are of less interest here theoretically. Nevertheless, I provide some illustrative cases which prove that ejectives may spread completely onto another segment.

A process of complete assimilation is found in the Nakh language Chechen. Nichols (1994a: 19-20; 1997: 950-51) reports that in Chechen, when the initial vowel in the converb -ina is syncopated (after umlaut) after any single consonant but a nasal or /f/, a preceding /l, s, t/ (as well as t’) spread their Root nodes onto the following nasal, resulting in complete assimilation. Note that this does not seem to occur with /s, s, f/. Some syncopated but non-assimilating forms are shown in (83a), and assimilated forms are shown in (b); (D = a class prefix marker).

(83) Infinitive Anterior Converb Gloss
a. tasă tes-na 'throw'
  latšă lāts-na 'catch'
b. lată letta 'stick to'
  D-aat’ā dāt’a ‘split, explode’
  D-a:lā dalla ‘enter, cross threshold’

It seems likely that the form in (b) with the geminate ejective has only one glottalic release; geminate affricates also have only one release. (Compare the transcription of my own data below). These data represent spreading of the whole Root node rightwards onto the timing slot of the initial consonant of the nasal converb suffix.

A similar process of complete assimilation is found in allegro speech with the same suffix, except that any postvocalic consonant can spread onto the following suffixal nasal. Thus the term ‘having bought’ can be realized either as [ʔjetsna] or [ʔjetsse] (Nichols 1997: 710). Additional examples, with a broader distribution, can be found from my fieldwork with a speaker of a Jordanian variety of Chechen that I have termed Zerq’ Chechen (Fallon 1991).

The following show the range of optional assimilations, showing the imperative root and the assimilated converb forms of Zerq’ Chechen (from underlying /-na/).
Imp. Converb Gloss

a. dest distta 'swell'
b. χab xebba 'shrink'
χad χedda 'cut'
teq tegga 'sew'
te:q te:qqa 'crawl'
c. laeq' letjq'a 'hide'
hæq' hæqq'a 'ripen'
dæt' ditt'a 'rip (tr)'
faet' faett'a 'tear (itr)'

Final fricatives and sonorants also geminate.

The Eastern Cushitic language Hadiyya (Sim 1988:82-83) has a rule of complete assimilation for obstruents, which spread their Root node rightwards, completely assimilating a following /-t-/ suffixal morpheme, as shown in (b). Root-final nasals, however, only assimilate to the following place of articulation, and do not spread their nasality as well, as shown in (85a), which reveals the underlying form.

Leslau (1956) describes the South Ethiopian language Gafat and notes that the /t/ of a prefix is assimilated to a following dental. He notes that the same process occurs in other Ethiopian languages such as Geez, Tigre, Harari, Chaha, Ennemor, Muher, Masqan, Selti, and Wolane. Leslau observes that 'in Tigrinya, Amharic and Argobba the t is assimilated no matter what the 1st radical' (1956:113). The causative adjunctive prefix /at-/ for example, assimilates to the base in type B verbs and in verbs which are type A in their 'fundamental theme':
These examples are thus evidence of total spreading of the Root node. Another case of complete assimilation is reported in Soddo (Ethiopic Gurage; Leslau 1968:8).

In Amharic, the causative /as-/ is assimilated completely by a root with a following sibilant fricative (Leslau 1995:23):

(87) **|UR| PR | Gloss**
---|---|---|---
as-zämmätä | azzämmätä | 'have someone go on campaign' 
as-fällämä | affällämä | 'have someone decorated'
as-s'äjjäfä | as's'äjjäfä | 'fill with disgust'
as-s'afä | as's'afä | 'have someone write'

In this case, the whole Root node spreads (since both place features and laryngeal features are involved), though target and trigger appear to be sibilant fricatives.

In this section, several examples have demonstrated that ejectives, along with other segments with Root nodes, may spread their whole Root node onto another timing slot. The effect is not only the spread of ejection, but of all features under (and in) the Root node. Feature geometry predicts that this would be the case, no matter what the laryngeal feature, but it is reassuring to find empirical confirmation of this prediction in a new set of data.

### 3.9. Conclusion

Ejectives can fully participate in various assimilatory processes. They may assimilate completely by spreading the Root node, as we have seen in §3.8 for Chechen and Haddiya, for example. They may also assimilate along with other stops with respect to place features, as in Dakota, while preserving their laryngeal articulation (§3.7).

More interesting from a theoretical point of view is the behavior of ejectives with respect to laryngeal assimilations. Ejectives participated in complete Laryngeal spreading in most dialects of Oromo, and in some dialects of the Northwest Caucasus (§3.4). Mingrelian and Laz also demonstrate complete laryngeal assimilation (§3.5.4).
The individual laryngeal feature [voice] can spread independently of [c.g.], as we saw in Waata Oromo, and in Kabardian and other NWC varieties (§3.3). However, I have not found any clear case of ejection spreading alone. In formal terms, we find examples such as the following, where (88a) shows the spread of the whole Laryngeal node, including features which bear a [voice] specification, while (88b) shows the process of voice assimilation, without other laryngeal features spreading:

(88) a. Root Root
   Lar Lar Lar
   ([voice]) [voice]

However, there is no evidence for [c.g.] to spread without also spreading other laryngeal features. Thus in (89a), ejectives can spread, but only as one of several specifications on a Laryngeal node; the feature [c.g.] itself has not been found to spread from ejectives.

(89) a. Root Root
   Lar Lar Lar
   ([c.g.]) [c.g.]

This is a curious asymmetry which is not predicted by phonological theory. Recall that Lombardi, for example, predicted this finding but could not document it. And now after a near-exhaustive search, I have been unable to document this claim. What could this mean for the theory?

First, the inability to document the existence of such a change as /tk' —► [t'k'] without also /tg —► [dg] could simply be a gap in the data. Ejectives occur in no more than 20% of the world's languages. Unfortunately, many of these languages are not described well, or if they are described, they are in languages such as Georgian which are difficult for most scholars to mine for data. The number of grammars and grammatical sketches of languages with ejectives which I have consulted number fewer than 200, which, while it is a respectable number for a sample, is only about 15% of the total number of languages with ejectives. The number of high-quality, detailed grammars on such languages is of course much smaller. And of the number of languages which have ejectives, only some of them have (reported) laryngeal assimilations.
One scholar, Haas (1988:24), criticizes feature geometry because of the lack of examples in which ‘voicing assimilation takes place without affecting the feature [spread]’ (e.g. bh+t → bhd) or ‘aspiration assimilation occurs independently of the voice specification’ (though recall the Marathi neutralization data in (3)). These examples are parallel to the situation of ejectives and voiced stops. Yet Haas observes that ‘class-node assimilation is far more natural than single-feature assimilation’. And this does seem to be true. Thus another reason we have not seen ejectives act independently is because of all the languages with laryngeal assimilations, most of them seem to have the most common option of class-node assimilation: spread the whole Laryngeal node.

Lombardi has noted that ‘spreading tends to go hand in hand with neutralization’ (1991:176). Thus one reason we don’t see ejectives spread could be that ejection is often neutralized. As we shall see in Chapter Four on Deglottalization, ejectives quite commonly lose their glottal feature in consonant clusters. Kingston’s Binding Hypothesis claims that ejective release is most salient pre-vocally. The environment which shows ejectives spreading [e.g.] is usually preconsonantal, and thus prone to deglottalization. One type of clear-cut evidence of ejectives spreading would be action at a distance, which is extremely rare for laryngeal features, and quite often only sporadic in nature, and thus probably not rule-governed. Furthermore, many languages do not permit glottalic consonants in coda position, and so there are fewer opportunities for consonant-consonant assimilation to involve ejectives.

Another reason for the asymmetry involves the phonetic implementation of [voice] and [e.g.]. The feature [voice] is phonetically implemented as vibration of the vocal folds. It is relatively easy to sustain vocal fold vibration, and often it is quite difficult (though not impossible) to have mixed voiced-voiceless clusters. It is simply easier to have obstruent clusters agree with respect to [voice]. In other environments, too, it is often easier to continue voicing, hence the common process of intervocalic voicing, or post-nasal voicing of voiceless stops. The feature [e.g.], on the other hand, while involving glottal constriction, also involves raising the larynx for ejectives and lowering it for implosives. This additional gesture, while apparently not phonologically important, does play a phonetic role, since it is difficult (though not impossible) to make two piston-like gestures in a row. Therefore the lack of ejective assimilation may reflect this phonetic difficulty.

The asymmetry between [voice] and [e.g.] spread may involve the fact that although both features are formally marked, like the animals in Orwell’s Animal Farm, some are more marked than others. For example, according to Maddieson (1984) the
Plain unmarked plain voiceless stops are found in 92% of the world's languages. Plain voiced stops ([voiced]) are found in 67%, while voiceless aspirated consonants ([s.g.]) are found in 29%. Ejectives ([e.g.]) are found in around 16%. Thus although these laryngeal features are marked, some, like [e.g.], are more marked than others. Because of the reasons listed above, I propose the following markedness universal:

\[
(90) \text{Laryngeal Markedness Statement} \\
[e.g.] \text{ spread } \Rightarrow [\text{voice}] \text{ spread}
\]

This states that ejective spread implies that [voice] spreads; if both ejectives and voiced stops spread, then what is spreading is the Laryngeal node. Thus (90) formalizes the fact that ejectives do not spread by themselves.

An alternate to using the Markedness Statement would be to attempt to encode these relations with feature geometry. Since [voice] may spread independently, but [e.g.] can spread only if [voice] does, one might claim that [voice] is dependent from [e.g.]:

\[
(91) \begin{array}{ll}
\text{Ejective} & \text{Voiced} \\
\text{Root} & \text{Root} \\
\text{Lar} & \text{Lar} \\
[e.g.] & [e.g.] \\
\{} & \{\text{voice}\}
\end{array}
\]

While the representation in (91) accounts for this asymmetric behavior, it has a number of problems. First, current feature geometric representations do not permit features to be dependent upon other features. Instead, they are organized under a class node (Clements 1985). Thus this violates an important organizational principle. Second, such a representation would require voiced segments to be specified for [e.g.], though there is no phonetic or phonological evidence for this. This representation implies that they are a type of implosive, which is clearly false. I thus reject a representational encoding of these features, and opt for the Markedness Statement.

There is some evidence that contradicts the asymmetrical spreading as an absolute universal, however. Recall from §3.1.1 that several scholars have reported ejectives trigger laryngealization on an adjacent vowel. For example, Robins (1957) and Robins and
Waterson (1952) report that in Georgian 'it is clearly shown that the glottalized consonants, 
p’, t’, țj’, k’, and q’, are followed by vowels of a constricted or glottalized tamber, a 
feature also noticeable in listening' in addition to its effect observable from the kymograph. 
Lindau (1984) notes the Navajo ejectives are released into creaky voice of the following 
vowel. I have also noted that Nater describes a type of spread from ejectives onto sonorant 
consonants.

If we allow these admittedly allophonic processes, then the missing gap is filled, 
and our theoretical predictions are confirmed. We may even find phonological evidence in 
the spread from glottal stop to voiceless obstruents, as in Quileute. However, if we look 
for evidence of this among obstruents, from ejective to obstruent, the gap remains. The 
Laryngeal Markedness Statement formalizes the rarity of ejectives alone to spread, due to 
the rarity of individual feature vs. class node spreading, the frequent absence of ejectives in 
coda position, the tendency to deglottalize, the acoustic difficulty of hearing two release, 
and the physiological difficulty of producing consecutive larynx-raising gestures.
CHAPTER 4
DEGLOTTALIZATION

4.1. Introduction
Deglottalization of ejectives is a process in which they lose their glottal constriction, but retain the primary obstruction of the vocal tract, typically resulting in a voiceless unaspirated stop. An example of this (discussed in detail below) occurs in the shift from the conservative, literary Usux-Čaj variety of the Đokuzpara dialect of Lezgian, with its ejectives, to the deglottalized pronunciation in the spoken variety. Compare the literary pronunciation of ‘lamb’ [k’el] with the spoken variety [kel]. Deglottalization is predicted by current models of non-linear phonology and is of interest in testing theories of laryngeal neutralization, since Greenberg (1970:131) has observed that ‘syllabic initial position is favored for glottalic consonants in general’ (thereby implying possible neutralization in the coda), and since Lombardi’s (1991) theory of laryngeal neutralization predicts that ejectives are neutralized to plain unaspirated stops. The Ejective Model of the Glottalic Theory (see §1.4.3), a theory which posits ejectives in Proto-Indo-European, also requires a change from ejective to plain stop in such Indo-European branches as Tocharian, Germanic, and Armenian. Greenberg (1970:134) observed that glottalic sounds diachronically tend to lose their feature of glottalization, though his study concentrated mostly on implosives. This chapter therefore surveys various languages, and documents such a precedent as deglottalization of ejectives, in part in order to develop a cross-linguistic, typologically sound model of sound change, and to affirm current models of laryngeal feature organization which distinguish operations on the Laryngeal node versus individual laryngeal features.

This section has presented the purpose for examining deglottalization and will also outline the rest of the chapter. Section 4.2 provides some of the theoretical background pertaining to deglottalization as either the delinking of the Laryngeal node or the delinking of the laryngeal feature [e.g.). In §4.3, evidence is provided by such languages as Klamath and Nisgha for deglottalization as part of Laryngeal node delinking, and the chapter contrasts these languages with those in which the Laryngeal node remains intact.
Deglottalization as delinking of [constricted glottis] is examined in §4.4, and this process is found in Lezgian and Tigre, among others. Section 4.4.5 examines cases in which ejection is preserved, but other laryngeal features are delinked, again demonstrating the independence of the laryngeal features. Dialectal variation in the deglottalization of ejectives is examined in §4.5, and important precedents for the Glottalic Theory for the complete loss of glottalization are found in such languages as Stoney Dakota, Udi, and Fort Resolution Chipewyan. The rest of that section examines other loss of ejection, e.g. within certain places of articulation only. Section 4.6 presents data from a variety of languages in which loss of ejection is in free variation or is the result of loanword adaptation. In §4.7, I provide diachronic evidence for the loss of glottal features from languages from Africa, the Americas, and the Caucasus. The phonetic realization of ejectives which approaches deglottalization in rapid speech, and fieldworkers’ reports of this are covered in §4.8. A summary and conclusion are provided in §4.9.

4.2. Theoretical Discussion

McCarthy (1988:88) claims that in addition to spreading, another basic operation on association lines in nonlinear phonology is delinking, which he notes ‘corresponds to the traditional process of reduction’. And it is also under reduction that Kenstowicz (1993:159-62) discusses delinking. Feature delinking results in some type of lenition or neutralization. Clements and Hume note that neutralization ‘eliminates contrasts between two or more phonological features in certain contexts’ (1995:263). They note that neutralization rules which are neither assimilatory nor dissimilatory include rules of debuccalization which ‘eliminate contrast among oral tract features’ (discussed in Chapter Five) and ‘rules of devoicing, deaspiration, and/or deglottalization, which eliminate contrasts among laryngeal features’, the subject of this chapter. Clements and Hume (1995:264) note that ‘simple neutralization can be characterized in terms of node delinking’ which typically eliminates marked values in favor of unmarked values (263). Delinking has been used to account for a wide variety of phonological phenomena. It has been used for vowel reduction, syllable-final laryngeal neutralization (Clements 1985; Lombardi 1991), debuccalization (see Chapter 5), and loss of secondary articulation features. Dissimilation has also been analyzed as delinking (Odden 1987; Lombardi 1987; see also Chapter 6).

An early form of delinking was expressed in Goldsmith (1976:45) with the circling of a tone and an arrow indicating change to zero. Thráinsson (1978:36) used a similar
device to convey the deletion of groups of features. Clements and Ford (1979:197) use a z-like symbol, which they note 'indicates the deletion of an association line'.

Clements and Keyser (1983:16) use delinking without much further comment other than describing it as an abbreviatory convention of autosegmental phonology. The laryngeal feature [+voice] is deleted syllable-finally in Turkish in their analysis, and replaced with a default [-voice] specification. Clements (1985:230) comments that it is well known that phonological processes may involve laryngeal features independently of supralaryngeal features, and cites as examples rules of voicing assimilation, aspiration, and deaspiration. Clements (1985:233) notes that 'the structural change indicated by the double-crossed line delinks the set of supralaryngeal tier features...'. Later, Lombardi (1991) analyzed laryngeal neutralization as a delinking of the Laryngeal node as a whole, or in certain languages, of only specific laryngeal features if other features are licensed in certain positions. A summary of her leading ideas was given in Chapter 3.2.

It is important to distinguish two different types of deglottalization. Blevins (1993) uses the term delaryngealization to refer to the 'loss of any or all laryngeal features', but since there are specific terms such as deglottalization, deaspiration, and devoicing to refer to the individual laryngeal features, I will restrict Blevins' term to refer only to complete loss of the Laryngeal node through delinking. Empirically, delaryngealization is demonstrated by examining the patterning of other laryngeal features to determine whether they also undergo neutralization. If there are no other laryngeal features (say, in a language such as Nisgha, with only ejectives and plain voiceless stops), I will assume that deglottalization is delaryngealization. The other type of deglottalization is delinking of only the feature [constricted glottis], while other laryngeal features are unaffected—deglottalization proper. The two types are represented below:

(1) \[\begin{array}{c|c}
\text{Delaryngealization} & \text{Degrllotallization} \\
\hline
\text{Rt} & \text{Rt} \\
\text{\dagger} & \text{\dagger} \\
\text{Lar} & \text{Lar} \\
\text{[c.g.] (or [s.g.] or [voice])} & \text{[c.g.]} \\
\end{array}\]

The result of delaryngealization and deglottalization is typically a voiceless unaspirated obstruent, which has no Laryngeal node (Lombardi 1991). However, occasionally languages may impose a certain degree of aspiration on the former ejective. It
is often difficult to determine whether this is simply release of the stop or true aspiration, since there is (almost?) never a contrast in neutralizing environments. To conform with the idea that the neutralized consonant is voiceless unaspirated, following Lombardi, I will assume this reflects a phonetic fact and that phonologically, the feature [spread glottis] does not play a role in most such cases.

4.3. Deglottalization as Laryngeal Node Delinking

Some statistical work related to the neutralization of ejectives was done by Kingston (1985a:252, citing his 1982 work), who found that of the 34 languages in the Stanford Phonological Archive which have ejectives, 22 do not allow them to occur in syllable codas. Eight languages in the sample, however, do not allow any stop in the coda. He notes that of the remaining 26 languages, 14 (54%) disallow ejectives in codas, while ejectives do occur in codas in 12 (46%) languages. Since a slim majority of languages have constraints against ejectives (and many have constraints against other laryngeal types as well), in which they often alternate with plain voiceless stops, an adequate phonological theory must capture this common process in a simple way. We begin by examining delaryngealization in Klamath.

4.3.1. Klamath

Perhaps the best-known example of loss of laryngeal features comes from Klamath, a Penutian language (Barker 1963a, 1963b, 1964). The data from this language were at the center of the debate on the simultaneous application of phonological rules in the 1970s, and on the role of the cycle. The details will not be reviewed here but the interested reader may consult Kisseberth (1972), Kean (1973), and Lightner (1976). Recent re-examinations of Klamath in relation to rule ordering paradoxes are found in Cole (1993, 1995). See Blevins (1995) for more on extraprosodic consonants in Klamath. Additional analyses are offered in Clements and Sezer (1983), Kingston (1985a), Steriade (1983, 1988), and Lombardi (1991). Klamath was also used by Clements (1985) to argue for the existence of the Laryngeal node in his seminal work on feature geometry.

Kingston’s observations on the distribution of laryngeal features, including a case study of Klamath, led him to develop his Articulatory Binding Hypothesis:

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1 Kingston’s text actually says the remaining 24 languages, but since his sample has 34, and 8 don’t have stops of any kind in the coda, this figure must be 26. This is confirmed since 14 languages which allow coda ejectives plus 12 that don’t, add up to 26.
Any glottal articulation which accompanies the articulation of a stop, i.e. a noncontinuant, will occur close to the release of that stop. Furthermore, this timing relationship between glottal and oral articulations in stops will be relatively stable. (Kingston 1985a:245).

Such observations helped lead Steriade (1993, 1994) to form her theory of aperture and release nodes (see §2.4.3.), and these ideas have been taken up by such scholars as Blevins (1993), who recently proposed a treatment of the laryngeal features in Klamath, based on Barker's data, which I will adopt in order to illustrate delaryngealization.

Blevins posits the following underlying segmental inventory:

(3) p t ŋ k q m n l w j
    pʰ tʰ ŋʰ kʰ qʰ ŋ ʃ ʒ ɹ ɬ wa j ɦ
    p' t' ŋ' k' q' m n ʃ ʒ ɹ ɬ wa j' ?
    s(h), (s')

In addition, there are four distinct vowels which may occur long or short: /i, i, e, e, a, a, u, u/ (Blevins 1993:238-9).

Klamath has a complex series of neutralizations, including sonorant deglottalization, which will not be discussed here. Among obstruents it appears that the whole Laryngeal node is involved, not simply those obstruents which are ejective. Based on data drawn from both Barker's published work (1963a, 1963b, 1964), as well as his field recordings, Blevins provides the following examples of obstruent neutralization in medial position. In (4a) and (b) below, an underlying ejective is neutralized to a voiceless unaspirated consonant before another obstruent or a marked sonorant (that is, a sonorant with a specification for [c.g.l] or [s.g.l]), though not prevocally or before plain sonorant consonants, and in (c) an aspirated affricate is neutralized to voiceless unaspirated.

Example (d) illustrates that voiceless unaspirated consonants remain unchanged.

(4) Klamath medial obstruent neutralization
a.  /lep'/        ‘be flat’²
    lepl'ep'a      ‘becomes flat’
    lepl'ep'li     ‘flat’

² Blevins' article apparently has a typographic error, with /laep' / for 'be flat', since Barker has <Lep'>, and the other words in Blevins' set do not contain the /a/.
b.  /mpʰet'/  'float'
   mpʰet'iqi  'floats up'
   mpʰet'wa  'floats in water'
   mpʰet'na  'floats along'
   mpʰetplant'a  'floats downstream'
   mpʰetlaqs  'gizzard' (lit. 'sinks down, as a bird's gizzard')

c.  /pʰefʰ/  'foot'
    pʰefʰiqi  'puts a foot over'
    pʰefʰwa  'puts a foot into water'
    pʰefʰne:ka  'puts a foot into a hole'
    pʰefʰk'wa  'puts a foot across'
    pʰepʃ'a:k  'little feet (distributive)'
    pʰefʰa  'gets a foot (as a wooden leg)'
    pʰefʰa  'puts a foot inside'

d.  /s?ap/  'tell, say'
    s?apa  'tells, says'
    s?aptki  'wants someone to tell'  (Blevins 1993:246)

In word-final position, neutralization of obstruents is to the aspirated series, (with concomitant affrication), not to the voiceless unaspirated series.

(5)  a.  /ŋepʰ/  'hand'
    ŋepʰe:ʔa  'puts on a glove'
    [ŋepʰ]  'hand'

b.  /nʃ'ek'/  'in little bits'
    nʃ'ek'a:ni  'small, little'
    [nʃ'ekʰ]  'in little bits'

c.  /nkak/  'species of turtle'
    nkakam  'turtle's'
    [nkakʰ]  'species of turtle'  (Blevins 1993:246)

---

3 In this example, the neutralization is of first consonant of the initial stem, which is partly reduplicated. The affricate is glottalized due to fusion with a following glottal element (a floating [c,g,l] feature in the distributive suffix /-ʔa:k/ – Blevins 1993§3.4). See also §8.4.1.5 of this work.
As we have seen, there are alternations which neutralize all obstruents to a voiceless unaspirated segment when the target is followed by another obstruent, a glottalized sonorant, or a voiceless sonorant. Blevins suggests that neutralization in word-final position is the result of a general obstruent neutralization process in conjunction with a process of word-final aspiration/spirantization (formalized shortly below). She formalizes an obstruent licensing constraint in the following way, in which failure to satisfy the constraint triggers obstruent neutralization, with the assumption that plain sonorants lack Laryngeal nodes (Lombardi 1991).

(6) Klamath obstruent licensing constraint

IF [-son] — 0

<table>
<thead>
<tr>
<th>THEN</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 — [+son] Root node</td>
</tr>
<tr>
<td>0 — 0 Laryngeal node</td>
</tr>
</tbody>
</table>

Blevins interprets this constraint to license an obstruent with terminal laryngeal features ([e.g.] or [s.g.]) only if the obstruent is followed by a sonorant without a Laryngeal node. That is, laryngeal features are licensed before vowels and plain sonorants, but are not licensed before all obstruents, before glottalized or aspirated (voiceless) sonorants, or word-finally. The exact formulation of Blevins’ constraint is somewhat suspect, given that it refers to lack of structure (i.e. license laryngeal obstruents only before segments without a Laryngeal node). Nevertheless Blevins’ generalization is clear.

Steriade (1983, cited by Blevins 1993) proposed a negative constraint in which laryngeal features are not allowed in the syllable rhyme. Lombardi (1991) formalized a positive constraint which licenses segments only before a sonorant segment within the same syllable. David Odden (p.c.) proposes an analysis in which the glottalized and voiceless sonorants are not sonorants (defined by total vocal tract configuration), and that following Lombardi, Laryngeal nodes are required to be followed by sonorants. Aspiration of final stops is simply release, since sonorants are not turned into voiceless sonorants.

Blevins, however, argues against such syllable-based accounts on two grounds. First, they do not account for the parallelism between word-initial consonant clusters and those in other positions, since word-initial clusters, as syllable onsets, should allow any
feature to be licensed, when in fact, there is neutralization of the first consonant as Blevins predicts, since only voiceless unaspirated segments occur as C₁ before C₂ consonants with a Laryngeal node. That is, we find only plain voiceless obstruents as C₁ before other stops (e.g. [tpʰ, tp, kp']), and only plain sonorants before marked sonorants ([w₁, lm]). However, Blevins (1993:254-5) mistakenly includes clusters of the type /tp, kp/ among those in which the second consonant has a Laryngeal node. While Steriade’s analysis does not account for neutralized onset clusters, Lombardi’s formalization has been misrepresented by Blevins. Lombardi’s constraint permits Laryngeal nodes only before the feature [+son] in the same syllable; it does not mean any Laryngeal node can be licensed in a syllable onset. Thus Lombardi’s account correctly predicts neutralization of the first obstruent in an onset since it is not before [+son]; the second consonant, being before a sonorant, may indeed bear laryngeal features.

Blevins’ second objection to syllable-based neutralization is that ‘it requires syllabifications which are not consistent with those required for other rules of the language’ such as stress assignment, closed-syllable laxing, and vowel reduction/deletion under prefixation (255-6). For example, the form /saqpaq’wis/ ‘a single braid’ has a uvular ejective in the coda (since the syllable receives penultimate stress, it must be heavy to attract the stress). Nevertheless, the retention of glottalization before /w/ would force the sequence to be syllabified in the onset. A theory which licenses these features only within the onset (Steriade) or within the syllable before a sonorant (Lombardi) fails to account for these facts. Blevin has contributed a valuable analysis of Klamath. In brief, Klamath has a rule (constraint) of laryngeal neutralization which results in the deglottalization of ejectives and in loss of aspiration.

Obstruent neutralization to aspirated plosives is the result of neutralization followed by a general process of word-final aspiration/spirantization. The aspiration is formulated by Blevins as follows:

(7) Word-final aspiration/spirantization

\[
\begin{array}{c}
\overset{\text{\textbackslash o}_{\text{word}}}{\text{\textbackslash A}_f} \\
\text{[spread glottis]}
\end{array}
\]

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According to Blevins, this rule associates a fricative aperture position with a pre-specified [spread glottis] laryngeal feature to word-final segments (including some devoicing in all types of sonorants). She also assumes, but does not formalize, a process in which for obstruents, the feature [spread glottis] delinks from the Af position and attaches to the closure position. The result, according to Blevins, accounts for the phonetic fact cited in Barker (1964:24) that such word-final segments are not so much aspirated as they are affricated with aspirated offglide, e.g. ‘hand’ varies as [nepʰ – nepʰ] and ‘arm’ is [weqʰ – weqX] (Blevins 1993:247). And it captures the generalization that all word-final obstruents are aspirated and affricated. This type of neutralization is predicted to be ‘extremely rare’ and, theoretically speaking, ‘extremely complex and costly’ by Lombardi (1991:185-6), who admits that Takelma may be (another) language with neutralization to aspiration; another case is Kashaya, which aspirates plain stops in the coda (Buckley 1994:87-88). David Odden (p.c.) suggests this might be an areal phenomenon, since Klamath and Takelma are geographically adjacent. As we shall also see in the chapter on ejective voicing, grammars of at least some languages seem to choose neutralization or alternations to marked categories. These languages, however, do seem to buck the general tendency toward neutralization to plain voiceless stops.

In short, Klamath is a language with neutralization of the Laryngeal node as a whole. Ejectives, by losing their Laryngeal node (by their not being licensed in certain positions), are deglottalized as a result. In word-final position, obstruents are neutralized, but a process of aspiration/affrication changes the unmarked value to that of [spread glottis].

4.3.2. Nisgha

Nisgha, a Tsimshianic language spoken in British Columbia, shows delaryngealization in reduplicated elements in conjunction with spirantization (Shaw 1987, citing her own fieldwork and Tarpent 1983; see also Lombardi 1990). Nisgha has voiceless and ejective stops and affricates, and voiceless fricatives, along with glottalized sonorants. Therefore, with only two obstruent and two sonorant series, loss of [c.g.] is loss of the only specified laryngeal feature, and therefore of the Laryngeal node as a whole. Example (8a) shows the normal reduplicative prefix. (8b) shows that prefix-final affricates become fricatives, while dorsal stops also spirantize, as seen in (c). Example (d) shows that deglottalization of both ejectives and laryngealized sonorants occurs in the reduplicant, (e) shows that ejective affricates both deglottalize and spirantize, and (f) illustrates that glottal stop, stripped of its...
laryngeal feature, is realized as uvular [χ], the only other eligible [+low] consonant in Shaw’s analysis. The vowels of the reduplicant are predictable: [a] after uvulars, [a] after glottals, [u] before [kʷ, kʷ', xʷ, w, w'], and [i] elsewhere.

(8) a. t’á:p t’ip-t’á:p ‘to drive something in’
qá:p qap-qá:p ‘to scratch something’
?ux ?ax-?ux ‘to throw something’
ťe:χ-kʷ taχ-ťe:χ-kʷ ‘to have finished eating’

b. páts pis-páts ‘to lift, carry something’
k’áts-kʷ k’is-k’áts-kʷ ‘to have arrived (boat, vehicle)’

c. t’ák tiχ-t’ák ‘to forget something’
lúkʷ luxʷ-lúkʷ ‘to move something’
tśoχ tśoχ-tśoχ ‘to be embarrassed, ashamed’

d. hît’ hat-hît’ ‘to stick’
tîk’ tiχ-tîk’ ‘to feel silly, shy’
tam tim-tam ‘to press something’
qîn qan-qîn ‘to chew on something’

e. hâís’ has-hâís’ ‘to bite something’
t’úts’-kʷ t’is-t’úts’-kʷ ‘to be black’
tś’âfl’ tś’ix-tś’âfl’ ‘(music) record (sg.); to have a rippled surface (pl.)’

(q’âfl’) q’ol-q’âfl’ ‘to be slightly crooked’
(húfl’) hat-húfl’-q’olkʷ ‘to boil’

f. t’a?-t’a? [t’âχ-t’a?] ‘to clap’
qa?-qa? [q’âχ-qó?] ‘to go get someone/something’

(Shaw 1987)

In addition to the obvious deaffrication, the back consonants (except the voiceless velar) also undergo lenition. These details will not be explored in depth. What is crucial for the purpose of this chapter is to demonstrate loss of laryngeal features in the final consonant of the reduplicative prefix. Note that ejection is not lost simply due to lenition (since there are no ejective fricatives); they are also lost when there is no lenition, as the form /hît’/ →

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4 Incorrectly glossed as ‘to be black’ in Rose (1996:99); Shaw’s (1987) article has this as ‘to bite something’ (298), and the form below that /t’úts’-kʷ/ is glossed as ‘to be black’. 152
/hat-hit/ 'to stick' illustrates. Note that the delaryngealization does not appear to result from simple phonotactic restrictions against ejectives before another consonant; the language permits forms such as /t'ŭxs'-kw/ 'to be black' (Shaw 1987: 298) and /hux'-x'/ 'to be cooked' (299). And note that it is only the coda which loses glottalization; forms like /t'ip-t'âp/ 'to drive something in' and /h'is-išáá'/ 'to have a rippled surface (pl.)' show that ejectives in the onset of the reduplicant are preserved.

Much work in Optimality Theory has commented on the 'emergence of the unmarked' in which 'the reduplicant obeys a constraint that is otherwise violated freely in the language as a whole—one that may even be violated in the base of reduplication' (McCarthy and Prince 1995:329). In this case, the constraint would be one against, say, [c.g.] in the coda. Bases may violate this constraint. However, the lack of the feature [c.g.] (along with other constraints) in the reduplicant shows that this constraint must be ranked higher than Base-Reduplicant faithfulness. Whatever framework one chooses to employ, the facts remain the same: Nisg̱a loses the Laryngeal node in the codas of reduplicants.

4.3.3. Sahaptin
Delaryngealization is also found in Sahaptin (Plateau Penutian; Rigsby and Rude 1996:671). Sahaptin has a series of voiceless and ejective stops and affricates, and voiceless fricatives. Initial consonant reduplication, according to Rude (p.c.), is 'mostly for adjectives and other nominals and it imparts a distributive sense'. Reduplication is often used to form the plural; some basic forms seem to use only the reduplicated form. It is the only case which shows loss of glottalization.

(9) pláʃ 'white one' ppláʃ 'white ones'
       kw'-áalk  'long'          kkw'-áal  'long ones' (1996:671)

Noel Rude was kind enough to elicit the following forms on my behalf, from the last fluent speaker of Umatilla Sahaptin (the same dialect described in Rigsby and Rude):

(10) kw'-áalk  'that long/tall one'     k*k'w'-áalk  'those long/tall ones'
       tʃ'im       'sharp'          tʃtʃ'im       'sharp ones'
       t'áal        'noisy'          tt'áal        'noisy ones'
       t'nú         'thick'          tt'nú         'thick ones'

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Note that for this speaker the labialization remained in the reduplicated /kʷ/. Rude (p.c.) comments that the initial /t/ in the reduplicant has a distinct release, though not aspirated as in English; it is unlike a true geminate, as in Italian latte in that it is not merely lengthened, but has two releases. Each of the affricates has separate releases as well, showing that the data in (10) are a phonetic and not just a phonological transcription.

An alternate analysis would view initial consonant reduplication not as reduplication per se, but as gemination, with the addition of a C-slot, which marks the plural. In this view, apparent delaryngealization is accounted for since there is simply one laryngeal feature associated to one Root node, which is associated to two timing slots. However, one would not expect two releases in a geminate consonant, since there is only one segment (compare Arabic and Italian geminates with only one release), and therefore this analysis is incorrect.

Additional evidence for the fact that this is reduplication and not gemination comes from variant pronunciations of the reduplicated sounds, where an unstressed [i] occurs between the reduplicant and the base (Rude p.c.). In Rude's view, the reduplicant is underlyingly /Ci/. When this occurs in slow speech, ejection is preserved, e.g. [t'it'áal] 'noisy ones'. In rapid speech, the vowel devoices, and usually deletes, leaving a deglottalized plosive which is 'syllabic', as in other Pacific Northwest languages: [tt'áal]. The reduplicated vowel is still preserved in between sonorant consonants, as in /lámt/ 'blue', reduplicated as /li lámt/ 'blue ones', or /májšqi/ 'morning', reduplicated as /mímájšqi/ 'mornings'. In sum, Sahaptin illustrates delaryngealization in reduplication, though there are adjacency conditions which govern it.

The occurrence of ejectives within reduplicated words is permitted:

(11) /p'ip'í/ 'guts, intestines'
/k'uxsk'úxs/ 'ankle'
/k'úsik'úsi/ 'dog', derived from /k'úsí/ 'horse'

Therefore the constraint against ejectives is not simply within the reduplicant. To determine its domain, we will examine the distribution of ejectives in other positions.

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5 In isolation, pronounced emphatically, this form occurred as [t'í'tí'píip], but in sentential contexts is occurred as listed in the main text.
Ejectives may occur as the first member of a cluster in both onset and coda. Therefore, the potential deglottalization above is not due simply to a constraint against ejectives in preconsonantal position. Ejectives may occur pre-consonantally, in initial position (12a), within prenuclear onset clusters (b), medially (c), or in coda clusters—but never finally (d):

(12)  
a. /k'pis/ ‘cold (of water)’
    /k'pûl/ ‘mortar’
    /k'w'pînk/ ‘that one aforementioned’ (NW Sahaptin)
    /k'sûjas/ ‘eel, lamprey’
    /k'jitûn/ ‘tooth’
    /q'w'tîp/ ‘strong’

b. /pt'iîts/ ‘girl (sg.)’
   /k'w'i(t)l/ ‘day’

c. /ikáit'χw'a/ ‘he ate it all up’
   /fáxîk-/- ‘(to) cut’
   /jâtîl'piu/ ‘wet’
   /ak'paj?ak'paj/ ‘kidney’
   /pâpatk''aJf't'χa/ ‘they are getting married’

d. /iJîits'k, ìs'îits'k/ ‘grass’
   /mît'tîl'k/ ‘mud’

Although ejectives cannot be reduplicated when segmentally adjacent, they can be reduplicated, as one form for ‘mortar’ shows: /k'p'pûl/. Therefore the Adjacency Parameter (Odden 1994) on delaryngealization must be Root adjacency. In short, Sahaptin delinks the whole Laryngeal node when in contact with another (specified) Laryngeal node, a situation which occurs in reduplication.

4.3.4. Maidu

Another language with complete neutralization of the Laryngeal node is Maidu (Shipley 1956, 1963, 1964). In (Mountain, or Northeastern) Maidu, which has voiced implosives, ejectives, and plain obstruents, syllable-final obstruents cannot be implosive or ejective—they are neutralized to voiceless unaspirated stops. As Uldall (1954:8) wrote, ‘in unstressed position [the glottalized sounds] are often replaced by unaspirated surds. They
are not released before other glottalised sounds or plosives'. There are morphophonemic alternations for the ejective; the bilabial is shown in (13a); the alveolar, in (b), and the velar, in (c). I have culled the following examples from Shipley’s (1963) dictionary.

(13)

a. jèp’im kawáju ‘stallion’ jèpsi ‘men’
b. batám hit’i ‘butter’ hitpe ‘fat, obese’
  hátlut’i ‘a very fat one’ tetélut ‘enormous’
  pít’iki ‘anus, rectum’ pítk’il ‘be constipated’
  ìs’ímk’utt’i ‘rabbit (clothes creature)’ k’utt’it’i ‘bird (creature + dim.)’

c. bolók’om soló ‘moccasin’ bolókti ‘put on shoes’
  láklak’am piwí ‘beet (red root)’ láklakpem t’ókpm hòní
  màk’ám sòli ‘girls’ puberty rite song’ màk ‘dance at girls’ puberty rites’

’tat’ak’am wetémi t’akkaka
‘sound of people dancing’
‘about this time, yet, still, up to now’

The only syllable or word-final /d/ I found in Shipley’s dictionary was /walad/, a personal name of a Cap Singer; no alternation was given. Otherwise, the voiced implosives never occur at the end of a syllable, either underlyingly or in phonetic representation.

In Lombardi’s (1991) analysis, Maidu licenses laryngeal features only before sonorants, in syllable-initial position; their occurrence elsewhere triggers neutralization, which must be analyzed as delinking of the whole Laryngeal node (delaryngealization), though practically speaking, delaryngealization affects only ejectives.

Paul (1967), however, describes Auburn Nisenan, a southern dialect of Maidu. Her corpus is based on words elicited in isolation. She has several words with implosives and ejectives in word-final position, though she notes that for [p’], [t’], or [k’], ‘glottalization, if it occurred, was extremely lenis’ (1967:15). Below, I compare similar forms cited in Shipley (1963), which lists words according to their morphophonemic form; they do not show syllable-final deglottalization.
Although ejectives occur in word-final position, they are weak, as Paul mentioned. Nevertheless, there does not appear to be delaryngealization in Nisenan, at least for citation forms.

4.3.5. Other Cases of Delaryngealization

In this section, we will examine a few additional cases of delaryngealization only briefly, since some data require better documentation. We will begin with Tigrinya. Leslau (1941:8) notes that in Tigrinya, velars, at least, neutralize to /k/ before the second person suffix/-ka/. For example:

(15) /sâbâr-ka/ → [sâbâr-ka] ‘you have fallen’
/sârâk'-ka/ → [sârâkka] ‘you have stolen’

(cf. presumed form /sârâk'-â/ ‘he has stolen’)
/Tadâgka/ → ['îaddâkka] ‘you have found’

Thus Tigrinya may be said to have delaryngealization, at least for the velar place of articulation. Note that /-k/-final stems with /k/-initial morphemes (fake geminates) are said to undergo spirantization. However, Hayes (1986b:336) does not mention what occurs with stems ending in /g/ or /k', nor does the summary by Hudson (1995) address this point.

Coahuilteco, a language isolate of Texas, may have had a process of deglottalization, which is inferred from graphemic evidence:

‘In the only morpheme combination in the text in which two glottalized stops happen to occur together, the first consonant loses its glottalization, so that fîp’ appears as fîp before t’: pin pîlapfîp’ ‘lies’ (25:4) tâpâfîpt'âm ‘he deceives me’ (54:10-11)’ (Troike 1996:651, referring to a grammatical sketch by García 1760).
Mingrelian (Harris 1991c:323; and Gudava and Gamqrelidze 1981:211) might have delaryngealization before the narrative marker /-k/. This is implied, and examples show devoicing, but no example for an ejective in this position is provided.

There are several additional cases of deglottalization which seem to result from dissimilation, and so they will be examined in more detail in Chapter 6. However, for the sake of completeness, they will be cross-listed here. Deglottalization of reduplicated forms is widespread in the Pacific Northwest (in Tsimshian including Gitksan (Rigsby 1970), Coos, Kalispel (Vogt 1940), and Squamish)), according to Silverstein. The first of two ejectives, especially in reduplicated roots, is often deglottalized. It is also found in Tillamook (Reichard 1959). Dissimilation of ejectives which results in deglottalization is also found in the Daghestanian language Lezgian (Haspelmath 1993, and §4.4.1), the Northwest Caucasian language Abaza (Lomtatidze and Klychev 1989), as well as Quechua (Ohala 1993). There are sporadic cases of deglottalization in Ethiopian Semitic languages such as Gafat, Gurage, and Soqotri, all of which are detailed in Chapter Six.

4.3.6. Laryngeal Node Preservation

Before exploring the other major type of deglottalization (as [e.g.] delinking) in the next section, for comparative purposes, I provide a few examples of languages which have no constraints against laryngeal features, at least in certain positions or in certain places of articulation.

Kabardian (Colarusso 1992) has no Laryngeal Constraints (though as we saw in Chapter 3.3.2.1, there is spreading of [voice]). The examples in (16a) show preservation of ejection in word-final position, and the examples in (b) show the preservation of [voice]. Plain voiceless obstruents are of course permitted (c).

(16) a. /t'akʷ/ ‘small; few; a little’ (19)
/kʷəf/ ‘(the) dark, darkness’ (51)
/naməc'/ ‘apart from, besides’ (59)
/na-p'ɪs'ə/ → [nəp'ɪs'] ‘false’ (43)

b. /q'ab/ ‘pumpkin’ (30)
/jəd/ ‘donkey’ (30)
/kwad/ ‘many’ (49)
/fiz/ → [fiz] ‘woman’ (19)
/dajʒ/ ‘near’ (22)
Kabardian therefore appears to have no Laryngeal Constraint.

Zerq' Chechen (Fallon 1991) alveolars show that there is no Laryngeal Constraint:

(17) bæt 'mouth'
    d-æ:t' 'rip (intr) (n)'
    bæd 'duck (animal)'

The uvular /q'/ contrasts with plain /q/; there is no voiced counterpart. Other places of articulation, however, do have a constraint in that /p', tʃ', k'/ do not appear syllable-finallv. This constraint is the result of a sound change which voiced non-initial ejectives (see §7.4.2.1). The appearance of some ejectives in final position in Zerq' is due to a rule of apocope.

English preserves a [voice] distinction in all positions. Some dialects of Bengali (Ray, Hai, and Ray 1966) show no (word-final) neutralization, nor does Bhojpuri (Shukla 1981), though both these languages have constraints on medial coda consonants in clusters. This brief section simply serves as a reminder that languages are free not to impose constraints on various features in various positions.

4.4. Deglottalization as [c.g.] Delinking

4.4.1. Tigre

In Tigre (Ethiopian Semitic), in medial coda position, where there is a consonant in the following onset, ejectives 'show a tendency to weaken' (Raz 1983:5). According to Raz, full release is not achieved unless a vowel follows (cf. Kingston's Binding Hypothesis). In his monograph, Raz indicates the optional weakening with parentheses around the ejective underdot used in his transcriptions. Here I transcribe only the deglottalized versions. Examples include:
This deglottalization can give rise to morphophonemic alternations, as in /k’at’af/ ‘leaves (collective)’ vs. /k’atfat/ ‘leaf (countable singular)’ (though Raz himself does not provide such examples in relation to deglottalization). The transcriptions above, and forms like them were confirmed in my fieldwork with Tigre speaker Dair Negasi Afar. For example:

(19) [k’ans’a] ‘he got up’  [k’anasko] ‘I got up’
[k’at’af] ‘leaves’  [k’atfat] ‘leaf’

The loss of ejection was only in medial coda position; word-finally, the ejective is preserved, e.g. [haritj’] ‘flour’, [afluk’] ‘branch’ (when not debuccalized), and [bet’] ‘egg’. Although Raz stated that voiced plosives /b, d, g/ may become voiceless in syllable-final position, where they were still phonetically distinct from voiceless sounds, my own consultants did not show such devoicing. Therefore, the speech of my own consultants cannot be analyzed as delaryngealization.


I analyze my data as the syllable-final loss of a Laryngeal node bearing the feature [e.g.]. This loss is interpreted phonetically as a plain voiceless obstruent, following Lombardi (1991). The preservation of laryngeal distinctions word-finally could be formalized as word-final extrametricality, or the conditioning environment of deglottalization could be specified as an obstruent in the onset of the following syllable, within the word.

The velar ejective in Tigre deglottalizes ‘only when followed by close juncture’ (Raz 1983:5). Raz gives only one example: /afluk/ ‘forked branches’ is pronounced as [afluk] (though my own consultants also debuccalized this form in isolation to [aflu?]).

Trager and Bloch (1941 [1972:73]) define close juncture as ‘the transition from one segmental phoneme to the next within the utterance (whether this is a morphologically simple form like black, port, or a morphologically complex one like blacker, importation,
the man). In contrast, open juncture is 'the transition from the pause preceding an isolated utterance to the first segmental phoneme, and from the last segmental phoneme to the following pause'. However, it appears, given Raz's description (though there are not many examples), that this process must exclude velar ejectives from deglottalizing, since they apparently do it only word-finally, as mentioned above. I will therefore require a Coronal place specification for the ejectives /t', ñ', s'/ts'/. The labial ejective is rare, especially in the coda, but Raz does not give data to test this claim. Alternatively, we could use the Elsewhere Condition, and first debuccalize velars, then the remaining ejectives would deglottalize, without reference to place. (Note also the apparent differences in domain).

![Diagram: Tigre Deglottalization](Cor)

4.4.2. Lezgian

Lezgian (Daghestanian; Trubetzkoy 1939/1969, Haspelmath 1993) has four series of stops and affricates: voiceless unaspirated, voiceless aspirated, voiced, and ejective. In this section, we will concentrate on what Haspelmath calls 'pre-ejective ejective aspiration' (see also Chapter Six). When two ejectives (or two voiceless obstruents) are separated by an unstressed high vowel underlyingly, there is a syncope rule which brings them in contact, transferring the vocalic articulation as a secondary articulation of the first consonant, and the result is deglottalization of the ejective. There is no dissimilation if the root vowel is stressed, as in the absolutive singular.

---

6 Compare Trask's (1996:75-6) definition of close juncture as:

'1. The close phonetic association that exists between segments not separated by any kind of grammatical boundary...2. A similar phenomenon sometimes taken as typical of consonant clusters in certain languages, and realized, for example, by lack of release of the first of two consecutive plosives...'.

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As we can see from the above examples, the initial ejective of the absolutive singular corresponds to the voiceless aspirated plosive in the plural. I infer that what Haspelmath calls aspiration is really the release of the stop before another stop. (There is no contrast between voiceless aspirates and unaspirates in preconsonantal position, though even voiceless unaspirates are aspirated before another consonant (e.g. /tsyk'/ ‘flower’ vs. [tsʰukʰer] ‘flowers’). This process also occurs when plain consonants come in contact with an obstruent: /pik'/ ‘wooden container’ and /pʰik'er/ (plural) (56). The syncope rule applies first, and then deglottalization occurs before another consonant. Although aspiration is distinctive in Lezgian, I assume in this position it is simply the release of the consonant, accompanied by the timbre of the high vowel which was deleted.

Voiced consonants can occur in a similar environment (e.g. /Kytk'/ ‘moth’) but they do not induce syncope and therefore do not occur in an environment for devoicing. Therefore the environments are not entirely comparable. Nevertheless, it is only the ejectives which lose their laryngeal feature [e.g.] due to dissimilation when adjacent to another ejective.

4.4.3. Zayse

Zayse (Omotic, Hayward 1990b) has the following obstruent inventory:

(22) b d ~d̂ ~d̂z ~d̂s g
p t ~t̂ ~t̂j k
6 d ~t̂s' ~t̂j' k' ?
s f h
z 3

Hayward notes that word-final /t̂s'/ deglottalizes, and is pronounced like its plain counterpart /ts/. He observes that ‘not many cases of deglottalization have been observed, although it does seem to be a regular phonological process’. Unfortunately, the voiced
affricate /dz/ does not occur in word-final position, nor does any singleton voiced consonant. Thus there is ambiguity about whether it is the whole Laryngeal node which delinks or simply the feature [e.g.].

At the root level, there appear to be no laryngeal constraints. For example, the underlying forms /?ots/- 'beat', /?ik/- 'approach', /wod/- 'kill' prove the existence of root-final glottalic sounds, though the geminate implosives /?b/ and /?d/ are often 'pronounced with strong preglottalization' (218) so that /?o?b?/ 'armpit' is realized as [/o?b?]. Voiced pulmonic stops occur in such underlying root forms as /tajb/- 'count', /meed/- 'shave (reflexive and nonreflexive)', and /heeg/- 'become thin', while voiceless final consonants are found in such forms as /kaat/ 'king' (1990b:283). Voiced consonants can occur finally, though seemingly only as underlying geminates which are degeminated, as in /?ojdd/ 'four (counting form)', realized as [?ojd], vs. /?oj?d? tam/ [?oj?d? tam] 'forty' (226). At least in Hayward's transcription, ejectives can occur finally, such as in /w?ota?/ 'farmer' (283), though this may be subject to the deglottalization rule and thus reflects an underlying, not a phonetic, transcription. Plain affricates also occur, as do final voiceless stops, as in the final /l/ of the negative imperative morpheme, e.g. /bugi-dokkit/ 'do not clear (scrub)!' (pl.) (235) and in forms such as [?iz?p] 'six' (underlying /?iz?pp/).

Here follow a few examples of the deglottalization in Zayse. The suffix -aats' indicates the plural of nuclear kin (1990b:229):

(23)  Plural  Plural + nominative
?anguss-aats  ?anguss-aats'-î  'elder kinsmen'
bar-aats  bar-aats'-î  'younger kinswoman'

It is clear from the forms in (24) that the nominative case suffix does not contain a glottal stop which causes ejectives of the preceding affricate. I show roots ending in a plain affricate, which are not deglottalized in the nominative, and I also give an example with a root-final vowel, after which the nominative ending becomes a glide, in order to show that the suffix does not contain initial glottal stop. (Glottal stop is contrastive in Zayse).
Another example of this can be found in the plural marker /-aats/' in certain deictic expressions. It is possible that this is the same morpheme as in (23) and (24). Hayward gives a transcription closer to the underlying forms, indicating ejection for the absolutive forms below, but he also cross-references his section on deglottalization. I therefore give the final deglottalized forms to more clearly show their alternations. Examples are shown in (25):

<table>
<thead>
<tr>
<th>Absolutive pl.</th>
<th>Nominative pl.</th>
<th>Gloss</th>
</tr>
</thead>
<tbody>
<tr>
<td>hâjdaats</td>
<td>hajdaats'ı</td>
<td>'these near speaker'</td>
</tr>
<tr>
<td>jiiddaats</td>
<td>jiiddaats'ı</td>
<td>'those at lower level than speaker'</td>
</tr>
<tr>
<td>godiiddaats</td>
<td>godiiddaats'ı</td>
<td>'those equally near to speaker and addressee'</td>
</tr>
<tr>
<td>sójddaats</td>
<td>sojddaats'ı</td>
<td>'those far from both speaker and addressee'</td>
</tr>
<tr>
<td>jiddiiddaats</td>
<td>jiddiiddaats'ı</td>
<td>'those at lower level than speaker'</td>
</tr>
<tr>
<td>wójddaats</td>
<td>wojddaats'ı</td>
<td>'those at higher level than spkr.'</td>
</tr>
</tbody>
</table>

There is also a productive alternation between ejective and pulmonic affricates for nouns referring to male vs. female members of ethnic groups.

(26) gardula[ts] ‘Gidole man’     gardul[ts]'o ‘Gidole woman’
mela[ts] ‘Gemu man’              mela[ts]'o ‘Gemu woman’

I assume that this process involves deglottalization, though I acknowledge the possibility that the marker for females may be [ʔo], which triggered fusion. (This fusion process may have occurred in deriving non-causative or non-transitive verbs—see Hayward 1988:295, footnotes 22-23).
Zayse is another possible example of a language which delinks the feature [e.g.] on
the alveolar affricate, since it shows alternations which involve deglottalization. However,
because single voiced consonants, and the voiced alveolar affricate in particular, do not
occur in syllable finally (*[meladz]), it is impossible to tell whether [e.g.] or the whole
Laryngeal node delinks. The Zayse data are presented in this section because final voiced
stops do occur in phonetic representation, and thus the neutralization appears to affect only
the ejective affricate.

4.4.4. Deglottalization with a Grammatical Role
This section examines various languages in which deglottalization has grammatical
significance. However, the data here may be ancient relics or is otherwise irregular.
Hayward (1988:277) notes that there may have been an archaic pattern of
intransitive/transitive pairs of verbs in North Omotic, especially Zayse. The stem-final
ejective indicates intransitivity, while the plain member is found in transitives. Hayward
does not comment on whether this could have been deglottalization in the transitive or
ejection in the intransitive, though he speculates (1988:295 fn 22-23) that the
transitive is basic, and ejection derived. Here I simply note for convenience this process in
the chapter on deglottalization. Here follow some examples (Z refers to Zayse):

(27)  Intransitive                          Transitive
  ?a[k’]- Z. ‘pass the night’             ?a[h]- ‘cause to pass the night’
  k’aj[ts’]- Z. ‘snap - of a rope chain’  k’aj[s]- ‘snap a rope/chain’
  fii[k’]- Z. ‘gather together’           fii[s]- ‘gather together’
  di[t’]- di[t]- Z. ‘grow’                 di[t’]- ‘bring up, rear’
  ka[t’s’]- ka[t’s]- Z. ‘cook’             ka[t’s]- ‘cook’
  maa[t’] Wolaitta ‘come into milk’       maa[t’]- ‘milk’

Deglottalization is found in the Omotic language Benchnon (Gimira). Breeze
(1990:22-3) mentions a process of suffixation of the causative. In certain classes of verbs,
the suffix /-s/ is added (28a), causing alternations in some of the stems. The suffix is also
subject to a type of palatal harmony reminiscent of Chumash (Applegate 1976, Poser
1982), in which sibilants agree with respect to their values for [anterior]. Final bilabial
stops are sometimes dropped (28b). But if stem-final /-p/ is not dropped, it is
deglottalized before the suffix (28c). Superscript numbers indicate tone, with 1 the lowest.

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This last form suggests that while an ejective can occur in (word-final) coda position, its ejection is lost before another consonant within the coda.

Stem-final glottalized affricates become deglottalized in the causative:

(29) gats'2-3 'use' gats'2 'cause to use'
k'aš'1 'itch' k'aš'1 'cause to itch'

However, these processes appear to be irregular in their precise allomorphy and they also contain in some instances idiosyncratic tonal changes. If we viewed the forms in (29) 'itch' as also taking a sibilant causative suffix, which is perhaps later deleted under OCP constraints against adjacent sibilants, then both (28c) and (29) could be unified as deglottalization before another consonant. However, Breeze does not make this suggestion and there is not enough data to test this claim adequately.

Thus in Benchnon, there appear to be two types of deglottalization. One affects the labial ejective of certain roots before a sibilant-initial suffix. The second instance of deglottalization affects the causative forms of stems with final affricates, indicating grammatical significance for the difference between plain and ejective stops. Perhaps, however, this only plays as large a role as the morphologically conditioned voicing alternations do in English pairs like 'a house [s]' vs. 'to house [z]'

Trager (1946) describes an interesting form of consonant mutation, or ablaut, in Taos, which is not 'now functioning', i.e. it is non-productive, showing only two to seven tokens of each type. Hale (1967), however, notes that the deglottalization alternations are 'highly productive in all of the Tanoan languages'. This change can be observed in comparing the basic stem of verbs in their third singular (subject of gender I or III) preterit active form (the basic stem of the verb), and the basic stative stem, found in the third singular resultative stative. In cases where there is no stative, ablaut can be seen in the verbal noun, which is based on the stative stem. The consonant mutations involving
deglossalization are seen in (30a) below, while those involving apparently ‘reverse debuccalization’ are shown in (b) – perhaps Trager should have analyzed the nonglottal stems as basic; it is unclear from his article why he chose to view the changes in this direction, except for his reliance on ‘the basic stem’. Miscellaneous changes are shown in (c).

(30)  

\[
\begin{array}{ccc}
\text{a.} & \text{b.} & \text{c.} \\
p' & p & m- \rightarrow p- \\
t' & t & w- \rightarrow k^w- \\
\tilde{ts}' & \tilde{ts} & w- \rightarrow x^w- \\
k' & k & j- \rightarrow \tilde{t}- \\
\end{array}
\]

For actual examples, I will list only those involving apparent deglossalization:

(31)  

\[
\begin{array}{ccc}
\text{'p'o}
\text{odá} & \text{'pøda} & \text{‘he lost it / it is lost’} \\
må-p'øw & må-'pøwma & \text{‘he squeezed / it has been squeezed’} \\
t'âmá & 'tâmà & \text{‘he helped him / he was helped’} \\
t'ó & 'to?one & \text{‘he danced / dance’} \\
'\tilde{ts}'i & \tilde{tsi} & \text{‘he tied it / it is tied’} \\
'k'olå & 'kolla & \text{‘he ate it / it was eaten’} \\
\end{array}
\]

(1946:200)

Loss of glottalization thus plays a grammatical role in Taos.

4.4.5. Ejective Preservation and Other Laryngeal Constraints

In this section, I illustrate the preservation of ejectives, with concomitant constraints on or neutralization of other laryngeal features. This illustrates the independence of laryngeal features from one another.

Aronson (1989:225) reports on final devoicing in Georgian. Georgian has three stop/affricate series: voiced, voiceless, and ejective, and it has voiceless and voiced fricative series. In word-final position, voiced obstruents /b, d, ʒ, ɡ, z, ʒ, k/ are devoiced to /p, t, ʒ, k, s, ʃ, χ/. For example:

For example:
Compare this with the regular occurrence of ejectives in word-final position:

(33)  
\[
\begin{align*}
[\text{vts'q'wet}'] & \quad \text{‘tear, snap (1sg.pres.)} \\
[\text{vrek}'] & \quad \text{‘ring (1sg.pres.)} \\
[\text{vts'ets'j}] & \quad \text{‘pull out (1sg.pres.)} \\
[\text{vxw etj'l}] & \quad \text{‘collect (1sg.pres.)}
\end{align*}
\]

(Robins and Waterson 1952:61)

In addition to the confirmation through alternations, Robins and Waterson (1952) write that ‘in normal utterance of isolated words [voiced] consonants were heard as wholly or partly without voice in initial and final position, and before voiceless fricatives and aspirated or glottalized consonants, especially in a final cluster’ (66). An example of devoicing in initial clusters includes /tobob/ → [tʰɔ'ba] ‘to heat’ and /bt'q'vna/ → [ʔt'q'vna] ‘to pinch’.

These forms may enter into phonological alternations. Vamling (1991) gives the form /a-tb-bobs/ ‘he warms something’ vs. /tb-eba/ ‘it warms up’, but since this is a morphological sketch, details of pronunciation are not provided. In final position, compare /antebt/ → [antʰepʰt]. ‘you (pl.) kindle’ (Robins and Waterson 1952:68); /-eb/- is the future/present tense formant and the final /-t/ is the plural marker. Other forms may show an alternation between voiced and voiceless consonants in both onset and coda clusters. This contradicts Lombardi’s (1991:176) claim that Georgian is a language ‘with no neutralization or spreading of laryngeal features in consonant clusters’.

In Hupa (Athabaskan; Woodward 1964; Golla 1970, 1996; Gordon 1996), which has voiceless unaspirated, aspirated, and ejective stops and affricates, syllable-final consonants may be only voiceless or glottalized, but not aspirated. In these sources, I have not been able to locate active morphophonemic alternations. Instead, there appear to be simply phonotactic constraints, such that no aspirated stop appears finally, while ejectives may. Some examples follow, where (a) illustrate final ejectives, and (b), final voiceless stops:

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Lombardi analyzes this language as having a constraint on only the feature [s.g.] (not the whole Laryngeal node, since ejectives may occur finally), which is licensed only before a tautosyllabic [+son].

Another language with a similar constraint against aspirated stops is Tol (Hokan; I. Lombardi 1977). There are three series of stops and affricates: plain voiceless, voiceless aspirated, and ejective, e.g. /tśats/ 'mouse', /tś'ats/ 'thin' and /tś/ 'honey'. Syllable-finally there is only a contrast between ejective and non-ejective; utterance finally, Fleming and Dennis note, nonejective stops have 'at least some degree of aspiration' (122). Following Lombardi, I analyze Fleming and Dennis' notation of final aspiration as simply release; the authors primarily use a (morpho)phonemic transcription which does not reflect deaspiration. In the following cases, underlying aspirates are deaspirated word-finally; Fleming and Dennis do not indicate the meaning of the vowel-initial suffix:

\[(35) \quad \begin{array}{ll}
\text{sit} & \text{sit}^h\text{-in} \\
\text{tśets} & \text{tśets}^h\text{-em} \\
lup & \text{lup}^h\text{-uk} \\
\text{ha'lek} & \text{holo'k}^h\text{-es}
\end{array} \]‘avocado’
‘tortilla’
‘hail’
‘bow’

In the data listed below, ejectives do not lose their ejection word-finally.

\[(36) \quad \begin{array}{ll}
\tilde{\text{matś'}} & \text{mośts'}^h\text{-ik} \\
\tilde{\text{tśets'}} & \text{tśets'}^h\text{-em} \\
\text{tit'} & \text{tśt'}^h\text{-im} \\
\text{wit'} & \text{wit'}^h\text{-is}
\end{array} \]‘toasted corn drink’
‘giant’
‘louse’
‘firewood’ (Fleming and Dennis 1977:122-23)
Thus this provides additional evidence against the Unified Laryngeal Features Hypothesis, discussed in Chapter Three, and in favor of the relative independence of laryngeal features.

4.5. Dialectal Variants

In this section, data is presented in which one dialect has ejectives where another dialect does not. Since it is not always clear whether the correspondence between ejectives in one dialect and a plain obstruent in another represents a synchronic rule or constraint of deglottalization, or whether it reflects a diachronic sound change involving loss of ejection in one dialect, the evidence is presented in this separate section. First I will examine dialects in which the feature [c.g.] is no longer phonologically relevant. Then we will observe a variety of cases involving deglottalization in which the feature is lost in certain positions or in certain places of articulation.

4.5.1. Complete Loss of [c.g.]

Rice (1978) discusses deglottalization in Resolution Chipewyan (RC), which now has only voiceless unaspirated and voiceless aspirated stops or affricates. Compared to the Central Chipewyan described by Li (1933a, 1946), ‘glottalized consonants have disappeared, merging with the unaspirated series of consonants. No glottalized consonants were found in RC, either in stems or prefixes’ (144). Ejectives are widely assumed to be present in Proto-Athabaskan (Cook 1981), so they are not an innovation of Central Chipewyan. I present Rice’s examples, with transcription normalized for the IPA:

<table>
<thead>
<tr>
<th>Central Chipewyan</th>
<th>RC</th>
<th>Gloss</th>
</tr>
</thead>
<tbody>
<tr>
<td>-i's</td>
<td>e'i's</td>
<td>‘paper’</td>
</tr>
<tr>
<td>i'o</td>
<td>i'o</td>
<td>‘grass’</td>
</tr>
<tr>
<td>i'a ‘bottom’</td>
<td>i'a'e</td>
<td>‘pants’</td>
</tr>
<tr>
<td>t'o'an, t'o'ané</td>
<td>tódééné</td>
<td>‘leg, bone’</td>
</tr>
<tr>
<td>i's'a</td>
<td>i'se</td>
<td>‘hat’</td>
</tr>
<tr>
<td>i's'i</td>
<td>i'si</td>
<td>‘canoe’</td>
</tr>
<tr>
<td>e'i's'uži</td>
<td>i'suz</td>
<td>‘beads’</td>
</tr>
<tr>
<td>?álk'etaye</td>
<td>két'a</td>
<td>‘six’</td>
</tr>
<tr>
<td>?álk' étayi</td>
<td>kéti</td>
<td>‘eight’</td>
</tr>
<tr>
<td>t'uk'e</td>
<td>k'uke</td>
<td>‘lake’</td>
</tr>
<tr>
<td>t'éθ, t'e, t'éθ</td>
<td>kéástéθ</td>
<td>‘bread’</td>
</tr>
</tbody>
</table>
In Resolution Chipewyan, then, the feature [e.g.] has been lost completely, and lexical entries have been reanalyzed as consisting of plain voiceless stops and affricates, a result of merger. This is an important precedent for the Glottalic Theory, which requires the complete loss of glottalization in such language families as Germanic.

Cook (1989) reports on field work conducted in Fort Resolution with a variety of speakers, including older and monolingual speakers (unlike Rice's younger speaker). Cook believes that while one may analyze the loss of glottalization (and other changes) as merger, it may also be seen as 'a phenomenon of retarded or underdeveloped phonemic contrasts' (246) from the point of view of language acquisition. Both perspectives, however, point to the loss of ejectives and their merger with a voiceless series.

Shaw (1980:21) observes that in Stoney, a Dakotan dialect, 'the ejective series has been lost, neutralizing with the voiceless aspirated series (except in the speech of a few old and very conservative speakers).’ There are also no glottalized fricatives. Cook (1995) examines the Stoney spoken by residents of the Paul Band in Duffield, Alberta. The ejectives of fluent speakers are replaced by voiceless unaspirated stops, not under the influence of English or Cree, which are spoken in the area, but due to internal motivation, and not convergence, in Cook’s view. Here are some examples:

(38) Fluent speakers | Semispeakers
---|---
ijtâp'ip'în | tapîpîn | 'eyelashes'
p'optâkîa | poptâkîa | 'cranberry'
t'at'át | tatát | 'paralyzed'

Of the three Stoney reserves in Alberta, only in Morley do children acquire Stoney as their first language, and it is in this dialect that the ejectives /p', t', ts', k'/ are completely merged with the aspirated counterparts. Conservative speakers in the Paul and Alexis reserves maintain the ejectives, though in those dialects they ‘occur relatively rarely’ (Cook 1995:227). Additional Stoney data may be found in Shaw (1980, 1985, though this latter work is not comparative in nature).

In another Siouan language, Quapaw, which is a dying language, Cook (1995, citing Rankin 1978) reports that in the speech of semispeakers, 'ejectives are deglottalized and aspirates are deaspirated to merge with the corresponding voiceless (tense) counterparts’ (1995:227). Siebert (1989) shows ejectives, but is based on data gathered in 1940.
Dolgopolsky (1977:1) describes the realization of 'emphatization' in all Eastern Neo-Aramaic dialects: it is either ejection, half-glottalization, or non-aspiration (and non-glottalization), but is always accompanied by 'a backward movement of the tongue and a recession (backward movement) of the adjacent vowels or of the whole word to which the "emphatic" consonants belong' (1977:1-2, fn 2). Dolgopolsky assumes that the original Neo-Aramaic dialects (as well as Proto-Semitic) had ejectives. In some Neo-Aramaic dialects such as Tür-‘Abdīn, the emphatics are realized as voiceless non-aspirated (that is, they have deglottalized), while the non-emphatic voiceless consonants are aspirated.

I should point out that the assumption that ejectives are original (in Proto-Semitic) is controversial, though this theory is the probably majority view (Alan Kaye, p.c.). Scholars who believe ejectives existed in Proto-Semitic include Bergsträsser (1928), Martinet (1975 [1953]), Sasse (1981), Bomhard (1988), and Zemánek (1990). Hetzron (1992:413) acknowledges that 'only guesses may be made about the dead languages', but he states that the 'glottalized articulation' of emphatics 'is generally reconstructed for Proto-Semitic'. This point is also affirmed by Wedekind (1994:1148). More traditional reconstructions are found in Gray (1924), Leslau (1945c), Moscati (1964), and Kaye (1986, 1997).

Job (1989:132), citing Talibov (1980), observes that deglottalization was unconditional and resulted in unrestricted change in Udi, a Daghestanian language, which, he claims, is the only Caucasian language which lacks ejectives. This is apparently true of only the Nidz dialect, as Catford (1992:194) cites Talibov (1974) and a personal communication from S. Kodzasov. Catford confides in the quality of his sources, but also notes that in his own work with a speaker of the Vartashen dialect of Udi, the ejectives have a short VOT, averaging 27 ms, which is 'not far above the threshold for perception of such an interval' (1992:194). The description of Udi given in Pančvidze and Džejranıšvili (1967) also makes use of ejectives in the transcription.

Schulze-Fürhoff (1994:453-4) notes that in Udi, the ejectives are subject to variable phonetic representation, apparently depending on the degree of aspiration found in the voiceless aspirates. Generally, Udi has a triadic series of voiced, voiceless, and ejective stops.

'The voiceless stops /p/, /t/, and /k/ are clearly aspirated in the dialects of Nidz and Oktomberi (pʰ, tʰ, kʰ), but less aspirated in Wartašen. The realisation of the "ejectives" depends on that of the voiceless stops: the more aspirated the stops, the less glottalized the "ejectives". In general we can say that the "ejectives" are clearly
glottalized in the language of elder speakers in Wartašen and Baku, but more and more unmarked elsewhere. Thus, the following varieties can be observed:

<table>
<thead>
<tr>
<th>glottalized</th>
<th>neutral</th>
<th>aspirated</th>
</tr>
</thead>
<tbody>
<tr>
<td>k'</td>
<td>k</td>
<td>Ø</td>
</tr>
<tr>
<td>k'</td>
<td>Ø</td>
<td>kʰ</td>
</tr>
<tr>
<td>Ø</td>
<td>k</td>
<td>kʰ</td>
</tr>
</tbody>
</table>

'As the general binary opposition is preserved, disregarding the phonetic realization, the traditional interpretation of the "ejective" set as being glottalized can be maintained in a phonemic description. This also facilitates comparison with other Lezgian languages.'

In short, the phonetic realization of the voiceless stops and the ejectives seems to be interrelated. The more aspirated the voiceless series, the less ejective, even to the point of apparent deglottalization, is the glottalic series. Colarusso (1988:81-82) makes a similar point for some East Circassian varieties.

In some Laz dialects, the ejectives have been replaced by simple voiceless unaspirated stops (p.c. from G. Charachidze to J.C. Catford cited in Catford 1992:193); unfortunately no examples were provided. However, see the examples cited by Holisky (1991), and described below in §4.6.

In sum, there are several dialects which have completely deglottalized their ejectives, while sister dialects have retained them. These include Resolution Chipewyan, Stoney Dakotan, Quapaw, Tür'-Abdîn Neo-Aramaic, the Nidż dialect of Udi, and unspecified Laz dialects. The sound change required by the Glottalic Theory that some Indo-European languages undergo loss of glottalization is thus well attested on typological grounds, and simple to express in phonological terms as the delinking (and loss) of the feature [e.g.]. We next examine cases of deglottalization in which the feature [e.g.] is still active in the phonology of the dialect in question, though it is neutralized in some contexts.

4.5.2. Other Cases of Deglottalization

Much interesting and important work on ejectives has been conducted by Job (1984, 1989), for the explicit purpose of exploring the phonological behavior of ejectives in light of the Glottalic Theory of Proto-Indo-European. In his pathbreaking (1984) paper, he found fairly widespread occurrences of deglottalization in the languages of the Caucasus. Citing Mejlanova (1964:192 ff.), Job found (partial) deglottalization in the spoken Usux-Čaj variety of the Dokuzpara dialect of Lezgian, where ejectives in the literary variety correspond to plain voiceless stops in the spoken language. Both languages preserve
corresponding voiced and voiceless sets. Facts from other dialects suggest that the forms with ejectives are older, and hence that deglottalization is an innovative process (see Talibov 1980). Representative examples are shown below.

(39) Literary | Spoken | Gloss
---|---|---
k'el | kel | 'lamb'
k'anda | kanda | 'want'
t'ur | tur | 'spoon'
fut'q'u | jotqu | '(kind of hat)'
q'adar | qadar | 'measure'
kʰup' | kʰup | '(Russian) kizjak'
balk'an | palkan | 'horse' (Job 1984:35)

The deglottalization does not generally affect apical affricates like /s'ud/ (e.g. /s'ud/ ‘ten’ in literary vs. /s'id/ in the spoken dialect). Bokarev (1981) provides some data which show that glottalization is found in other Lezgic languages. The first word in (39) ‘lamb’ /k'el/ is /k'al/ in Agul, and /k'u/ in Xinalug. Some of the words with velar ejectives derived from lateral ejective affricates *ti' or *dd' (Bokarev 1981, Nichols 1993).

A similar process is also reported for the Migragh dialect. The deglottalization is not exceptionless, but I do not have more information on its domain. Deglottalization also occurs in certain grammatical alternations, as shown below (Job 1984):

(40) Lit. & Spoken | Gloss | Lit. | Spoken | Gloss
---|---|---|---|---
netʰ | 'louse' | nit're | netre | 'louse-erg.'
wakʰ | 'pig' | wak'az | wakaz | 'pig-dat.'

Nichols gives an approximant reconstruction of Proto-Nakh-Daghestanian ‘wild boar, wild pig’ as *(bV)tʰ'o. Compare Literary /wak'/ with Udi /boq'/ and Lak /burk'/. It is therefore probable that the ejectives of Literary Lezgian are the historically more conservative form and that the dialects mentioned are innovative.

Haspelmath (1993:22), citing Talibov (1980:71-72) notes that in the Axceh dialect of Lezgian of which Dokuzpara (Doquzpara) is one subtype, the dialect alternates between plain and aspirated, while the standard alternates between ejective and aspirated:
(41) Standard Axche dialect Gloss
nek'er / nekʰ neker / nekʰ 'milk'
met'er / metʰ metar / metʰ 'knee'
req'er / reqʰ reqer / reqʰ 'way'

In sum, these Lezgian dialects show a parallel example to the process required by the Glottalic Theory, although the feature itself was not completely lost.

Job (1984) also reports that according to Mikailov (1959), deglottalization occurs in the spoken Khujada variety of the South Avar Andalal dialect. Many of the Daghestanian languages have an intensive (also called strong, fortis, or sometimes geminate) series, which is realized on both voiceless and ejective consonants in the Avaro-Andi languages. For stops, they are strongly affricated, and intensive affricates are unaspirated with lengthened affrication (Catford 1977:289, 1992:199-200). Examples are shown below, which are phonemically transcribed (phonetically, they would show only a single release):

(42) Lit. Spoken Gloss
ts'ts'oko tstsoko 'skin'
antst's' m atsts 'language'
t't'eze tftTeze 'stand still'
ratT'o 'tail'
Tunk'k' Tunkkk7 'mouse'

Job (1984) has made the following observations regarding the behavior of ejectives, with respect to deglottalization, followed by my comments in parentheses:

- Lezgian dialects which contain four types of stops do not introduce voiced stops during deglottalization but unaspirated voiceless stops. (This falls out naturally if we view deglottalization as the delinking of the Laryngeal node, and if, as Lombardi has proposed, an obstruent with no Laryngeal node is interpreted as voiceless unaspirated. See Chapter 7 for more on ejective voicing).

---

7 The original transcription in Job's article used the Soviet Caucasologist symbol ʘ to represent the voiced pharyngeal fricative; I have normalized it in accord with the IPA. Catford (1992:202) contains a waveform of an initial intensive velar ejective in the related language Avar.
• South Avar dialects showed a preference for deglottalizing coronal affricates, which changed to voiceless affricates. (Perhaps deglottalization of affricates results from the relative difficulty of maintaining a glottalic egressive airstream during production of the fricative component of an affricate ejective. See Ladefoged and Maddieson (1996:178) for the relation between ejection and fricatives).

In his summary, Job (1984:36) concluded that 'Deglottalization is by far more common than glottalization'. This seems to be in accord with the observation that lenition is often more common, ceteris paribus, than fortition (e.g. Hyman 1975:161-170, Lass 1984:177-83, Hock 1986:80-96, Donegan 1993:109). And nonlinear phonological theory has encoded this in the basic operations of spreading and, in the case of deglottalization, delinking of association lines, as opposed to the marked process of feature changing or using marked features such as [constricted glottis] as defaults.

Next we turn to the native languages of the Americas. Kari and Buck (1975) mention several dialectal variants involved in Ahtna (Athabaskan). In particular, there are several variants in the pronunciation of the glottalized consonants at the end of a word (or the last glottalized consonant in a word). While Central and Western dialects maintain the glottalized sounds, the Upper Ahtna dialect deglottalizes the sound to a plain obstruent (written in Kari and Buck as a voiced stop, but here as a voiceless unaspirated obstruent), opposed to aspirated and glottalized stops. For example, Central (C) and Western (W) dialects use /kets/ for 'mittens', while the Upper (U) dialects use /kets/. Likewise, for 'mink', C, W have /tʰeht's'uuts'i/ while U has /tʰeht's'uutsi/ (1975:xvi). The other glottalized consonants are deglottalized in U:

<table>
<thead>
<tr>
<th></th>
<th>C, W</th>
<th>U</th>
<th>Gloss</th>
</tr>
</thead>
<tbody>
<tr>
<td>hwtʰii'</td>
<td>hwtʰii'</td>
<td>hwtʰii'</td>
<td>'potlatch'</td>
</tr>
<tr>
<td>ḫatʃ'ukat'i</td>
<td>ḫatʃ'ukati</td>
<td>'ball game'</td>
<td></td>
</tr>
<tr>
<td>tʰaak'i</td>
<td>tʰaaki</td>
<td>'three'</td>
<td></td>
</tr>
</tbody>
</table>

There are thus at least several cases of deglottalization in Ahtna dialects. Kari (1979:11) notes that stem-final [k' and [q'] are deglottalized to [k] and [q] in the Mentasta-Batzulnetas dialect of Ahtna.

In Berta (Nilo-Saharan; Andersen 1993), the uvular [q] and the palatal [tʃ'] are allophones in the native lexicon, though they are contrastive due to Arabic loanwords. To a
certain extent, they are free variants, as in [tʃʰɛdɛ̞ - qɛdɛ̞] ‘his, hers, its’. More usually, though, the voiceless uvular occurs before back vowels and the palato-alveolar ejective, before front vowels.

(44) **Uvular stop**

| qâfàa    | ‘blood’    | ߶tʃʰirà | ‘cut!’    |
| qôf| ‘oil’    | ߶tʃʰéŋ | ‘basket’ |
| qûrfeè | ‘boat’    |        |          |
| âbɔmbôq | ‘dewlap’  |        |          |
| d’aqàq | ‘throw!’  | dâtʃʰí | ‘throw PRES’ |
| s’àas’áq | ‘falling’ (verbal noun) | s’atʃʰí | ‘fall PRES PART’ |

(45) **Alveopalatal ejective**

| dùqà | ‘food’ | dùqêe | ‘foods’ |
| lûntʃʰùu | ‘of body oil’ | lûntʃʰí | ‘body oil’ |

Andersen notes there are also roots which violate the tendency:

(46) s’atʃʰàl-à ‘chew!’ ʃéeqè ‘sand’

bûs’uqêe ‘body’

He believes that the phonetic motivation for the [q] – [tʃʰ] variation might be found in a historical explanation by way of interdialectal variation. The Berta spoken by one of Andersen’s consultants from Begi in the Asosa district of Ethiopia has a velar ejective [k’] which corresponds to both [q] and [tʃʰ] in the Abeegu dialect. He proposes that this Begi dialect is conservative in that [k’] has become ‘uvular and non-ejective before non-front vowels’ and palatal before front vowels. Berta has the bilabial ejective [p’] and the ejective fricative [s’], which have not deglottalized. However, for the velar place of articulation, when it was backed, ejection was apparently incompatible and so deglottalization occurred.
Finally, I mention a few minor, irregular cases of deglottalization. Stroomer (1987:18) discusses the sporadic loss of glottalization of /k/ in various Oromo (Cushitic) dialects of Garsen and Garissa (O) and the Waata dialect (W):

(47) OW mak’aa ‘name’
    OW makaa id.
    W k’uwaqqa ‘I settle, live somewhere’
    W kudaqqa id.
    W k’aara ‘corral’
    W kaara id.
    O k’adzeela ‘straight’
    O kadzeela id.
    OW kunjoo ‘(swollen) navel’ cf. Boraana k’unjoo

There thus appears to be only limited deglottalization in Oromo.

Tucker (1929:51) notes that in Suto-Chuana (Sotho-Tswana) in the Northern Transvaal, ejectives have ‘no simultaneous glottal closure, and the plosive is very weak, reminding one of the “devoiced” b d g heard in the pronunciation of many English speakers.’ This, then, suggests deglottalization of ejectives, though David Odden (p.c.) notes it may be a conservative feature, since glottalization of unaspirated consonants ‘is an areal innovation in Southern Bantu’. Finally, Chirikba (1996:69) notes that in the Sadz dialect of Abkhaz (Northwest Caucasian), there has been deglottalization of the labiodental fricative in the morpheme ‘thin’: *a-f’a > a-ffa.

In this section, we have examined data from various dialects and seen that some dialects differ from others in lacking ejectives. This suggests a process of deglottalization in those dialects which lack ejectives, either in one place of articulation or in one environment, or for the series as a whole. We turn next to look at deglottalization as an apparently free variant, and as a strategy for loanword adaptation.

4.6. Free Variation and Loans
Deglottalization is also in evidence in so-called free variation and in loanword phonology in languages all over the world. For example, in Chipewyan (Athabaskan; Scollon 1979:333), deglottalization appears to be in free variation. Scollon does not specify the dialect, though Cook 1991 observes that it is the Fort Chipewyan variety studied in Scollon
and Scollon 1979. In addition to Scollon’s data, I supplement it with that cited in Cook (1991):

(48) \(?erefî’s ~ ?erefî’is\) ‘he wrote, paper, mail’  
\(\text{ts’ékwi} ~ \text{t’ékwi} \sim \text{tâjéwi}\) ‘woman’  
\(?et’axâ ~ \text{taxâ}\) ‘suddenly’

Another form, \([\text{telt}’î]\) is realized in Fort Chipewyan as \([\text{telt’}i]\) ‘they were sitting’, in which deaffrication (but not deglottalization) took place. Scollon cites Rice (1978), who, as we have seen, notes that in Fort Resolution Chipewyan, there has been complete loss of glottalization on consonants. It is interesting to see, in a sense, the process of deglottalization move from free variation in the Fort Chipewyan variety described by Scollon, to completion in Fort Resolution Chipewyan. However Cook criticizes the Scollons’ data, noting that ‘these changes are more sporadic and idiosyncratic, unlike the shift of alveolars to alveopalatals in the innovative speech of fluent speakers, nor do they occur in the speech of competent Chipewyan speakers’ (1991:428).

Tsimshian (Penutian; Dunn 1979) has three stop series: aspirated, glottalized and plain, which Dunn claims is voiced. Dunn reports that in Tsimshian ‘glottalized segments often simplify by losing the glottalization and then becoming voiced’ (1979:12). Thus both ejectives and glottalized sonorants can deglottalize and then become voiced, apparently optionally. Examples are presented in the order given in Dunn:

(49) \(k’\text{wil}i\) \(\text{gwili}i\) ‘three (general number)’  
\(\text{gasgoos}\) \(q’\text{asq’}oos\) ‘crane, stork’  
\(q’\text{asq’}adzn\) \(\text{gasgadzn}\) ‘ants’  
\(\text{ts’awes}\) \(\text{dzà}’\text{west}\) ‘salal’  
\(\text{caldzap}\) \(\text{cals’ap}\) ‘town’  
\(?\text{naaxl}\) \(\text{naaxl}\) ‘killer whale’  
\(?\text{naa}\) \(\text{naa}\) ‘bait’

If we treat the plain series as not voiced, but simply voiceless unaspirated, opposed to the aspirated and glottalized series, then the alternations shown above may simply be considered deglottalization. Otherwise, if there is reason to treat the plain series as
phonologically voiced, then there appears to be true feature changing (generally a powerful device which nonlinear phonology has tried to avoid). The other method is to undergo a two-part process of delinking followed by voicing (see Chapter 7 on ejective voicing). At any rate, Tsimshian displays variable loss of ejection.

For Squamish (Salish), Kuipers (1967:40) recorded root-final ejective in /jit'j/ 'be all around' as /tj/ in /jî'tj/ 'round'. And compared to Cowlitz /mit'/ 'blue grouse', he recorded Squamish /mu'-m?i-t-m/ 'id.' He also notes that 'It is not impossible that /?K/ and /?K'/ are in free variation in Squamish', where ?K stands for an obstruent, though it is unclear whether this is optional deglottalization or possibly spreading of [e.g.] from the glottal stop onto the obstruent.

Holisky (1991:406) notes that in Laz (Kartvelian), 'there seems to be a tendency toward loss of glottalization in clusters...especially those with /k'/, citing Dumézil (1967:1), who reports that /sk'/ and /fk'/ have become /sk/ and /fk/ in the speech of his informant. Laz also has variation between plain and glottalic stops, especially from Turkish borrowings, where there was no original ejective, e.g. /fuk'ara ~ fukara/ 'poor', /saat'i ~ saat/i 'hour', and /ark'adafi ~ arkadafi/ 'comrade' (1967:2). However, the ejecitivization of voiceless stops in foreign loanwords is normal in Kartvelian (Aronson 1997:938). Holisky implies that this is loss of glottalization, but perhaps it is simply a doublet. Almost all of the speakers of Laz live in Turkey, and all who live there are bilingual in Turkish (Anderson 1963:5). Thus the nonglottalized case may be adoption without nativization because of this bilingualism.

In Svan (Kartvelian), Harris (1991b: 20) reports that there is some variation between /ts'/ and /s/, and /tʃ'/ and /ʃ/, with apparent loss of affrication and ejection. Paris (1974) describes the Besney dialect of East Circassian and notes some interesting alternations between ejective stops and their cognate pulmonic fricatives. At times the alternations appear to be in free variation, but in other cases there appear to be semantic distinctions based on the deglottalization and lenition processes.

(50) χ̅/b̅/q̅w ω.χ̅e.jə.yə.n \{ 'gather together, accumulate' ω.b̅e.jə.yə.n \}
z[a:ʃ] 'e.q̅w.e.yə.n \{ 'assemble, reunite'
χ̅/k̅'w'/w g*a.χ̅e ~ g*a.k̅'e ~ g*a.w.e 'acid (taste)'
χ̅/k̅w/ w.χ̅e.jə.yə.n \{ 'to make something soft round' ω.k̅.e.yə.jə.n \} 'to roll a round object'

180
The data above support Kingston’s Binding Hypothesis (2), which states that laryngeal contrasts are more commonly found among stops because of their release, than among fricatives. When the Besney ejective stop spirantizes, it loses its glottalic component. Though there are ejective fricatives, as in Kabardian, they are typically rare and often alternate with affricates (cf. Amharic [Sumner 1957], and Dime [Fleming 1990:506]). Fleming 1990, for example, says that ‘both [s’] and [ts’] occur initially but the problem is one of hearing them distinctly. None of my Dime informants seem to have been able to distinguish between these allophones in initial position. In other positions it is virtually impossible to tell them apart.’ Bender (1992:53) also notes the alternation in Amharic, where ‘s’ (sometimes pronounced [ts’]) yields to t’ in Shewa Province (e.g. s’Ahaj ‘sun’ > t’Ahaj).

In Yapese (Malayo-Polynesian; Jensen 1977:104) there is variation in locative prefixes between /p’e/ and /pe?/. In this apparent case of fission (see Chapter Eight), the removal of the glottalization on the stop results in a separate glottal stop—one segment becomes two (or conversely the labial plus glottal stop are fused into one segment). For more on Yapese, see §8.4.2.2.

In Ik, (Kuliak; Heine 1975) /ts’/ is ‘occasionally’ realized as /ts/. They are phonemically distinct, as shown by the minimal pair:

(51) ats ‘come!’
ats’ ‘chew!’

However Heine does not specify when deglottalization takes place.

Appleyard (1975) notes some deglottalization in an older stratum of loans from Amharic into Kemant (Cushitic):

(52)  
\begin{tabular}{ll}
\hline
Amharic & Kemant \\
\hline
‘t’abbabä & jaabä ‘be narrow’ \\
‘j’anä & jan ‘load’ \\
‘t’amä & tam- ‘taste’ \\
‘k’addämä & kädäm ‘be in front’ \\
\hline
\end{tabular}

Tucker and Bryan (1966:357) report that in Uduk (Nilo-Saharan) there is variation between plain and ejective consonants, at least in the following words: /ākä ~ āk’a/ ‘dog’
and /a ~ t’a/ ‘to be’. However, Robin Thelwall (p.c.) notes only the forms /ak’ə/ for ‘dog’ and /ə/ for the copula, and he tells me that Beam and Cridland’s dictionary cites these forms the same as he does; he reports no ejective variation in the dialect he investigated. Thelwall speculates that such variation could be from another dialect, or due to the nature of Tucker and Bryan’s questionnaire.

In this section, we have seen various examples of deglottalization in free variation and in loanword phonology. We have already seen how dialects can differ with respect to deglottalization and so we will finish with deglottalization from a diachronic perspective.

4.7. Diachronic Data

In this section of the chapter, we will examine potential cases of diachronic deglottalization, which is especially important for the Glottalic Theory. In the traditional reconstruction of Proto-Indo-European, Series I, the traditional voiced stops, remained largely voiced, but they devoiced in Germanic and Armenian, contrary to the lenition hierarchy (e.g. Foley 1977, Hock 1986; see also Mohanan 1993), in which sounds generally become more sonorant when they weaken. Compare this shift, for example, with the clear lenition of e.g. Pre-Germanic voiceless aspirates becoming voiceless spirants. If we take the Tocharian writing system at face value, then they devoiced in Tocharian as well, as indicated in introductory handbooks such as Baldi (1983:147) and Beekes (1995:127). These handbooks (and Watkins 1992:2092) also indicate devoicing in Hittite (though the interpretation of the writing system and the Sturtevant’s Law phenomenon are somewhat controversial). Under the Glottalic Theory, these languages must undergo deglottalization to become a voiceless series.

Gamkrelidze and Ivanov (1995:31) posit that evidence of prior glottalization in Germanic may be found in the Danish stød, and ‘a similar phenomena in North Germanic dialects, e.g. Icelandic [va’tn] ‘water’’. Series II, the traditional voiced aspirates, alternate allophonically between aspirated and unaspirated voiced stops and yield voiced stops initially and voiced fricatives medially. Series III, the voiceless stops, analyzed by Gamkrelidze and Ivanov as aspirated, spirantize. Because Germanic preserves PIE traits with respect to aspiration and voicing, they claim that if anything ‘the Germanic phonological system is archaic’ (36). They claim that ‘the major changes in the Germanic stop system are essentially limited to the phonetic process of spirantization of Series II and III allophones’ (35-6). However, this statement neglects the fact that phonologically, the feature [constricted glottis] no longer plays a role in the phonology, and the laryngeal
features of [voice] (and allophonically, of [spread]), have simplified to a system of voicing. Subsequently, of course, there has been lexical reanalysis involving the features [c.g.] and [continuant]. The Armenian and Tocharian Series I stops are handled in roughly the same way.

Curiously, Gamkrelidze and Ivanov provide very little typological support for the process of deglottalization, citing only the case of Lahu (Matisoff 1970), which 'under certain phonetic conditions' loses glottalization, turning it to high tone. This example was used as a parallel for the suprasegmentalization of glottalization in Germanic. However, Lahu is a Southern Lolo language of the Lolo-Burmese group, and these languages do not have ejectives. Indeed, Solnit (1992:112-113) denies that there were even glottalized unit consonants in Lolo-Burmese (though he does acknowledge the tonal influence of what was a glottal stop prefix). (See also the refutation of Job’s analysis in §4.7.3). Gamkrelidze and Ivanov do provide some historical parallels for voicing of the glottalic series, the other dramatic change required in the Glottalic Theory which we will discuss in Chapter 7, so typological confirmation of deglottalization processes is imperative if the Glottalic Theory is to be consistent with its emphasis on both synchronic and diachronic typology.

Some critics of the Glottalic Theory have doubted the possibility of ejectives becoming voiceless stops. Awedyk (1993:263), for example, has claimed that 'a direct development of PIE ejectives into voiceless stops in Proto-Germanic bears a low phonetic plausibility'. As this chapter has shown so far, this is ample evidence to refute Awedyk’s estimate of phonetic plausibility. In neutralization, ejectives often become voiceless non-glottalic consonants (e.g. Klamath, Maidu, Lezgian), which is analyzed as the loss of the Laryngeal node or a laryngeal feature—a direct development, though their deglottalization is conditioned. And in cases of permanent feature loss, ejectives are merged with the voiceless series (e.g. Fort Resolution Chipewyan, Stoney Dakota, and Udi). The rest of this section will provide diachronic evidence for deglottalization, with subsections on the languages of Africa, the Americas, and the Caucasus. However, many of the reconstructions are only in their initial stages, and so some data should be treated with caution.

4.7.1. Languages of Africa

In Bender’s (1987) ‘first step toward Proto-Omotic’, he has reconstructed segments which undergo deglottalization. (See also Leslau 1952, Bender 1988, Fleming 1988). Bender (1988:124) states that Janjero has no glottalics, though its sister languages do, thus
indicating complete deglottalization. For example, *t' and *ts' deglottalized in Janjero (but
remain a glottalized implosive or ejective in other languages). Janjero's reflex of *s' is /t/,
and its various reflexes of *c' are all deglottalized. The affricate /ts'/, Bender observes, is
often realized as [ts] in final position (25). Janjero also has deglottalized its reflex of *k' in
initial position, (while voicing it medially and sometimes finally, and debuccalizing it in
final position). Compare, for example, Gimira /k'ets'/ ‘warm’ with Janjero /kitju/. And
compare Omotic groups 1-3 (01-3, e.g. Welaitai, Kullo, Malo, Chara, etc.) /k'aš'/
‘scratch’ with Janjero /kaʔ/ (1988:150). Compare also PO *t' am ‘breast’ with Janjero
/tam-/ vs. Gimira /t' jam-/ Dizoid /t'iam/ etc. PO *tj'ub ‘smoke’ is /tjuuwa/ in Janjero,
while it’s /tj'uba/ in Dizoid and /tj'ub/ in Aroid (Bender 1988). Here are several more
correspondence sets from Bender's 1988 reconstruction of Proto-Omotic:

(53)  Gloss  PO  01-3  Gim  Jan  06  07  08
‘root’  *ts’ap’  įs’aB  įs’ap’/m3  tas(s)a  Kf. įs’ap’o.
      įT’ammo
‘bite’  *saT’  sat’s  saT’/1  jašs  jaC
‘smoke’  *tj’ub  įj’UB  įj’ubl  įjuuwa  įs’u(b)
‘louse’ n/a  įj’u(gu)įj  įs’uš/4  tuʔa
‘scratch’ *k’Vts’  k’aT’  kaʔ  Kf. k’uįj  k’unıš’
‘warm’ n/a  k’ets’/1  kįτju  Kf. keeC  Dz. k’ešua

Thus there appears to be abundant evidence for complete loss of glottalization in Janjero.
Loss of glottalization is also found sporadically in other Omotic languages.

Wedekind (1979:151) observes that in word initial position, Sidamo (Highland East
Cushitic) /k/ can correspond to Burji /k'/; for example Sidamo /kurre/ ‘mouse’ corresponds
to Burji /k’unturee/ There are instances in both languages in which /k/ corresponds to /k/,
so this suggests a loss of glottalization in word-initial position in Sidamo. This is in accord

8 Bender's abbreviations are as follows: 01 is North Omotic, divided into the Welaita
cluster, Basketo-Doko-Dolo, and Malé. 02 is South Omotic, with its three branches
Zaisé-Zergula, Koré-Gidichio (Haruro), Gatamsé, and Ganjulé. 03 is Chara, while 04 is
Gimira (Gim), Bensho, and Shé. Janjero (Jan.) is 05, while 06 is Gonga (Kefoid),
North Gonga (Kefa [Kf.-Mocha], Central Gonga Anfillo, and Bworo. 07 Dizoid refers
to Dizi (Dz), Sheko, and Nao; Mao is 08, along with Hozo-Sezo, and Mao of Bambeshi.
Finally, 09 is Aroid: Ari, Hamer-Kara, and Dimé. PO refers to Proto-Omotic. In the
transcriptions, B = (b/p/t/w) and C = an undetermined consonant.
with the reconstructions proposed by Arvanites (1991) and Ehret (1995). Leslau (1952),
citing the Italian scholar Cerulli, notes that 'The alternation t':t seems to be rare in the
Sidamo group. Note Sidamo ut't'a 'fence': Hadiya wotâ (Cerulli 193), and Sidamo futta
'cotton': Hadiya fut'ô (Cerulli 200'). Although the alveolar alternations are thus apparently
rare and irregular, the velar correspondences suggest deglottalization.

Hayward (1984:30) shows that in the Cushitic language Elmolo, deglottalization of
velars took place word-finally, compared to its retention in the sister Galaboid language
Arbore, as the following examples show:

(54)  Arbore     Elmolo
     neek'     neek    'lion'
saak' / ʃaak'  saak    'fever'
diik'     diik    'blood'
waak'     waak    'God'
fak'-     fak-    'add to'

Between sonorants and vowels, there is evidence that the same process occurred.

(55)  Arbore     Elmolo
     -ek'es-    ekis    'kill'
     reek'a    rreka 'back'
     bili[ʔi]to (< /bilik'-to/)  pir(i)ka    'lightning'
     ?iʔ!i zaŋk'ođe  ijaŋkođe    'I dreamt'
     fak'a     faka    'add to (p)!'

For initial position for at least Proto-Eastern-Cushitic *k', Sasse (1979: 47) reports a reflex
of a glottal stop in Elmolo (see Chapter 5 on Debuccalization), though in some cases,
Elmolo's reflex is a voiced implosive [g] (Sasse 1979, Dolgopol'sky 1977:7). Sasse
(1979:48) reconstructs PEC *k'ab 'cold' and we see retention of the ejective in Galla
/k'ab-an/ and Gidole /k'ap-p-an-aw/ 'become cool', with deglottalization in Arbore in
initial position /keb-eta/, and deglottalization and uvularization in Somali /qab-ow/ and
Konso /qap-p-an-agaw/ 'become cool (of liquids)’. Thus this change is best expressed as
loss of velar ejectives in Elmolo.
Leslau (1952) has uncovered a wealth of examples involving deglottalization in Ethiopic Semitic9. He believes this pattern is due to influence from Sidamo, a Highland Eastern Cushitic language which we have seen above, though given the commonness of deglottalization, I do not think that Leslau is correct in this assumption. Concrete examples are given below in (56) and (57) below, where it may be observed that in almost all the languages, there is deglottalization of at least some of the words containing the velar ejective /k'/-yet this phenomenon seems rather sporadic. The vowel transcriptions are unmodified from Leslau's data.

<table>
<thead>
<tr>
<th></th>
<th>'carry on arm'</th>
<th>'crow'</th>
<th>'day'</th>
<th>'fold'</th>
<th>'to lame'</th>
<th>'to last'</th>
<th>'leaf'</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>k'ønattam</td>
<td>k'urä</td>
<td>k'änä</td>
<td>ik'k'äsäm</td>
<td>k'øt'äl</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Am</td>
<td></td>
<td>k'urä</td>
<td>k'än</td>
<td>anäkkäsä</td>
<td></td>
<td>k'øt'äl</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>krättam</td>
<td>k'urä</td>
<td>kärä</td>
<td>käppam</td>
<td>nák'äsäm</td>
<td>käsäm</td>
<td>k'øt'är</td>
</tr>
<tr>
<td>E</td>
<td>krättam</td>
<td>kürä</td>
<td>kärä</td>
<td>kääbmam</td>
<td>äkkässäm</td>
<td>k'õt'är</td>
<td></td>
</tr>
<tr>
<td>Ed</td>
<td></td>
<td>kürä</td>
<td>k'äppa?a</td>
<td></td>
<td></td>
<td>kä?är</td>
<td></td>
</tr>
<tr>
<td>En</td>
<td>k'ránt'a</td>
<td>k'ärä</td>
<td>k'äpa</td>
<td>ek'äsä</td>
<td></td>
<td>kä?är</td>
<td></td>
</tr>
<tr>
<td>G</td>
<td>k'urä</td>
<td>k'änä</td>
<td>kääbmam</td>
<td>anekkäsäm</td>
<td>ekkäsäm</td>
<td>k'õt'äl</td>
<td></td>
</tr>
<tr>
<td>Gt</td>
<td>k'årt'a</td>
<td>kürä</td>
<td>kärä</td>
<td>k'äpa</td>
<td>ekkäsäm</td>
<td>k'õt'är</td>
<td></td>
</tr>
<tr>
<td>H</td>
<td></td>
<td>kurrä</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M</td>
<td>kønättam</td>
<td>k'urä</td>
<td>känä</td>
<td>kääbmam</td>
<td>äkkäsäm</td>
<td>k'õt'ë</td>
<td></td>
</tr>
<tr>
<td>Ms</td>
<td></td>
<td>känä</td>
<td>kääba</td>
<td>nák'k'äsä</td>
<td>ekkäsäm</td>
<td>k'õt'äl</td>
<td></td>
</tr>
<tr>
<td>S</td>
<td>k'uri</td>
<td>k'äbä</td>
<td></td>
<td></td>
<td></td>
<td>k'ut'äl</td>
<td></td>
</tr>
<tr>
<td>W</td>
<td>k'ønätj'e</td>
<td>k'uri</td>
<td>k'äbä</td>
<td></td>
<td></td>
<td>k'ut'äl</td>
<td></td>
</tr>
<tr>
<td>Z</td>
<td></td>
<td>k'äbä</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

9 The following abbreviations will be used: A = Aymallal, Am = Amharic, C = Chaha, E = Eža, Ed = Endegëñ, En = Ennemor, G = Gogot, Gr = Gurage, Gt = Gyeto, H = Harari, M = Muher, Ms = Mask'an, S = Selti, W = Wolane, Z = Zway. (See also Leslau 1979, 1997a for Chaha, and 1995, 1997b for Amharic).
On the face of it, this appears to be a classic case of lexical diffusion, in which few of the languages are consistent with respect to phonological environment, though most of them retain the velar ejective in words like ‘leaf’.

Following the pattern of the alternation k':k, the Gurage dialects also have the alternation t':t. Leslau (1952: 68) cites the following examples: Am /t'ät't'ät'/ ‘applaud’, M /ag t'ääfam/, S W /t'ät't'ät'/, En /tät'/, C /t'ät'/, E /t'ät'/, Gt /tät'/, Ms /tät'/; Am /jät'/ ‘brigand’, M Ms G A Z W /jät'/, C E En Gt Ed /jät'/; C E /säntüm/ ‘cauterize’, En Gt /säntüm/, M /särrät’äm/, sllät’äm/; Am /wät’t’tärä/ ‘distend’, Ed /wät’t’tärä/, A /wät’t’tärä/, C /wät’t’tärä/, E M G /wattärä/, Ms /wattärä/, Gafat /wattärä/, A /tät'/ ‘finger’, En /at’ebä/, Gt /at’äjäbä/, Ed /at’el/, Ms G /at’ebä/, A /at’abä/, S W Z /ant’abä/, C /atebä/, E /atebä/, S /t’üm/ ‘fist’ but cf. Kambatta /tuntäma/, Gudella /tontöma/, Gt /tambä/.

In sum, the situation seems similar to the velar ejective examples, where various dialects appear to be inconsistent in their use of deglottalization. It seems that South Semitic offers a rich arena for the further, more detailed study of deglottalization and possibly lexical diffusion.
Fleming (1976) discusses several cases of apparent deglottalization in Omotic. For example, in Mocha the word for ‘lighten, flash’ is /p’arik/ while the cognate word for ‘bright, shiny’ in Dime alternates between /b’elxan/ and /p’elxan/, where the /k/ seems to be spirantized as well as deglottalized. In the Omotic word ‘burn’ there is some evidence of deglottalization, since Sheko /at’/ and Dime /ats/ correspond to Dizi /at/. The Dime word for ‘hippo’ /ts’id/ corresponds in Welamo to /tsade/. The word for ‘honey’ or ‘bee’ shows possible deglottalization in Bako: /anisw/ vs. Galila /anț’i/, Dime /anis/’. Sheko /jants’/.

Ehret (1994), in his reconstruction of Nilo-Saharan, proposes deglottalization of proto-ejectives in several languages: Songay, For, Maba, Dongolawi, Tama, Nara, Gaam, Temein, Nyimang, Proto-Daju, and Proto-Nilotic in the dental stop series, for example. Examples are abundant in Ehret (1995). Ehret’s (1995) reconstruction of Afro-Asiatic also contains a few instances of deglottalization in Egyptian and Semitic, though some of the conditioning is unusual; cf. the remarks in §4.5 on deglottalization in Neo-Aramaic.

Fleming (1983) contains some interesting preliminary work on Nilotic, in particular, Kuliak. For example, the Proto-Kuliak *k’ and Ik /k’/ correspond to /k/ in Eastern Sudanic. Kuliak Ik *k’an- ‘take’ is inferred from /k’anet-es/ ‘take’; compare Eastern Sudanic Gaam /k’an/ ‘take away, take aside (tr)’ (468). An ejective in Ik also corresponds to a deglottalized variant in Central Sudanic Avukaya, as in Ik /k’os/ ‘plate, trencher’, compared to Avukaya /käpi/ ‘paddle (spoon)’ (457). Ik /ats’/ corresponds to deglottalized variants in two dialects of Central Sudanic Madi: /azaza; aza/, as well as Lugbara /azozo/ ‘pain’ (457). The direction of the change appears to be deglottalization, based on reflexes in cognate languages, and the naturalness of the change.

### 4.7.2. Languages of the Americas

In his detailed areal-typological overview of the indigenous languages of North America, Sherzer (1976:258) reports the following general changes involving ejectives and glottals:

(58) Deglottalization  
\[ \text{glottalized series} \rightarrow \text{corresponding non-glottalized series} \]

The one exception is that many languages have /t/’ but not /t/ (in Sherzer’s transcription, [t’] but not [t]). Unfortunately he does not refer to specific examples, so I will attempt to document some here.
Broadbent and Pitkin (1964:21) provide evidence for the change of *t̩ > t̩ in the Wintun languages Wintu, Nomlaki, Hill Patwin, River Patwin, and Suisun, with alternation between l ~ t̩ in Patwin.

Haas (1964) compared Yana and Karok and found a few cases for each place of articulation in which Yana ejectives correspond to Karok obstruents. She notes that Yana /k̩/ 'has some excellent correspondences to Karok /s/ and also to Karok /x/ (83). Oswalt (1964) also notes instances in which Shasta ejectives correspond to Karok plain obstruents.

Jacobsen (1977) proposes (but does not make an attempt 'to completely justify') the sound changes involved from Proto-Washo to Washo. He states that 'in syllable-final position' glottalized (ejective) stops have lost their glottal closure so that *p' becomes /p/, merging with the series of voiceless stops (61). Unfortunately, no specific examples are given to justify this proposal.

Hinton (1991:140-41) observes that 'Glottalized consonants have been reconstructed for Proto-Hokan (Jacobsen 1976 and Kaufman [1988]), and if that is valid, then glottalization must have been lost in the ancestry of Yuman languages.'

Despite Sherzer's remarks, I have been unable to find much solid evidence for deglottalization as a regular sound change in North American native languages. We have, however, seen the change in Fort Resolution Chipewyan and in Stoney Dakota.

We move now to languages of Central and South America. Oltrogge’s (1977) work on Proto Jicaque-Subtiaba-Tequistlateco yields several examples of deglottalization. However, several are confirmed only by a single member of this correspondence set. For example, Oltrogge proposes deglottalization of Proto-Jicaque-Subtiaba (PJS) *k' to /k/ in Jicaque stem-finally, except following a back vowel (where it debuccalizes), while it remains ejective elsewhere. For example:

(59) PJS > Jicaque
*lik' |-lik (-fpu)la? 'back (body part)'
*lok' (la)lak'(on) luk' 'smooth'

Oltrogge’s description would seem to predict that /luk'/ would debuccalize, since it follows a back vowel. I hope additional examples could illuminate our understanding of deglottalization in these languages.
Suárez (1973) study of Macro-Pano-Tacanan posits the merging of glottalized and plain voiceless stops (deglottalization) in Proto-Panoan, Proto-Tacanan, Yuracare and Moseten, as opposed to Tehuelche, which retained the ejectives.

Orr and Longacre (1968) have proposed various deglottalization processes in the historical phonology of Proto-Quechumaran, an analysis which is not without controversy. In their view, the Riobamba (R) and Tena (T) dialects of Quechua have merged the 'closeknit cluster' of consonant plus laryngeal with the plain consonant. In these dialects, there was also subsequent voicing after nasals. They also note that in Cuzco, when word-initial in a syllable checked by a sibilant, it has the reflex /p/ for proto *p’, but in all other environments it has /p’/ (533). *t’ merged with *t in Ayacucho (A) and R, remains t’ in Cochamba (B), becomes tʰ in R when word-initial before *i, but deglottalizes elsewhere. *k’ remains k’ in B, but in ART deglottalizes to k. In Quito, when following *j in a cluster, *k’ > h, but elsewhere it merged with *k. Some examples of deglottalization follow:

<table>
<thead>
<tr>
<th>(60)</th>
<th>‘To shame; embarrass’</th>
<th>‘bird’</th>
<th>‘to boil’</th>
<th>‘sand; play’</th>
<th>‘bundle’</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>*p’inqa-</td>
<td>*p’ijqu</td>
<td>*t’impu-</td>
<td>*t’iju</td>
<td>majt’u</td>
</tr>
<tr>
<td>A</td>
<td>p’ina-</td>
<td>p’isqu</td>
<td>t’impu</td>
<td>t’iu</td>
<td>majt’u</td>
</tr>
<tr>
<td>R</td>
<td>pingana-</td>
<td>pijki</td>
<td>tʰimbu</td>
<td>th’iju</td>
<td>majtu</td>
</tr>
<tr>
<td>T</td>
<td>pinga-</td>
<td>pijku</td>
<td>timbu-</td>
<td>tiju</td>
<td>majtu</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>(61)</th>
<th>‘stick; wood’</th>
<th>‘to tire’</th>
<th>‘groupwork; hired work’</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>*k’aspi</td>
<td>*sajk’u-</td>
<td>*mink’a</td>
</tr>
<tr>
<td>A</td>
<td>k’aspi</td>
<td>sajk’u-</td>
<td>mink’a</td>
</tr>
<tr>
<td>R</td>
<td>kaspi</td>
<td>sajk’u-</td>
<td>minka</td>
</tr>
<tr>
<td>T</td>
<td>kaspi</td>
<td>sajk’u-</td>
<td>minga</td>
</tr>
<tr>
<td>Q</td>
<td>kaspi</td>
<td>sajk’u-</td>
<td>minga</td>
</tr>
</tbody>
</table>

The authors also report sporadic loss of glottalization ‘under obscure conditions’.

Proulx (1974) however, notes that ‘it is therefore probable that the habit of aspirating (and glottalizing) such groups of words originated in Aymara and spread to these dialects of Quechua’ (262). Proulx cites work which suggests that because of a lack of
consistent examples among aspirates and glottalic sounds, these laryngeal features are not a
genetic feature of Quechuan languages. Campbell (1995) provides a useful and balanced
survey between the genetic hypothesis, which would support the above examples of
deglottalization, and the diffusionist view, which would not. He concludes that a genetic
relation between Quechua and Aymara is ‘tempting’, and he strongly suspects the two
families are related, but cautions that the evidence is ‘insufficient for such a conclusion’
(195). For a descriptive, synchronic treatment which includes references to the historical
controversy, see MacEachern (1996). We turn next to the languages of the Caucasus.

4.7.3. Languages of the Caucasus
Nichols (1993) discusses the following cases of deglottalization from Proto-Northeast
Caucasian (PNEC) to Nakh: *tsts’ (cc’) is degeminated to /ts’/ initially in Nakh, but
deaffricated and deglottalized non-initially to /tt/ elsewhere. The same is also true for the
alveolopalatals: *tjtj’ (cc’) yields /ts/ initially in Nakh, but elsewhere it is deaffricated,
alveolarized and deglottalized to /tt/. PNEC #tsts’Vr ‘name’ yielded /ts’je/ in Chechen, but
/ttur/ in Riča Agul among others (where the # indicates a quasi-reconstruction based on
surveying the daughter languages, but not strictly using the comparative method).
Noninitially, #aRtJtJ’i ‘right (adj)’ yielded /æt’tu/ in Chechen (cf. Bats /at’t’â/ and
Chadakolob Avar /han’tJ’iil/).

There is also complex consonant gradation involving deglottalization, as well as
shift in manner (affricates alternate with fricatives) and with variation between alveolar and
palatal series. Compare, for example, the final consonants of Nakh ham(V)ts, ham(V)tt,
‘apple; plum; medlar, etc.’ compared to the Daghestanian forms which
universally end in /tt’/ (Nichols 1993:28).

Note also the Nakh-Daghestanian degemination and deglottalization in such pairs as
*tl’l’ ~ *l’, as in Akhvakh /tll’l’/ ‘meat’ and Tsez /refil/, and also the same alternation, but
involving gradation with the uvulars (Nichols 1993:28). Here are some of the
Daghestanian pairs which show apparent deglottalization:

(62) (bV)do (hV)tlt’o (CV=) uqq (CV=)uqq’ (CV=) tltl (CV=) tltl’ ‘boar’ ‘ashes’

Compare for example, the Bezta /myq’e/ ‘grain; naked-hulled barley’ with the Tsez form
/maqa/ ‘barley’). However, because this phenomenon of gradation is not well understood,
it is possible that we are dealing not with deglottalization, but with some sort of consonantal augmentation or ablaut.

Colarusso (1989b) provides a few examples of deglottalization in his sound changes from Proto-Northwest Caucasian (PNWC) to the NWC daughter languages. Because, in Colarusso’s words, PNWC is a ‘tough nut to crack’, reconstruction is difficult and examples of each sound change are few.

\[
\begin{align*}
(63) & \quad \text{PNWC } */t'-%u/ \rightarrow \text{Circassian } /tx^*a/ \text{ ‘butter’} \\
& \quad \text{PNWC } */t'-%u-w-ä-tla/ \text{ ‘butter-cl-con-lie = churn’ } \rightarrow \text{Proto-Ubykh } \\
& \quad \quad */t\chi^w^{-}wà-tla/ \rightarrow \text{Ubykh } /t\chi^w\omegaà-tla/ \\
& \quad \text{PNWC } */boq'a/ \rightarrow \text{Circassian } /bya/ \text{ ‘chest, breast’}
\end{align*}
\]

The first example contains, for Circassian, an unusual Ubykh-like type of regressive assimilation (or deglottalization).

A different type of deglottalization, with subsequent fusion, occurs in Archi. Kibrik (1994a: 306) notes the following process, in which an ejective plus voiced sequence yields the ‘strong’ (intensive) stop, symbolized by the macron, which is similar in some ways to a voiceless unaspirated geminate. He claims it is determined phonotactically, i.e. by syllable position:

\[
(64) \quad \text{‘to throw’ Inf. } *lāp' + \text{ bos } > \text{ lapus}
\]

Unfortunately this is the only example he provided.

If we accept the controversial Nostratic hypothesis (see Kaiser and Shevoroshkin 1988 for a recent survey and the papers in Salmons and Joseph 1998), there would be numerous cases of deglottalization from Nostratic initial **q’ and **k’, for example, to various reflexes in Turkic, Mongolian, Tungus, and Uralic/Dravidian, with only Kartvelian and perhaps for a time Indo-European preserving them.

Finally, I clarify one purported example of deglottalization cited in an important and otherwise excellent paper which misrepresents the facts. Job (1989), citing Burling (1967), claims that ‘the Proto-Lolo-Burmese ejectives are represented by nonaspirated voiceless stops’ in Lisu, Lahu, and Akha; ‘the Burmish languages Atsi and Maru show preservation of the ejectives’ (1989:132). A more careful reading of Burling however, reveals that the sounds which Job refers to as ejective, Burling calls ‘glottalized’. Often
these terms are interchangeable, but Burling uses the notation of plain voiceless stop followed by the glottal stop <ʔ> to represent these glottalized stops. Atsi (Tsaiwa) and Maru have a voiceless aspirated, a voiced, and a voiceless unaspirated series (S₁, S₂, and S₃, respectively). The voiceless unaspirated series is ‘always followed by a vowel with glottal constriction’ (Burling 1967:7). There is also a so-called glottalized nasal series, in addition to the plain nasals. ‘One cannot confidently specify the phonetic character of the original N₂ or S₂ series, but they do seem to have some parallel characteristic, possibly glottalization’ (7). Burling does refer to the Atsi glottalized stops as ‘voiceless’ (16), but they do not seem to be ejective, as judged from the following passage:

‘These stops are unaspirated and unvoiced, but the more striking phonetic characteristic of the series is the quality which they impose upon the following vowel. These vowels have the voice quality which has sometimes been termed ‘creaky’...It is my belief that the voice quality of these Atsi vowels is imposed by the constriction of the muscles of the larynx. This constriction in no way interferes with the fundamental vibration frequency of the vocal cords (such vowels take all the tone contrasts of the language) but it does impose a very distinctive quality upon the voiced portion of the syllable. In all likelihood this ‘creaky’ voice quality is initiated by a release of the stopped glottis occurring simultaneously or very shortly after the release of the other articulators, although no marked glottal stop is audible. (1967:16-17).

Burling notes that no matter the precise phonetic realization of the stop series, it is still phonologically contrastive. In sum, there seems to be no evidence to claim Burmese has ejectives. The so-called glottalized stops seem to be phonologically glottalized vowels. And while such a case is certainly of interest in a more complete survey of the feature [constricted glottis], it is beyond the scope of this dissertation. But Proto-Lolo-Burmese should not be cited as an example of diachronic deglottalization, as some like Awedyk (1993) citing Job (1989) have done.

4.8. Phonetic Realizations

In this section, I present two additional types of evidence for loss of the glottalic airstream mechanism. First, many fieldworkers report deglottalization in certain speech styles, where rapid speech often shows weaker ejection than in slow speech. Second, many fieldworkers have reported overall weak realization of ejection, sometimes so weak that to non-native speakers, ejectives seem to have merged or almost merged with a voiceless series. Given Ohala’s observation that ‘sound change is drawn from a pool of synchronic
variation' and that listeners' perceptions play a role in language change, the facts presented below show the variable nature of the phonetic realization of ejectives (see also Chapter Seven), and the possibility for such weak glottalization to be reinterpreted as deglottalization. First, we turn to two cases of fast speech.

Larsen and Pike (1949:277) note that in Huasteco (Mayan) in normal or rapid speech 'in a sequence of /t'/ or /k'/ plus a non-glottalized consonant, the prior consonant is replaced by /t/ or /k/ respectively; thus /t'/ plus /b/ yields /tb/, /k'/ + /j/ yields /kj/, and so on. /t'/ is similarly replaced by /t/ before /t', ts', tj'/.' Also, velars /k, k*, k', k*w/ are deglottalized (and delabialized) before any velars. Their comments thus strongly suggest a process of preconsonantal deglottalization, but they provide no specific examples, only the generalizations listed above.

Watters (1987:393) mentions a process in the Totonacan language Tepehua in which ejectives often deglottalize and glottal stop deletes in fast speech. He gives as an example /t'ahun ?umá: ?alá:fu]/ » [tu:umá: alâ:fu]/ 'X is eating an orange'. Watters notes that the glottal (elements) tend to be retained 'the closer [they are] to the primary stress'; deglottalization thus appears to be a gradient, post-lexical process.

In many languages, it has been reported that ejectives tend to be so weakly glottalic that it is difficult to distinguish them from voiceless unaspirated stops, which suggests a process of deglottalization. Let me also refer the reader to Appendix A, which details the impressionistic phonetic realization of ejectives in a variety of different phonological environments and styles, many of which seem to favor deglottalization.

In Northeastern Maidu (Shipley 1956) glottalized stops are pronounced with more fortis articulation initially. However, in other positions and styles, there is variation:

'In deliberate speech, the voiceless stops are unaspirated in certain environments...; the aspirated allophones of these stops tend to lose aspiration in rapid speech. Similarly, the glottalized stops become very weakly glottalized so that the aspirated and glottalized series fall together to some extent. This merging is incomplete, but only a practiced Maidu ear can clearly distinguish a glottalized from an unglottalized stop in an allegro utterance' (236).

We have seen in §4.3.4 that Maidu has laryngeal neutralization; here, however, Shipley is speaking more generally of deglottalization (in onsets) in allegro speech. Such weak glottalization apparently caused Dixon (1911:684) some difficulty in his Maidu fieldwork: 'the fortis [glottalized] is often by no means strongly marked, and is often difficult to separate from the surd [voiceless]'.
Other fieldworkers have had difficulty hearing weak ejectives. Montler (1986:8) notes that in Saanich (Coast Salish) the glottalized stops are ‘ejective but weakly so. It is often difficult, especially in the anterior consonants, to perceive the contrast’ (cited in Rigsby and Ingram (1990)). As a result, fieldworkers will often misperceive a weak ejective as deglottalized. Wickstrom (1974) and Powell’s Eastern and Western Gitksan pedagogical materials ‘frequently represent the glottalized stops incorrectly as voiceless ones’ (Rigsby and Ingram 1990:259-60).

In Slave (Howard 1963:44) ‘ts’ and tJ’ frequently have a glottalization so lenis in character as to escape notice’ (though Rice 1989 noted that Slave ejectives were strongly glottalized)\(^\text{10}\). In Tewa (Hoijer and Dozier 1949:140) ‘the glottal release survives (in slow speech) or is simultaneous with (in rapid speech) the oral release’ (140). Kinkade (1963) observed in his monograph on Upper Chehalis that ‘although the glottal release of glottalized stops is usually quite distinct and sharp, it may sometimes be reduced, and is often rather slight in a consonant cluster, such as occurs in the morpheme /-tJ’p/ ‘fire’, and in narrative speech. It is sometimes so slight that it is difficult to hear the glottalization’ (190).

The ejectives /p’/ and /k’/ in Berta are ‘weakly glottalized and often approach [p, k] in realization’ (Triulzi, Dafallah and Bender 1976:520). Bender (1997:820) notes that Berta /p’/ and /p/ are in alternation, as are the velars (833). Triulzi et al. also comment that the fricative /θ/ seems to fill the position of the missing /t/ in the stop series. In this case, the alveolar ejective seems to have not only deglottalized, but lenited to the interdental fricative.

Cole (1955:21) notes that the Tswana (Southern Bantu) /p’/ may simply be unaspirated [p] in unemphatic speech, and he finds the same for /t/’ and /k/’. Ziervogel (1952:4) notes that in Swazi (Nguni Bantu), the cluster /nt/’ is often pronounced as /nt/ (which in turn is often heard as /nd/)\(^\text{11}\). In (1948), he called /nt/ the ‘older form’.

In sum, we have seen several examples of languages whose ejectives may pattern phonologically as glottalized stops, but whose phonetic implementation is closer to an

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\(^{10}\) As I note in Chapter 7 on voicing, Rice (1989, 1996 p.c.) reports that Slave ejectives often undergo deglottalization, and, merging with the voiceless unaspirated series, are often voiced intervocally.

\(^{11}\) Some scholars would say that /nt/ is phonetically realized as [nt’] and thus there is ejectivization, not deglottalization.

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unaspirated voiceless stop, and thus may be said to have undergone a phonetically gradient deglottalization.

4.9. Conclusion
In this chapter, I have shown with a wealth of examples that deglottalization of ejectives is a common and natural type of lenition. Following current models of feature geometry, we have been able to distinguish two general types of deglottalization. One is deglottalization as Laryngeal node delinking (delaryngealization), in which not only ejectives, but other laryngeal features are neutralized as well. The typical position for this is in the coda, as the examples in §4.3 from Klamath, Maidu, and Nisg̱a’a (for the reduplicant). Kiparsky (1995) notes that codas are the most common target of weakening, as do Donegan and Stampe (1979) and Burquest and Payne (1993). Sahaptin (§4.3.3.), and some Klamath data, also show delaryngealization preconsonantally in onsets. The second type of loss of glottalization is deglottalization as [e.g.] delinking. The examples provided are admittedly not as robust as the theory would predict, but as we saw in Chapter Three, many phonological rules tend to operate at the level of class nodes such as the Laryngeal node, rather than on individual features. Nevertheless, I have documented examples from Tigre (in coda position; §4.4.1) and Lezgian (in onset position; §4.4.2) which show evidence of feature delinking. The fact that [e.g.] may act independently of the Laryngeal node is evidence in favor of current models of laryngeal features, and against those which view laryngeal features as multi-valued. Further evidence of this was presented in §4.4.5, where ejectives suffered no constraints, but other features such as [s.g.] did.

Because absolute neutralization is a powerful theoretical device, and because it is difficult to document synchronically, I have not found synchronic examples of loss of ejection. However, when comparing various dialects such as Fort Resolution Chipewyan, Stoney Dakota, and Udi to other dialects of their respective languages (§4.5.1), we found merger, the diachronic equivalent of absolute neutralization. Complete loss of glottalization also occurs in Janjero (§4.7.1). Not only does phonological theory predict this to be possible, but the Glottalic Theory needs such a change to account for sound changes in its version of PIE sound paths. The originators of the theory, especially Gamkrelidze and Ivanov, while paying lip service to diachronic typology, did not present an impressive array of evidence for their argument. Job (1984, 1989), whose data is used in this chapter, provided an important contribution for the Glottalic Theory, but he did not provide changes of the exact type required by the theory. In this chapter I have demonstrated through
comparison of dialects and a wealth of diachronic data, the possibility of complete (and partial) loss of glottalization. Thus the diachronic typology of ejectives is more firmly based in empirical facts. The Glottalic Theory's requirement for deglottalization has ample precedent and relatively high probability in this catalog of sound changes.
CHAPTER 5
DEBUCCALIZATION

5.1. Introduction

5.1.1. Chapter Outline

Debuccalization is the loss of primary supraglottal articulation with retention of, or replacement by, a glottal gesture such as [h] or [ʔ]. This process has been called by various names (some of which apply only to ejectives, or to fricatives), including: aspiration (Goldsmith 1981, Lipski 1984), dearticulation (Durand 1987, 1990), deobstruentization (Straight 1976), de-oralization (Lass 1984), ejective reduction (Moshinsky 1974), glottal formation (Hayes 1986), glottaling (J. Harris 1994), glottal replacement (Gimson 1970, Roach 1979), the unfortunately and confusingly named laryngeal neutralization (McCarthy 1989), modular depotentiation (Foley 1977)\(^1\), omission (Boas and Deloria 1941), oral depletion (Trigo 1988, 1991) and unbonding (Dunn and Hays 1983), as well as more general terms such as lenition and weakening (Hock 1986, Ferguson 1990). The most common term now, however, is debuccalization (coined by the late Robert Hetzron 1972:65\(^2\)), which McCarthy (1988) has resuscitated and which has

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1 In Foley's framework, modular depotentiation is actually seen as a type of strengthening in which strong elements cannot undergo further strengthening and thus undergo weakening. Both of his examples (Spanish \(l > h\), and English \(t > ?\) before syllabic \(n\)) are seen as types of strengthening. In this work I will join the overwhelming number of analysts who would see these examples as a weakening or lenition, and, because the end result is glottal, will consider this debuccalization.

2 Hetzron stated that 'Except in Gyeto, glottal stop may also come from the partial (apparently unsystematic) "debuccalization" of the ejectives \(q, t\,\text{and}\,\tilde{c}\ldots\). The scare quotes indicate that the term was not yet generally accepted. McCarthy (p.c.) first found the term in Hetzron's (1972) article, though he suggests that perhaps Hetzron calqued the term from French. Hetzron (p.c.) claimed the term as his own 'brainchild', though he says he may have first used it orally in French at a conference before it was in print in 1972. McCarthy's reference to this term as 'traditional' is therefore misleading. However, the term 'buccal' is well established in phonetics. Compare Kuipers' (1960:25) use of the term 'buccal features' to refer to 'place and mode of articulation', in contrast to laryngeal features and 'features consisting in the general shape of the mouth.
since been adopted in most recent autosegmental literature (e.g. Harris 1990, Kenstowicz 1993, Roca 1994, Clements and Hume 1995).

In the second part of this introduction, I will provide some background on debuccalization and show that it is a relatively common process for both pulmonic and glottalic obstruents. In §5.2, I provide some of the theoretical background for debuccalization, beginning first in §5.2.1 with problems relating to the patterning and representation of glottals (the end result of debuccalization), and then in §5.2.2., discussing various proposals to formalize debuccalization. Using the Clements and Hume (1995) Constriction-based model of feature geometry, I predict that there should be four different types of debuccalization: Root Node Debuccalization, Oral Cavity Debuccalization, C-place Debuccalization, and Individual Place Feature Debuccalization.

I begin with Individual Place Feature Debuccalization in §5.3. This type of debuccalization delinks an individual place feature, while the segment retains the secondary articulation, creating a complex glottal segment. I provide evidence from Irish, Circassian, Yuman, and Guddiri Hausa. I go on to critique Halle’s formalization of debuccalization in §5.3.5, showing the inadequacy of the Articulator-based model of feature geometry. Finally, I discuss a case of debuccalization with loss of secondary articulation in Kashaya in order to motivate (at least) two types of debuccalization.

The problem of indeterminacy, the inability to know for sure which type of debuccalization has taken place, is addressed in §5.4, before I distinguish the three other types of debuccalization. Indeterminacy arises from multiple solutions which are compatible with the data. Of course some solutions are more commonly accepted, or make more common assumptions than others, but the theory, not the data often determines the analysis. For example, ejectives are often not the best class of segments on which to test for types of debuccalization since ejectives debuccalize to glottal stop, where both laryngeal and (possibly) stricture features are preserved. Therefore this chapter includes data from non-ejective sounds as well in order to test theoretical predictions.

resonator (plain – palatalized – labialized)’. There is, as well, earlier French usage, e.g. Leslau (1941:4), who said that /t'/ 'se prononce comme un t , mais avec une plus forte tension buccale suivie d'une occlusion glottale, donc t'''. (There are undoubtedly earlier uses of the term *buccal*). The term *debuccalization*, however, is certainly not found before 1972. Leslau (1957:270), for example, used the phrase ‘alternance between the emphatics and the glottal stop’, and in (1963:8) he used the periphrastic ‘alternance between glottalized and the glottal stop’, where debuccalization would have been less cumbersome.
Root Node Debuccalization, discussed in §5.5 is, as the name suggests, Delinking of the Root Node, with a default glottal to fill in the timing slot. I discuss three clear-cut cases, in Usarufa, Kasimov Tatar and Buginese, which motivate this type of debuccalization. Depending on theoretical assumptions, there could be many other cases, including in some dialects of English.

A plethora of evidence is provided in §5.6 for Oral Cavity Delinking, in which only laryngeal features are preserved, but most other features are lost. This is the type of case which usually springs to mind when one thinks of debuccalization. Kashaya provides several rules which involve Oral Cavity Delinking. In addition, I discuss cases from Yucatec Maya, Amharic, Icelandic, Klamath, and Kagoshima Japanese.

Section 5.7 on C-place Delinking does not provide a single solid case of this type of debuccalization, in which place but not [continuant] is lost. Most of the difficulty lies in determining whether glottal features bear stricture, something most phonologists rule out. However, I provide circumstantial evidence which suggests that this process is possible. And, depending on certain theoretical assumptions, a number of languages may have this type of debuccalization.

The last section of data provides examples of debuccalization across time and in different dialects, or in free variation, from the languages of Africa, the Caucasus, and the Americas. The final section provides a summary and some concluding remarks.

5.1.2. Background on Debuccalization

Debuccalization is a common process which recurs in many different language families all over the world, as well as in child language (Stemberger 1993). In several English dialects, for example, voiceless stops debuccalize in various environments, though typically syllable-finally (Lass 1976, Roach 1979, Milroy et al. 1995). In (1a) below, common in American English, /t/ debuccalizes before a syllabic nasal (and in some dialects, before a syllabic lateral, as in bottle). Syllable-finally, there is often glottalization (or glottal reinforcement) concomitant with oral articulation (b), though some dialects such as Cockney have fully debuccalized final voiceless stops (c).
a. Debuccalization  b. Glottalization  c. Debuccalization

t ➔ ?  p, t, k ➔ ?p, ?t, ?k  p, t, k ➔ ?

kitten [kɪʔn]  nap [næʔp]  map [mæʔ]
mitten [miʔn]  great [ɡreʔn]  mat [mæʔ]
button [bʌʔn]  kick [kɪʔk]  mack [mæʔ]

Milroy et al. (1995) have argued that the processes represented as (b) (glottalization) and (c) (glottal replacement, referred to here as debuccalization) are independent phenomena, at least in the Tyneside dialect they studied, and in this chapter, I will not be directly concerned with glottalization. We will see below that there are several languages which debuccalize but which do not seem to have intermediate glottalization.

Indo-European scholars have long been aware of the change of Proto-Indo-European (PIE) *s to /h/ in Greek (e.g. Brugmann 1897, Buck 1933; see also Steriade 1982, Ferguson 1990, and Kisseberth 1993:301). Bopp 1833 [1845] §53 wrote of the correspondence between Sanskrit /s/ and Zend (Avestan) /h/. Examples from PIE are given below, where Latin has retained PIE *s, while Greek has debuccalized it:

(2)  PIE *s ➔ Greek /h/

<table>
<thead>
<tr>
<th>Latin</th>
<th>Ancient Greek</th>
</tr>
</thead>
<tbody>
<tr>
<td>sex</td>
<td>héks</td>
</tr>
<tr>
<td>septem</td>
<td>heptá</td>
</tr>
<tr>
<td>sequor</td>
<td>hépomai</td>
</tr>
<tr>
<td>sub</td>
<td>hypó</td>
</tr>
</tbody>
</table>

It is quite common for voiceless fricatives to debuccalize to /h/. Most common is the change from /s/ ➔ [h], though often under various conditions; (Fergusson 1990 offers an interesting contrast between Ancient Greek and Spanish types of sibilant debuccalization). Witness, for example, Sanskrit visarga, in which final /s/ became h-like (Whitney 1889, Burrow 1955:99, Steriade 1982:60). PIE *s ➔ /h/ in Old Persian, Armenian, and British Celtic (Beekes 1995:134). Andalusian and Latin American Spanish /s/ ➔ [h] (Goldsmith 1979, 1981; Lipski 1984; Fergusson 1990). Other cases of sibilant debuccalization of the type /s/ ➔ [h] include the Northern Turkic language Yakut (Krueger 1962, cited in Fergusson 1990), and various Eskimo-Aleut dialects (Woodbury 1984; Dorais 1986 for Inuktitut). Other cases of fricative to [h] debuccalization include Germanic /s/ (from PIE
*k) > [h] (Lass 1997:216-21), Scots English /θ/ → [h] (Lass 1984:114), and Hawaiian *f > /h/ (Crowley 1992).

Likewise, it is quite common for stops to debuccalize to glottal stop. Examples include Middle Chinese *p, t, k > [ʔ] (Chen 1973), Top End (Gunwinjguan, Australia; Harvey 1991) *k > /ʔ/, and Samoan and Hawaiian *k > /ʔ/ (Crowley 1992). Some languages like Guininaang Kalinga (Philippines; Gieser 1970) have both stop and fricative debuccalization: /k/ → [ʔ] and /s/ → [h]. Other cases include Malay and Fife Scots, discussed in §5.7.2.

I should point out that the tendency for stops to debuccalize to glottal stop and fricatives to glottal fricative does not always hold. Proto-Polynesian *f and *s have a reflex of /ʔ/ in Rarotongan (Crowley 1992:99-101), and Makasarese *s > ? (Mills 1975). Since these are the only such examples I have found (except for *h > /ʔ/ in Palauan), and since these are not phonological processes, but historically correspondences, I think the generalization that fricatives always debuccalize to [h] is a fair generalization.

Stops may also debuccalize to [h]. Armenian /h/ is from earlier /p/, as is the case in the Dravidian language Kannada; Latin /h/ is from earlier *gʰ; /h/ in the Uralic languages Ostyak, Hungarian, and Yurak comes from /k/; in the Dravidian languages Pengo and Kuvi /h/ comes from /c/; and in related Manda and Kui, /h/ derives from /k/ (Lass 1984:179). Thompson and Kinkade (1990) note that in the Salishan language Tillamook *p and *p' have become /h/. As we shall see below, some cases of stops becoming /h/ are from aspirated stops, while others may be through voiceless fricatives, as in Germanic. As Jeffers and Lehiste (1979) point out, such phonetic correspondences do not necessarily equal phonological processes. Foulkes (1997) examined a number of such cases of /p/ > /ʔ/ > /h/, and, using laboratory phonological experiments, he determined that the change /ʔ/ to /h/ may be initiated before /u/ due to the acoustic similarity of [fu] and [hu]. Foulkes found no evidence for a direct change of /p/ to /h/. However, as we shall see below in §5.6, there are languages with synchronic alternations between voiceless stops and /h/, so such direct changes should not be ruled out.

Other types of segments can debuccalize besides pulmonic obstruents. In Klamath, aspirated and glottalized sonorants debuccalize to [h] and [ʔ], respectively, after plain sonorants, e.g. /jal-jal-ʔi/ 'clear' is realized as [jaljalʔi] (Blevins 1993:268-71; Clements 1985; and Lombardi 1991). The debuccalization of implosives to glottal stop is found in Dime (Fleming 1990) and Arbore (Hayward 1984). The focus of this chapter, however, is

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on the debuccalization of ejectives, with data from other languages where they help support a theoretical argument.

Catford (1992:196) notes that in ejectives,

'not infrequently the (oral) articulation is lost, leaving only the glottal closure, which is an essential feature of the glottalic initiation (air-stream mechanism) of these sounds. In the absence of an oral constriction, the supraglottal air cannot be compressed, and the originally initiatory glottal closure acquires articulatory function, leaving a (pulmonically initiated) glottal stop'.

Catford was speaking specifically about the ejectives of Caucasian languages, but his comments apply cross-linguistically to the tendency for ejectives to lose their oral articulation. They also illustrate the dual nature of glottal sounds as a type of initiation (ejection), and a place of articulation.

An insightful account into some of the phonetic reasons for debuccalization may be found in the following quote from the phonetician Kohler (1994:45):

'The complete closure required for a plosive is effected at the vocal cords, which leaves the supraglottal articulators free to accommodate to the surrounding gestures.'

In other words, as suggested to me by Keith Johnson (p.c.), if the acoustic goal of a stop is to produce a stop gap ('an interval of relatively low energy, conspicuously lacking in formant pattern or noise' (Kent and Read 1992:234)), then this may be achieved by a glottal stop, which leaves the oral articulators free to prepare for the next sound. Similar principles apply for the aperiodic noise required by fricatives. (See Burquest and Payne (1993:45) for a similar point). Debuccalization thus fulfills some of the perceptual needs of the listener while accommodating the ease of articulation for the speaker. And perhaps it is for this reason that debuccalization is so common.

5.2. Theoretical Considerations

5.2.1. Problems with Glottals

In this section, we will examine a number of problems relating to the representation of glottals, which are the result of debuccalization. We will begin with the problem of phonetic realization of glottals, and then consider several paradoxes: First, glottals are seemingly placeless in terms of glottal transparency and yet they pattern with the class of gutturals. Next, they are variously classified as belonging to the natural class of glides vs.
that of obstruents. There are also varying opinions on whether they should best be represented with laryngeal features or the feature [continuant]. Finally, issues such as the role of underspecification come into play.

Shuken (1984:111) noted that ‘in many languages the phonetic phenomena described as [?] or [h] are varied and complex’. But perhaps Durand (1987:81) said it best when he noted that ‘the labels “glottal stop” and “glottal fricative” cover a multitude of phonetic sins’ – ‘sins’ which involve such various categories as breathiness, whisper, glottal constriction of various types, etc. There has been a vigorous debate on this issue in recent pages of the Journal of the International Phonetic Association (see Catford 1990, Ladefoged 1990, Kloster-Jensen 1991, Laufer 1991, and Livonen 1992). This debate came to a head when the IPA (1993b), in considering the most recent revisions to its alphabet, voted 14 to 10 not to remove [h] from the glottal column. Whatever may be the exact phonetic realization of glottals, it seems fairly clear that debuccalization results in phonological laryngeal (glottal) sounds.

Besides the phonetic variability of glottals, there is the issue of laryngeal transparency. Steriade (1987a, 1995) observed that laryngeals are seemingly placeless in allowing vowel harmony across laryngeals but no other consonants. (See also Stemberger 1993). Yet McCarthy (1988, 1994) has observed that laryngeals act with the gutturals in Semitic in root structure constraints and other phonological phenomena. Rose (1996) has proposed that glottals are specified with a Pharyngeal place only when there are other gutturals in the language’s inventory; otherwise they are placeless.

Another point of contention related to laryngeals is the debate about whether they act as glides or as obstruents. Clements (1990:322) put it aptly:

‘Laryngeals tend to behave arbitrarily in terms of the way they class with other sounds, avoiding positions in syllable structure that are available to true glides, and patterning now with obstruents, now with sonorants in a way often better explained by their historical origin in any given language than by their inherent phonological properties’.

Jakobson, Fant and Halle (1952:19, 23) grouped [h] and [?] as glides vs. true consonants. Chomsky and Halle (1968:303) also classified them as glides, along with [w] and [y], as [+sonorant, -consonantal, -vocalic]. Most phonologists have followed suit, though of course the feature [vocalic] is now considered obsolete, having been superseded by [syllabic]. Arguments in favor of this view include the fact that Malay nasality spread is blocked by an obstruent or liquid, but glides [w, y] and laryngeals [h, ?] allow nasality to
spread (Kenstowicz and Kisseberth 1979:243-4). Hume and Odden (1996:349) claim that by definition glottals (laryngeals) are glides:

'it is tautological that languages cannot exploit a consonantal contrast with laryngeals, since by definition [+consonantal] segments necessarily require a particular degree of supraglottal constriction, and laryngeals necessarily have no supraglottal constriction.'

Additional evidence for the glide status of glottals comes from the fact that the laryngeals [h, ?] pattern with oral glides [j, w] as hiatus breakers between vowels (Kenstowicz and Kisseberth 1979:244). In Nhanda (Pama-Nyungan; Australia; Blevins and Marmion 1995), for example, [?] and [j] are allophones of the same phoneme, and they also break hiatus, e.g. [iju] ‘south’ varies with [i?u] due to a rule of yod deletion after a stressed /i/ which is filled by the default consonant, glottal stop.

Opposed to the view that laryngeals are glides is the view that they are obstruents. This is implied by the traditional IPA descriptions of these sounds as glottal stop and glottal fricative. One example in which the glottals act as obstruents, as opposed to glides is in Semitic, where the glottals, along with the pharyngeals and uvular fricatives (to the exclusion of glides) form the natural class of gutturals (Kenstowicz and Kisseberth 1979:244; see also Schane 1973:27). However, this patterning is not compelling evidence since the glides /w, j/ do not have the relevant guttural property (Hayward and Hayward 1989; McCarthy 1989, 1994). In Malay, /h/ patterns with the voiceless obstruents in deleting after nasals in prefixes in Malay (Durand 1987:83-4, interpreting Hassan 1974:51-2); Malay will be discussed in more detail in §5.7.2. Kean (1972) argues that /?, h/ should be classified as [-sonorant], not with the glides /w, j/, based on data from Klamath in which the true glides but not the glottals pattern with the vowels. Michelson (1986) considers Onandaga [h] and [?] to be [-sonorant], i.e. obstruents, since the two glottals ‘group together with the oral obstruents and not with the sonorants (/n, w, j/) in the Northern Iroquoian languages’ (fn 5, 163), although unlike the obstruents or sonorants, the glottals cannot be the first element of a cluster. Another fact supporting in a small way the obstruent view is that debuccalization of obstruents results in a glottal. (Glides rarely

For a reanalysis of cases like these, see Hume and Odden’s (1996) arguments against the feature [consonantal], in which they propose the notion of impedance, the rough inverse of sonority. Laryngeals and vocoids are most susceptible to nasalization since their impedance values are low, and targets of nasal spreading, which vary cross-linguistically, cannot have impedance values greater than some language-specific maximum.

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debuccalize - but see Trigo Ferré 1988.) If glottals are specified as obstruents, then
debuccalization may be expressed without changing major class features, thereby
simplifying the number of changes made in a relatively common change. Finally, Stevens
and Keyser (1989:93) have recently defined /r/ and /h/ as [-sonorant]. ‘We regard this
classification to be consistent with the articulatory correlate of [-sonorant], that is, the
formation of a constriction above the glottis. In the case of /r/ and /h/, this contribution is
at the level of the false vocal folds.’ See also Bessell (1992), and Buckley (1994:26), who
have argued for the obstruent status of glottals. In §5.3.4, I present data from Kabardian
glide fortition which suggest that its glottal stops are obstruents. There are, in short,
compelling arguments from both sides. This may suggest a variable representation for
glottals. Indeed, glottals play a variable function within languages. An issue raised by
Macaulay and Salmons (1995), who note the variant analyses of glottal stop, is that
sometimes it is seen as a consonantal phoneme (patternning with stops), and sometimes as a
prosodic feature (involved in hiatus, the role of Danish stød, etc.).

Another burning issue surrounding laryngeals is how they should be represented:
either with laryngeal features under the Root node (the majority view), or with the feature
[continuant], or both. Kenstowicz (1993:489) has claimed that there is little independent
evidence that other processes group [?] with oral stops and [h] with oral fricatives. Some
scholars have argued that the soft palate (nasal) and laryngeal sounds cannot make stricture
distinctions and thus [continuant] is irrelevant to glottals (e.g. Trigo Ferré 1988).

Among those who believe in the representation of laryngeals by stricture are Lass
Arguments mustered in favor of this view include the observation that most often, stops—no
matter their laryngeal features—debuccalize to glottal stop and fricatives debuccalize to
glottal fricative, a point which is captured simply by preservation of the original value of
[continuant]. Also, in debuccalization, laryngeal specifications must often stipulate a
change from voiceless or no laryngeal features to [+constricted glottis] for stops. It is
doubtful whether all debuccalized stops must first be glottalized, and whether the feature
[c.g.] is phonologically relevant (though of course it is phonetically). Finally, some
scholars such as Stemberger (1993:135) admit that they are unsure which proposal is
correct. We will return to such issues in §5.7 in the context of C-place delinking. Next I
will review various proposals for the formalization of debuccalization.
5.2.2. Formalizing Debuccalization

Autosemantic phonology represents assimilatory phenomena as the spreading of an association line, as we have seen in Chapter Three on Ejective Assimilation. McCarthy (1988:88) claims that another basic operation on association lines in nonlinear phonology is that of delinking, which he notes ‘corresponds to the traditional process of reduction’ or neutralization, as we have seen in §4.2. Clements and Hume (1995) note that debuccalization is a process which ‘eliminates contrast among oral tract features’.

Clements and Hume point out that neutralization at the level of the Root node eliminates all segmental contrasts to a default element such as schwa in English, or [?] as a reflex for preconsonantal stops in Toba Batak (Hayes 1986). When laryngeal features are delinked from ejectives, they create deglottalized segments, as we have seen in Chapter Four. If the place features of an ejective are delinked, the result should be a segment with no oral articulation — a glottal segment. For ejective stops the result will be [?]. Despite all the work on debuccalization, reviewed briefly below, no one has yet systematically tested the theory on the class of ejectives. (In passing, McCarthy [1988:88] briefly mentions this process in Ethiopian Semitic, and Harris 1990 examines some glottalic sounds in Arbore). Instead, most work on debuccalization has concentrated on voiceless stops /p, t, k/ which become [?], or on aspirated /pʰ, tʰ, kʰ/ stops or fricatives /f, s/, which become [h]. Both of these processes, while admittedly common, are also somewhat more complicated in that the plain voiceless stops must somehow become glottal, and the fricatives must specify the feature [spread glottis]. In this chapter, I will test the assumptions of current feature geometries, primarily with data from ejectives, but also from other types of debuccalizations. But first, I will review the analyses involving debuccalization of other segment types.

As we have seen in the review of features in Chapter 2, Lass (1976) discussed several cases in English of lenition in which the oral tract features are deleted, leaving only laryngeal features. Compare, for example, the voiceless stops in RP and American dialects with their Glasgow and Cockney counterparts. Depending on the dialect, words like bit and pity can be pronounced as [biʔ] and [piʔ]. For an excellent descriptive work, see Wells (1982); for more current theoretical frameworks, see Giegerich (1992), Jensen (1993), and Harris (1994). Lass concluded that glottal stop is the ‘reduction stop’, just as schwa is the reduced vowel.

Thráinsson (1978) analyzed preaspirated stops in Icelandic as the delinking of supralaryngeal features from the first component of the underlyingly aspirated geminate.
Goldsmith (1981) was also pivotal in establishing the notion of delinking place features in his analysis of the dialectal 'aspiration' of Spanish /s/ in coda position. Clements (1985:233) modified Thórdal’s formulation to fit in with his proposed feature geometry, in which debuccalization was the delinking of the SupraLaryngeal node, which eliminated both manner and place features. According to McCarthy (1988:92) this was initially plausible since in a change from /t/ to [ʔ], not only did the place feature [coronal] change, but so did the manner specification [-continuant] (assuming that glottal stop is a glide, which does not bear stricture features). But McCarthy (1988:92) goes on to note that debuccalization could also be regarded as delinking of the Place node, since the results of debuccalization, [ʔ] or [h], allegedly cannot bear manner distinctions (see §5.7 for an alternate view). I should note that McCarthy’s view that laryngeals cannot bear manner distinctions such as [continuant] has been disputed by Iverson (1989), among others.

Avery and Rice (1989:190-1) have analyzed English alveolar debuccalization using their theory of Coronal Underspecification (see also the papers in Paradis and Prunet 1991). As we saw in (1), there are dialects of English in which /t/ but not other voiceless stops alternate with glottal stop. Avery and Rice use Coronal Underspecification, the view that the place feature Coronal is absent underlingingly, to account for this phenomenon. They note that this alternation is natural since both (underspecified) /t/ and [ʔ] lack place specifications. ‘When the unmarked node Coronal is filled in in phonetic implementation, this segment is realised as [t]; when the default Coronal is not filled in, it is realised as glottal stop’ (191). Thus alveolar debuccalization has been reduced to matters of default fill-in for underspecification in a clever solution to one type of debuccalization. However, the authors avoid specifying the conditions in which the default is filled in with Coronal or not. In addition, since debuccalization may include many different places of articulation, it is clear that this theory of Coronal Underspecification alone cannot account for debuccalization at other places of articulation, as in Cockney. We turn our attention next to the formalization of debuccalization.

4 The exact formulation of Icelandic debuccalization has been criticized by Iverson (1989) and Hayes (1990), but the general idea still stands, and will be re-analyzed in §5.6.5 on Oral Cavity Delinking.
Another approach to debuccalization is found in Keyser and Stevens' (1994) analysis of Yucatec Maya. When a cluster of homorganic stops or affricates is separated across a word boundary, the first becomes [h] if it is a stop (stops are aspirated in Yucatec), or [s] if it is the affricate /ts/, e.g.

(3) a. /tun kolik k'aaʃ/ → [tun kolih k'aaʃ] ‘he’s clearing brush’
   /taŋ k pak'ik k kool/ → [taŋ k pak'ik h kool] ‘we’re planting our clearing’
   /leʔ iŋ w ot iʔo/ → [leʔ iŋ w oh iʔo] ‘that house of mine/my house there’
   b. /ʔuts t iŋ w iʔi/ → [ʔus t iŋ w iʔ] ‘I like it’ (lit. ‘goodness is at my eye’)
   /ʔts' u hoʔot tik/ → [ʔts' u hoʔot tik] ‘he scratched it’

(Lombardi 1990:383, citing Straight 1976)

Ejectives also debuccalize, e.g. /ʔtán a lik'tsikʔ/ → [ʔtán a liʔsikʔ] ‘You’re raising it’. However, the velar ejective debuccalizes before any consonant, and thus this rule is different since the homorganic condition does not apply.

Keyser and Stevens’ analysis, apparently inspired by Lombardi (1990), involves the ‘deactivation’ (i.e. delinking) of the feature [-continuant] on the first of two feature trees which share the same articulator node. The authors assume that ‘all terminal features below the deactivated [continuant] node are no longer implementable’ (230). Thus debuccalization is ‘an epiphenomenon which arises as a result of the deactivation of the feature [continuant], which causes the dominant node to recede from the supranasal node to the supraLaryngeal node’. The stops are specified with [spread glottis], which is dependent from the Glottis node, and thus their laryngeal features are not lost. Ejectives also debuccalize before any consonant, e.g. /k'ʔs/ → [ʔʔs]. Keyser and Stevens also view this as deactivation of [-continuant] with subsequent ‘recession of the dominant node to the supraLaryngeal node’. It is unclear whether other features have the ability to deactivate features below them, or whether it is unique to [cont].

Keyser and Stevens’ theory is unusual in that they view debuccalization roughly as the delinking of the feature [continuant], with subsequent preservation of original laryngeal

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5 For other analyses of Yucatec Maya, see Straight 1976, Lombardi 1990, Bessell 1992, and §5.6.3.

6 Given the previous example, it is unclear why the second and not the first stop debuccalizes.
features, though voiceless stops must be specified with [s.g.]. In their feature geometry, however, [continuant] is attached to each of the three main place features Lips, Blade, and Body – roughly Labial, Coronal, and Dorsal, respectively. (They adopt without attribution Padgett’s (1991/1995) proposal). When [continuant] is deactivated, so are the place nodes. The unstated motivation must be what Lombardi (1990) argued: that a Place without stricture is ill-formed, and is repaired by the deletion of Place.

In contrast, Browman and Goldstein (1989:241-2) propose, in their theory of gestural phonology, that debuccalization can be viewed as ‘deletion of the oral gesture’. But they point out that it is also true that the Vocal Tract Output [Constriction Degree] is unchanged by the gestural deletion since it remains noisy as [h] and remains an occlusion as [ʔ]. Thus implicitly, they view debuccalization as oral gesture deletion, with retention of something like the feature [continuant], and not necessarily the preservation of laryngeal features, a view which relies on acoustic output instead of articulation.

Sagey (1990:26) viewed debuccalization as delinking of place while keeping manner and laryngeal specifications. She notes that a consequence of defining [ʔ] as [-continuant, -sonorant] is that phonological rules which refer to [-continuant] should in the unmarked case refer to glottal stop as well. She does not know of evidence either supporting or not supporting this prediction. (For more on this, see §5.7.1).

A far different tact to debuccalization is seen in McCarthy (1989:51-52). In his framework, glottal laryngeals are seen as having [pharyngeal] place of articulation, with a dependent [glottal] where needed, to distinguish them from true non-laryngeal pharyngeals. Ejectives are seen as complex segments with two branching places of articulation, say, [coronal] and a sister [pharyngeal] node, with a dependent [+glottal] feature. In this framework, McCarthy speculates that class-node deletion could be eliminated in favor of complex segment simplification, which is required independently. Such a process is schematized below, in which an ejective /t/ has its [coronal] place delinked under some unspecified simplification algorithm. The result is a segment specified only for [pharyngeal] Place: a glottal stop.
McCarthy himself admits he was unprepared to answer how place assimilation will work for such representations, if [pharyngeal] is attributed to glottalized segments. In Mayan, for example, ‘one’ /hun/ becomes [hum] before labials, both plain and ejective. The nasal does not change to a pharyngealized labial nasal, or a glottalized nasal; instead only the [labial] component of the following consonant seems to spread. The same is also true of nasals which assimilate in place to a following velar /k k’ g/ in Amharic (Ullendorff 1955). McCarthy’s approach thus destroys the generalization of Place assimilation, or requires elaborate repairs. Another problem with this model is that it implies ejectives debuccalize to glottal stop at only one place of articulation; a whole series of ejectives which change to glottal stop would be formalized with as many different rules as there were places of articulation, which indicates loss of an obvious generalization. Such a case occurs in Kashaya Verb-final Debuccalization, discussed in §5.6.1, in which virtually all places of articulation of (derived) ejectives debuccalize. In addition, McCarthy does not address those debuccalizations in which voiceless stops become glottal stop, presumably because he believes all such stops are first glottalized. Finally, this theory does not show how voiceless aspirated stops may debuccalize to [h]; presumably, aspirated consonants would need to bear the [pharyngeal] feature as well. In sum, McCarthy’s proposal does not seem to be an apt mechanism of debuccalization.

Halle (1992, 1995), taking up McCarthy’s (1988) idea, proposes that the features [consonantal] and [sonorant] are features encoded within the Root node, which dominates an Oral node, a Nasal node, and a Pharyngeal node, in addition to several terminal features. His model of geometry is given below:
Halle (1992) proposes a constraint that requires [+consonantal] to dominate the Oral cavity, restricting its implementation to the Place features. Halle (1995:7) describes this as a requirement that 'the designated articulator for [+consonantal] phonemes must be one of the three Place articulators, Labial, Dorsal, or Coronal'. Halle (1995:14) assumes that 'formally debuccalization renders the part of the feature tree that is dominated by the Place node invisible...Since these articulators have been rendered invisible by debuccalization, it will be assumed here that the phoneme is automatically changed from [+consonantal] to [-consonantal] and its designated articulator becomes the larynx—the only articulator still visible in the feature tree'.

In Halle’s (1995) version of debuccalization, the Place node is circled and deleted ('rendered invisible'), and though he does not use the term delinking, the end result is the same. He notes that after debuccalization, the Larynx is the only remaining accessible articulator, but the resulting tree is not well formed since his constraint requires that a [+consonantal] segment have a designated articulator that is dominated by the Place node. He assumes that debuccalization triggers ‘a special set of repair rules, which apply automatically at various points in the derivation and reestablish the well-formedness of the representation.’ (15). In addition, he notes that it is necessary to postulate a special pair of redundancy rules which explicitly relate the fact that stops become [c.g.] and fricatives become [s.g.]. He notes the rules and their effects as follows:

\[
\begin{align*}
\text{(6)} & \quad \text{a.} & \quad [-\text{cont}] & \rightarrow [+\text{const}\text{ gl}] \\
& & \quad [+\text{cont}] & \rightarrow [+\text{spread}\text{ gl}] \\
\text{b.} & \quad \text{Upon debuccalization a segment becomes [-consonantal] and its AF} \\
& & \quad \text{[Articulator-Free] dependent features are deleted.}
\end{align*}
\]
c. If the designated articulator is rendered inaccessible by the application of a
rule, one of the articulators that remains accessible assumes the function of
designated articulator. If no articulator remains accessible in a segment, the
segment—but not its timing slot—is deleted.

The redundancy rules (6a) are 'implemented at an early stage in the derivation' and appear
'to hold of obstruents in many languages' (16). However, care must be taken to ensure
that phonemic distinctions are not obliterated, since in some rules only ejectives, and not all
stops, debuccalize. The repair rule (6b) converts the segment to a glide, and (6c) eliminates
the AF features except [-consonantal], 'since none of these can be stipulated in glides' (16),
especially [continuant].

In Halle's model, crucial reference is made to the feature [consonantal], by the
stipulation of (6b), which turns the segment into a phonological glide. However, as we
have seen, in many languages the glottals [?, h] pattern with the true consonants, not glides
(Kenstowicz and Kisseberth 1979:244), so such a move is not true cross-linguistically. In
addition, the existence of the very feature [consonantal] has been called into question
(Hume and Odden 1994, 1996). If as they claim, [consonantal] is not a necessary
phonological feature, the description of debuccalization will be simplified. More specifics
of Halle's view will be critiqued in §5.3.4.

Kenstowicz (1993), using a Hallean model, describes debuccalization as the
delinking of the Oral node. Kenstowicz (1993:489) notes that:

'While the original insight that such debuccalization processes involve elimination
of the Oral Place specification is generally accepted, most subsequent researchers
have rejected the idea that the [±continuant] distinguishing the oral stops versus
fricatives is retained and expressed and expressed as a [?] vs. [h] opposition. (See
Durand 1987 and Iverson 1989 for defense of this view, however.) First, there is
little independent evidence that other processes group [?] with the oral stops and [h]
with the oral fricatives.'

Kenstowicz later notes that in many languages, the laryngeals pattern with the glides,
undermining the argument that the laryngeals pattern with the obstruents. However, this
misses the generalization that fricatives debuccalize as [h], glottalized stops debuccalize as
[?], and voiceless stops can debuccalize both ways. Kenstowicz continues his argument
against this view:
Second, while it seems true that fricatives reduce to [h] (instead of to [ʔ]), both Clements (1985a) and McCarthy (1988) suggest that this generalization reflects the phonetic fact that (voiceless) fricatives are produced with an open glottis (allowing the greater airflow required to generate the turbulence of an oral fricative). Rather, the received opinion is that the outcome of a reduced stop as [ʔ] vs. [h] reflects the laryngeal features of the original stop as glottalized versus aspirated.’ (1993:489)

He notes that it remains to be seen whether all languages go through the missing link of a glottalized (non-ejective) stop, as it seems to do in (most dialects of) English. However, there is little evidence that all debuccalized stops derive from glottalized ones. There must therefore be some ad hoc stipulation linking the feature [c.g.] to plain stops, much as Halle (1995) does in (6). Furthermore, the connection between [s.g.] and fricatives must be made specific and formalized in the grammar.

A Dependency Phonology approach to feature organization, and its relation to lenition may be found in Chapter 11 of Lass (1984). A fuller statement is in Anderson and Ewen (1987). An elementary introduction is found in Chapter Eight of Durand (1990), while a brief review of these issues as the relate to debuccalization is found in den Dikken and van der Hulst (1988:7). The basic insight is similar to other theories in that debuccalization is the loss of articulatory gesture, and preservation of the categorial gesture (roughly, laryngeal features). However, the formalization is quite different from other non-linear theories, and I refer the reader to the previous references for more.

An innovative approach to debuccalization is sketched by John Harris (1990, 1994), and Harris and Lindsey (1995) within the framework of Government Phonology, a theory akin to Dependency Phonology which replaces features with privative elements. Harris proposes to eliminate ‘overridable default rules’. He suggests that the element ? represents both ‘an abrupt decrease in overall amplitude’, to describe oral and nasal stops and laterals, as well as glottal stop independently, since ‘this is the only articulatory means of achieving an amplitude drop without introducing marked resonance characteristics into the signal’ (1990:263). The element h° represents obstruent continuancy, and glottal fricative in the absence of a supralaryngeal gesture.

Harris (1990:298) explains how these elements relate to debuccalization:

‘Under a feature-based analysis, debuccalisation in such instances involves either a switch in the value of [constricted glottis] from minus to plus or, if this feature is underlyingly unspecified, a spontaneous filling-in of the plus value. In neither case has the change any local motivation. In contrast, the element-based approach correctly predicts that, since all stop consonants contain ?°, all are susceptible to debuccalisation to ʔ, irrespective of whether or not they are glottalic.’

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Thus because all stops contain an element which represents both stops and glottal stop, distinguished by various government relationships, debuccalization to glottal stop is perfectly natural, whatever the original laryngeal features, since debuccalization is ‘a process by which the resonance properties of consonants are stripped away’—the delinking of the RESONANCE node (roughly akin to Place) (Harris and Lindsey 1995:68, 77). Furthermore, there is no need for feature changing or fill-in. However, Harris does not touch on how stops could debuccalize to [h], as occurs in Icelandic or Yucatec Maya, among others.

In Harris’ analysis, glottalized consonants are contour segments with a complex portion in which the place and manner elements are fused followed by a simplex portion containing ?”. Debuccalization of ejectives (and implosives) in a language like Arbore ‘consists in the loss of the segmental material contained in the first portion of the contour structure, leaving only the ?” of the original release portion’ (1990:282). It is clear from such a view that the element ?” performs double duty in ejectives as both the laryngeal feature [constricted glottis] and the stricture feature [-continuant]. While Harris’s suggestions are innovative and insightful, they remain controversial, and have not been adopted outside government phonology frameworks.

5.2.3. Debuccalization in Constriction-Based Feature Geometry

For this dissertation, I will assume the Constriction-based (or stricture-based) model of feature geometry proposed first as the Unified Feature Theory by Clements (1989c); see also Hume (1992) and especially Clements and Hume (1995). The model unifies both consonantal place features and vowel place features, which also act as consonantal secondary articulations. It was redubbed the Constriction-based theory because primary place of articulation and [continuant] comprise one node, Oral Cavity, just as vowel place and height are dominated by another node, Vocalic. This model is illustrated below in (7):
Based on this model, I predict four different types of debuccalization, as shown in (8) below. First, in (8a), is Root Node Delinking, then Oral Cavity (OC) Delinking (8b), then C-place Delinking (8c), and finally Individual Place Feature Delinking (8d).

These processes make different predictions:
(9) a: Segments lose all features contained in the Root node. A glottal segment must be supplied as a default (assuming compensatory lengthening or Stray Erasure do not apply). This type is best determined when features under the Root such as [nasal] and [lateral] are lost, and it can be shown that the glottal sound is a default. Different outcomes of debuccalization (such as both [h] and [ʔ]) argue against a single default, and hence are not characteristic of Root Node Delinking.

b: Segments retain their laryngeal features, but lose all features dominated by OC (place and continuancy). This type is the quintessential form of debuccalization.

c: Segments may retain [continuant] but lose all features dominated by C-place (primary and secondary place). Empirical evidence is lacking, but much depends on theory-internal assumptions.

d: Segments may lose individual place features but retain secondary place features, which are dominated by the V-place node under Vocalic. The result is a glottal with secondary articulation. It is detected only when secondary place features survive debuccalization.

We will now turn our attention to analyses of debuccalization of ejectives and other consonants in order to test whether the four different kinds of debuccalization are attested in the data. In order to tighten the theoretical arguments presented in this dissertation, I will not present the data in the usual manner strictly by synchronic, diachronic, and other categories. Instead, I will fit the data where they best support the argument, starting with Individual Place Feature Delinking in §5.3, then talking about the problems of indeterminacy in §5.4. Root Node Debuccalization is analyzed in §5.5, while many examples of Oral Cavity Delinking are reviewed in §5.6. C-place delinking and evidence for glottals with stricture features is found in §5.7. Miscellaneous dialectal and diachronic debuccalization round out the chapter. A brief summary and concluding remarks are in §5.9.
5.3. Individual Place Feature Delinking

Halle (1995) has claimed that 'debuccalization renders the part of the feature tree that is dominated by the Place node invisible', a definition which strongly implies that debuccalization is deletion of the Place node. However, given the definition which I proposed in the beginning of this chapter in which debuccalization is 'the loss of primary supraglottal articulation with retention of, or replacement by, a glottal gesture such as [h] or [ʔ]', then debuccalization may apply to individual place features, as I shall argue in this section. The Clements-Hume Constriction model of feature geometry predicts that segments may lose individual place features but retain secondary place features (8d), since secondary place, dependent under the Vocalic node, is independent of primary place, linked directly under C-place. For convenience, the graphic representation of this type of individual place debuccalization is repeated as (10):

(10) Place feature delinking: \( k^w \rightarrow ?^w \)

```
  Root
   \[ \]
  Oral Cavity
   \[ \]
     C-place
       \# [dorsal]
       Vocalic
        \[ \]
        V-place
         \[ \]
         [labial]
```

The representation above shows the debuccalization of an underlying labialized dorsal /kʷ/ to a labialized glottal stop /ʔʷ/ through the delinking of the individual primary place feature [dorsal] under the C-place node, while the secondary place feature [labial] remains intact because of the Vocalic node's independence under C-place.\(^7\) Articulator-based theories

\(^7\) Hume and Odden (1996:352) have claimed that 'since laryngeals lack supraglottal articulation, they have neither C-place nor V-place specifications.' Bessell (1992) has shown the overwhelming truth to this claim, formalizing it with her constraint on the Pre-eminence of Primary Place (PPP), which states that 'segments lacking a primary place of articulation will not accept a secondary articulation' (64). There is, however, a minority of languages which prevent Hume and Odden's universal tendency from becoming an absolute universal. Such languages include the Abzakh dialect of Adyghe (West Circassian), which has synchronically phonemic /ʔʷ/ and /ʔ/ (Paris 1989). Abdakh Adyghe has [ʔ], and Kabardian (East Circassian) has phonemic /ʔʷ/ (Colarusso 1989).
such as those of Sagey (1986) and Halle (1992, 1995) cannot account for such changes if debuccalization is loss of Place, since the Place node also dominates secondary articulation features (e.g. [round] under Labial, and [back] under Dorsal). In this section I present evidence from four languages (or language families) that suggests the need to recognize individual place feature delinking, and that argue for the independence of primary and secondary articulation features. For briefer articles derived from this section, see Fallon (to appear a, b).

5.3.1. Irish
Although Irish does not have ejectives, it is a language which illustrates synchronic alternations which I argue support the parameter of Individual Place Feature Debuccalization, the type which preserves secondary but not primary articulation. Irish (Ni Chiosain 1991:111-2, 1994; Kisseberth 1994:540), which has a whole series of palatalized stops, has a complex set of consonant mutations whose morphological or syntactic environments Ni Chiosain does not detail. Of interest here is the fact that coronals debuccalize such that /t, s/ both become [h], as in (11a) below, while the palatalized coronals /t̠, s̠/ also debuccalize, but preserve their palatal secondary articulation as [hJ], as shown in (b)-(d). Ni Chiosain dubs this process ‘Coronal Delinking’ (1994:91).

(11) Irish coronal lenition.

\[
\begin{align*}
\text{a.} & \quad \text{tetlín} & \quad \text{hetlínj} & \quad \text{teth:n} & \quad \text{mo} & \quad \text{hetlínj} & \quad \text{mo hethm-i} '\text{my cigarette}' \\
& \quad \text{tab} & \quad \text{halo} & \quad \text{mo halo} & \quad \text{my land}' \\
& \quad \text{simí} & \quad \text{himí} & \quad \text{mo himí} & \quad \text{my interest}' \\
& \quad \text{solós} & \quad \text{holos} & \quad \text{mo holas} & \quad \text{my light}' \\
\text{b.} & \quad \text{tiní} & \quad \text{hinní} & \quad \text{hirmí} & \quad \text{mo hirmí} & \quad \text{my interest}' \\
& \quad \text{toxít} & \quad \text{boxt} & \quad \text{boxt} & \quad \text{mo boxt} & \quad \text{my temperature}' \\
& \quad \text{shílin} & \quad \text{hílin} & \quad \text{shílin} & \quad \text{shílin} & \quad \text{mo hílin} & \quad \text{my cherry}' \\
& \quad \text{slóil} & \quad \text{hóil} & \quad \text{slóil} & \quad \text{mo hóil} & \quad \text{my sail}'
\end{align*}
\]

In addition, in the Lezgian branch of the Daghestanian family, Rutul contains a so-called pharyngealized glottal stop /h/ (Alekseev 1994a), also reported in Nootka (Sapir and Swadesh 1939, 1955; Jacobsen 1969). There is also the palatalized and glottalized glottal stop of Benchnon (Omotic; Breeze 1990), though see the competing description of Wedekind (1990b). Breeze (1988:478) records a palatalized glottal stop in Dizi, e.g. /pʰaːbɪl/ ‘man’. And Bura (Chadic; UCLA 1992) has both /h\textsuperscript{w}/ and /h\textsuperscript{l}/. For the voiceless glottal fricative, there is the Irish palatalized [h], discussed below. In addition, there are labialized [h\textsuperscript{w}]s in Igbo, Amharic, Hupa, and Siona (Maddieson 1984).
The palatalized consonants seem to be monosegmental for the following reasons: first, like in Russian, there is a fundamental dichotomy between velarised and palatalised segments, with a full range of pairs distinguished by the presence or absence of the feature [Palatalised] (Ó Dochartaigh 1992:82-83). Virtually all consonants have a palatalized counterpart. Second, Irish does not have an underlying palatal glide (or any glide) (Ó Dochartaigh 1992, Ó Chiosáin 1994), so since it never occurs independently, such ambiguous segments as [hJ] must be interpreted monosegmentally. The unit status of the palatalized consonants is further seen in spreading rules such as nasal assimilation, where both primary and secondary place spread, e.g. /k'æn/ ‘one’ vs. [k'æn'-g'æn] ‘a short one’ (Ó Chiosáin 1991:114). If the palatalized sounds were clusters, we would expect only the place of the first consonant in the cluster to spread, e.g. hypothetical /k'æn-g'æn/ → *[k'æn-g'æn], which is obviously incorrect. Therefore the data above do illustrate debuccalization with preservation of secondary articulation, and not simply debuccalization within a cluster of a coronal obstruent before a coronal glide.

Ó Chiosáin (1991:113) argues that if laryngeals are indeed placeless, ‘only a representation in which primary and secondary place features are represented independently can characterize laryngeals with secondary articulations in known phonetic/phonological inventories’. And I would add, only a theory which has representations in which secondary place features are independent of primary place, can account for debuccalization of primary, but not secondary, features. I formalize Irish debuccalization below as the delinking of the individual place feature [coronal] from C-place, but with retention of the Vocalic node, which contains the features necessary for palatalization. The result is a placeless but palatalized glottal. (I assume the Laryngeal features, redundantly specified for [s.g.], remain intact).
Phonologically, how can a voiceless stop debuccalize to [h]? Phonetically, Irish stops are aspirated (Maddieson 1984:263), though I am not aware of phonological evidence that would insist on the voiceless stops being represented underlyingly with [spread glottis]. Historically, the coronal lenited to [θ] (Thurneysen 1946), which then debuccalized to [h]. It is widely assumed that fricatives are at least phonetically [s.g.], as mentioned above in §5.2.2, so that would account for /s, s'/ debuccalizing to [h, h']. Yet synchronic phonology does not always reflect historical change, and so we must be prepared to admit such morphophonemic changes as /t, t/ → [h, h'], most likely either by positing the stops as aspirated by redundancy, or by using [spread glottis] as a default. Note also that Irish has no glottal stop, so the glottal fricative is the only placeless segment available if debuccalization is to avoid introducing new phones.

Individual place delinking is only called into use (and empirically verifiable) when there is debuccalization with preservation of secondary articulation. One prediction of this type of debuccalization is that it will affect only one place of articulation, since if two places were affected, with two individual delinkings, it would undermine the idea that it was a single process. In Irish, with its extensive set of palatalized labials, coronals, and dorsals, only the coronal obstruents lenited in this way. Although there are only a handful of cases I can document to support individual place delinking, none show evidence of delinking more than one place of articulation.

5.3.2. Circassian

5.3.2.1. Data

Further support for individual place delinking comes from several diachronic cases, including Circassian (Northwest Caucasian). Kuipers (1963:72) has reconstructed Proto-
Circassian in some detail and notes the correspondence of uvulars in the Hakuči subdialect of Šapsug, compared to glottal stop in Šapsug, other West Circassian varieties such as Bžedux and Temirgoj, and in closely related Kabardian (East Circassian). Here are two such correspondence sets:

(13) Hakuči        Kabardian
q'ɑ  ?ɑ          ‘hand’
qʷɑ  ?ʷɑ          ‘speaking; threshing’

As the data show, plain uvular ejectives debuccalize to glottal stop in Kabardian, which is not at all unusual. What is interesting, however, is the preservation of labialization as a secondary articulation, even on glottal stop, despite the loss of primary place. Catford (1992:196) also observes that in the Northwest Caucasian languages, Proto-Circassian (PC) *q’ and *qʷ regularly became /ʔ/ and /ʔʷ/ (except in Hakuči and other Šapsug dialects).

Kuipers (1975) carefully reconstructed Proto-Circassian roots, using Bžedux as a representative dialect of West Circassian. The correspondence set Šapsug uvular ejective : Bžedux glottal stop enabled Kuipers to reconstruct uvular ejectives in Proto-Circassian, which did not have a phonemic glottal stop. The back consonants of PC include: *kʰ k: g k’ x y, kʰw kʷw xʷ, qʰ q: q’ x s, qʰw qʷw q’w xʷ, h; the unrounded velars are phonetically palatal [c, c’] etc. in daughter languages like Kabardian, though Kuipers does not mention their status in PC. Here are some examples of the debuccalizing data set, from Kuipers (1975). Forms with (T) indicate the Temirgoj dialect. In (14a) and (14c) below, the forms are in initial position; (b) and (d) illustrate medial position. Kuipers (1963, 1975) noted different outcomes when the uvulars were in a cluster, which will not be examined here.

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8 Another logically possible analysis is that simple debuccalization took place and the labialization results from fusion of glottal stop, followed by a labiovelar glide. Precedent for such an analysis can be found in Hausa /ʔ/ from *dij, where the voiced implosive has debuccalized, and, apparently after a syncope rule, the palatal glide is realized as palatalization on the glottal stop, after apparent fusion of the two segments. Compare Sokoto dialect [d̪iːjɑː] ‘daughter’ with Kano dialect [ʔaː] (Schuh and Yalwa 1993:79). However, labialized consonants are found in many series of Northwest Caucasian consonants, e.g. Hewitt (1989b) states that Abkhaz /tʷ, čʷ, kʷ, qʷ, hʷ, jʷ/ act as phonological units; cf. Russian palatalized consonants. Therefore I do not think there are sound phonological reasons to doubt that debuccalization happened in one step, as detailed below.

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The labialized consonants are traditionally analyzed as units, not clusters, in both PC and Circassian, e.g. Kabardian, largely because only posterior consonants (velar, uvular, pharyngeal, and glottal) are labialized. Ninety-six percent of consonants with labialized consonants have labialized dorsals (Bessell 1992:64). Glides (or any sonorant consonant for that matter) do not otherwise occur after any other consonant. The relative timing of the sounds also seems closer to unit sounds (with one C-slot) rather than to clusters (with two C-slots), judging from spectrograms in Colarusso (1988). Finally, the labialized consonants in the coda induce vowel-coloring effects on preceding vowels, e.g. /dəʔw/ → [dəʔw], /ɪʔəkʷ/ → [ɪʔəkʷ'], and /c'əʔwa/ → [c'əʔwa]. If the labialized consonants were clusters, the rounding would need to spread regressively onto the posterior consonant anyway in order to avoid adjacency violations, e.g. hypothetical /dəʔw/ → [dəʔw] → [dəʔw], thereby creating the segments in question anyway.

The correspondence between uvular ejectives and glottal stops does not necessarily mean that there was a direct sound change. For example, David Odden (p.c.) has
suggested that perhaps the uvulars underwent a process of becoming pharyngeals, before becoming glottals. Such a change of uvular to pharyngeal occurred in Interior Salish (Kuipers 1981), Nootkan (Jacobsen 1969), and also in Zerq’ Chechen *ti’ q’ > ti’ ñ (Fallon 1994). Alternations or change between pharyngeal ⧃ and ? are found in Semitic, e.g. in a stage of Neo-Aramaic (Hoberman 1985), in Hebrew (Rose 1996), and in Tigre (Raz 1983). However, I believe such a change was unitary debuccalization in Circassian. First, debuccalization is fairly typical of velar or uvular stops. Second, the voiceless pharyngeal in Circassian did not change, e.g. *ha > Bzhedukh /ha/ ‘barley’. Third, such a change would involve two changes in voicing: q” > ð” > ð’, and debuccalization is simpler than the other, rarer changes, and has the advantage of being formally easy to express as delinking of uvular place.

Next we will formalize this rule, but in so doing, we come across a problem with representing uvulars.

5.3.2.2. The Problem of Uvulars
The representation of uvulars presents the analyst with an embarrassment of riches: there are many possible such representations, especially as new structure and features are added. The problem is trying to determine which is correct for a given language, and deciding whether to permit parametric variation of different representations of uvulars. Cole (1987:93) was apparently the first to propose that Coeur d’Alene uvulars are complex segments, with two places of articulation, dorsal and pharyngeal (cited in McCarthy 1989). McCarthy (1989) examined the representation of gutturals in Semitic phonology, and proposed that the gutturals /χ, ʕ/ (McCarthy’s <X, γ>), analyzed as approximants, have a branching [dorsal] and [pharyngeal] place, where a redundant [-glottal] is dependent from [pharyngeal], while the uvular stop /q/ has the same representation, but is marked as [-approximant]. The same basic proposal may be found in McCarthy (1994). Herzallah (1990) examined the so-called back velar /k/ (which is not a uvular) in Palestinian Arabic, and represents it within the Constriction-based framework of Clements (1989c) with a branching [dorsal] and [pharyngeal] under C-place; Arabic ‘emphasis’ is argued to be [dorsal] and [pharyngeal] under V-place.

Elorrieta (1991) has argued that uvulars have two possible representations: one, a pure dorsal, in which Dorsal is specified as [-high] and [+back], and the other, a complex segment with two branching places, both Dorsal (under an oral node), and Pharyngeal, which is further specified for Tongue Root features such as [+RTR]. These latter types of
uvulars, which Elorrieta proposes for West Greenlandic Eskimo and Coeur d’Alene, trigger pharyngealization and/or lowering/backing in adjacent vowels. Trigo (1991) also considers two different representations of uvulars. The variable status of uvulars is also noted by Parkinson (1993), who proposes that uvulars which participate in guttural transparency do not bear [dorsal] features, but rather, are specified for [oropharynx] under the feature [pharyngeal]. See also Rose (1996) for representations of gutturals and laryngeals.

Related to the feature content of uvulars is the question of how the feature [pharyngeal] is organized in feature geometry. McCarthy (1994), for example, proposes that the Place node is organized with the feature [pharyngeal] and its sister, the Oral node, which dominates [labial], [coronal], and [dorsal]. Parkinson (1993) adapted this model to the Clements-Hume model. Kenstowicz (1994 §9.2) interprets one incarnation of McCarthy’s proposals, such that there is a Pharyngeal class node of articulation, sister to the Oral node. The Pharyngeal node dominates the features [dorsal] (which is also under Oral), [radical], and [pharyngeal], and is used to capture the class of gutturals. In this framework, uvular stop is realized as [dorsal] and [pharyngeal], with Dorsal under Oral, and [pharyngeal] under Pharyngeal (15a). The uvular guttural fricatives/approximants, however, are under the Pharyngeal place, with branching [dorsal] and [pharyngeal] (15b). The different representations account for the fact that /q/ does not pattern with the gutturals in Semitic. These representations are schematized below:

\[(15)\]
\[
\begin{array}{c}
\text{Place} \\
\text{Oral} \quad \text{Pharyngeal} \\
[\text{dorsal}] \quad [\text{pharyngeal}]
\end{array}
\]

\[
\begin{array}{c}
\text{Place} \\
\text{Oral} \quad \text{Pharyngeal} \\
[\text{dorsal}] \quad [\text{pharyngeal}]
\end{array}
\]

Now that we have reviewed some current representations of uvulars, we return to the problem of debuccalization in Circassian. Recall that plain and labialized uvulars debuccalize to plain and labialized glottal stop. Debuccalization of the uvular could simply be delinking of C-place. However, the problem arises with the preservation of labialization. I assume that the feature for labialization is [labial] under V-place, which is a daughter of Vocalic, which is a sister to either the place features, or, most likely, the
Oral/Pharyngeal nodes, under C-place. If C-place (or any node higher) is delinked, however, Vocalic would be lost. Since the uvular debuccalization must have been one process, there must be another solution. That would involve going further down the tree, in order to preserve Vocalic. However, if uvulars are represented with branching place specifications, then individual place feature debuccalization would involve two delinkings. This goes against the most common tenets of autosegmental theory. We could, as Halle (1995) does, permit two terminal features to spread together, and thus two could theoretically delink as well. But this proposal is quite controversial, and undoes some of the basic assumptions of nonlinear phonology. Even if uvulars had an oral [dorsal] specification and a secondary [pharyngeal] specification under V-place, as Trigo (1991) has suggested, there would need to be two delinkings, unless, say, the secondary [pharyngeal] (but not [labial]) were lost as a repair. Some of the two-delinking solutions are shown below for /qʷ/ → [?]:

(16) a. Herzallah  
     Root
     |  OC
     |   C-place
     |     ≠ ≠
     |       Dorsal Phar Vocalic
     |         [labial]

(17) a. Trigo  
     Root
     |  OC
     |   C-place
     |     ≠
     |       Dorsal Vocalic
     |         [labial] [pharyngeal]

We will adopt the McCarthy/Kenstowicz representation of uvular fricatives and apply it to the uvular stops. There is no principled reason why a uvular stop could not be represented in the same manner as uvular fricatives. In this case, loss of uvular stop would be expressed in one delinking, as loss of Pharyngeal. Applying (15b) to the Clements and Hume (1995) constriction model, we get the following representation:

(17) 

C-Place
   ≠
   (Oral) Phar. Vocalic
   |   [dorsal] [phar] V-place
   |       [labial]
Recall that Proto-Circassian did not have an extensive set of gutturals. Kuipers reconstructs no laryngeals, and only the voiceless pharyngeal fricative /h/, which would lack the [dorsal] branch under Pharyngeal. There is an extensive set of plain and labialized uvular stops and fricatives, in addition to velar stops and fricatives.

I know of no phonological evidence that would conclusively argue for the representation I am assuming in (17). However, in the daughter language Kabardian, Woods (1991) discusses the vowel allophones of Kabardian's two vowels /a, a/ and notes that plain uvulars condition the non-low vowel to become backed to [u], which I analyze as the spread of [dorsal], and the low vowel is backed to [a], which could be seen as the spread of [pharyngeal] (Woods notes no velar component in this allophone), though in this case the spreading is across tiers, from C-place/Pharyngeal to V-place. The interpretation of vocalic allophones is a controversial area (Kuipers 1960, Catford 1977, Anderson 1991, Choi 1991). Choi conducted an acoustic study of the vowels, and, assuming three phonemic vowels /i, a, u/, provides the formant values for each vowel. He transcribes the allophones for plain velars as [uw ¥ a] (velarized, or dorsalized), while the plain uvulars trigger uvularized allophones [w* ¥ a*], which could be analyzed as both [dorsal] and [pharyngeal] (to be distinct from the velar allophones). Therefore, this seems to be some evidence that uvulars are specified for [dorsal] and [pharyngeal], as is commonly assumed. However, whether these features are directly under C-place (or Place) in analyses like Elorrieta's, or Herzallah's, or as some type of secondary articulation under V-place (Trigo 1991), two delinkings would be involved. Therefore, grouping them both under a Pharyngeal node, which is a sister to Vocalic, accounts for the data as deletion of uvular place, with preservation of labialization, something which other models cannot do. After reviewing the data on Abdakh in the next section, we will revisit the representation of uvulars.

5.3.2.3. Abdakh

Another process of Individual Place Feature Delinking also occurs in Circassian, though this time the glottal stop preserves a palatal quality in Abdakh. Catford (1992) comments that the Proto-Circassian 'hushing' lamino-postalveolar sibilant ejective affricate *tc' has the reflex of a palatalized glottal stop /?V in the Abdakh (or Abadzakh) dialect of Adyghe; the language also historically debuccalized the uvulars, as described above. As Catford puts it, 'the oral articulatory occlusion has been lost, but a trace of the fricative part of the affricate, the configuration of the fore tongue, has remained, as a slight palatalisation of the
Citing his (1982:346) work on spectrograms of this sound, Catford notes that F1 and F2 of the vowels flanking the Abdakh word /maʔe/ 'a little', reach 500 and 1900 Hz respectively, ‘indicating mild palatalisation, and being, in fact, a residual trace of the convex tongue configuration of the former affricate’ (1992:196).

Some examples follow:

(18) a. Bzhedukh /maːca/ 'a little, few' (Kuipers 1975)
    Kabardian /maac’a/ ‘little, few’ (Colarusso 1992:144)
    Abdakh /maʔe/ ‘a little’ (Catford 1992)

b. WC /tcj’ale/ ‘youth, male child’
    Abdakh /ʔj’ale/ ‘youth, male child’ (Colarusso p.c.)

Phonologically, this could be seen as preservation of V-place [coronal] on a segment specified with primary coronal place and dependent features [-anterior, +distributed], a place which, through Individual Place Feature Delinking, debuccalizes to the palatalized glottal stop in Abdakh. I formalize this process below:

(19) C-place
    ┌─ Vocalic
    │   ┌─ V-place
    │   │   ┌─ ant [4-distr] V-place
    │   │   │   ┌─ coronal
    │   │   │   └─ coronal
    │   │   └─ [coronal]
    │ ─ [coronal]
    └─ [coronal]

Abdakh is thus the only language I know of which at least historically has undergone debuccalization at two places of articulation (alveopalatal and uvular), and preserved the secondary articulation on both. This appears to be a counterexample to the claim that a language which delinks an individual place feature will do so at only one place of articulation. First, I do not have any information on whether both processes applied simultaneously, so it is possible they occurred separately in time. Second, if we accept the representation of uvulars as Pharyngeal, and the postalveolar as a type of coronal, then the delinking applies to different structures: to the subplace class node Pharyngeal for uvulars, and to either Oral or [coronal] (as shown in (19)) for the lamino-postalveolar. Thus I do not believe a generalization is missed, since different structure is delinking. This is different from cases in which [labial] and [coronal] and [dorsal], all under C-place, delink
separately in what is one process. Note also that in Abdakh the secondary places are different: [coronal] for the postalveolar, and [labial] for the uvular.

The predictions of a model with Pharyngeal uvulars in terms of spreading and natural classes await further confirmation. The introduction of Oral and Pharyngeal creates an additional possible type of debuccalization: delinking of subplace class nodes, as opposed to individual place features (though for convenience, I treat the deletion of Pharyngeal in this section). One prediction of this model is confirmed by Circassian: Pharyngeal may delink (debuccalize) without affecting Oral. This formalizes why in Circassian the uvulars delink while the Oral consonants do not. (Kashaya, discussed below, has a rule of uvular debuccalization, and Egyptian and Levantine Arabic have debuccalized only /q/). Further predictions include the delinking of Oral, with Pharyngeal remaining unaffected. For example, /p' t' k' \rightarrow [?], while /q' \rightarrow /\text{unaltered}. I know of no such case at this time, though it could make sense phonetically, given that uvular ejectives are usually quite robust phonetically. Historically, Chechen non-uvular ejectives underwent voicing in non-initial position (Sommerfelt 1938 and Chapter 7), which supports Oral as the target of a natural class, as opposed to Pharyngeal. Therefore, since the Oral ejectives were targeted for a process, there is no principled reason to rule out Oral (but not Pharyngeal) debuccalization as a possibility which awaits empirical confirmation. Other predictions would include delinking of one or both specifications of place features ([dorsal] and [pharyngeal]) under Pharyngeal. McCarthy (1989) has proposed this to account for the changes of Classical Arabic to Egyptian and/or Levantine Arabic /q/ > /g/ (as loss of [pharyngeal]), and /q/ > /\text{loss of [dorsal]}, while Trigo (1991:128) considers delinking different components of uvulars to describe changes to pharyngeals, as in Proto-Nootkan *q' \rightarrow Nootka /\text{q/}, and Kedah [s] to the pharyngeal [s]. It remains to be worked out what these changes would entail in the Constriction-based model I am assuming here. Finally, I should note that if these subplace class nodes are required by the phonology of various languages, then the importance of secondary articulation as a diagnostic for Individual Place Feature Debuccalization becomes less important; instead, Individual Place Feature Delinking could be determined in part with respect to whether Oral and/or Pharyngeal places of articulation debuccalize.

5.3.3 Yuman and Guddiri Hausa
Another case of debuccalization with preservation of secondary articulation comes from evidence in the Yuman languages (Wares 1968, Kendall 1983). Proto-Yuman contained
*kʷ*, which was preserved in the daughter languages. However, many Yuman languages changed the labialized velar *kʷ* to the labialized glottal /hʷ/. Compare, for example Diegueño /xʷát/ vs. Walapai /hʷát/ ‘blood’, or Tipar /maxʷá/ ‘badger’ and Paipai /maxʷá/ ‘pig’ vs. Kiliwa ‘pig’, Mohave ‘badger’ /mahʷá/ (Wares 1968). I analyze this as the delinking of the [dorsal] place feature, while Vocalic, with its V-place bearing the feature [labial], remains unscathed.

The Guddiri dialect of Hausa is spoken mainly in the ‘defunct Katagum Division of the Bauchi State of Nigeria’ (Bagari 1982:244). Guddiri does not have /k'/, as in the standard Kano dialect; all tokens have undergone debuccalization. Examples in initial position are shown in (20a), while those in medial position are shown in (20b).

Unfortunately, the source for this data does not contain enough material to provide convincing arguments that these are unit sounds, so here the transcription is taken at face value.

\[
20
\]

\[
\begin{array}{llc}
\text{Kananci} & \text{Guddiranci} & \text{Kananci} \\
\hline
k'eetaa & ?eetaa & 'wickedness' \\
k'aunaa & ?aunaa & 'love' \\
k'ootoo & ?ootoo & 'feeding' \\
k'uunaa & ?uunaa & 'to burn' \\
mak'ijii & ma?ijii & 'enemy' \\
mak'eerii & ma?eerii & 'blacksmith' \\
mak'ee & ma?ee & 'to cling' \\
mak'alee & ma?alee & 'to stick' \\
mak'aa & ma?aa & 'good luck' \\
mak'oogoro & ma?oogoro & 'throat' \\
mak'oo & ma?oo & 'yearning' \\
fak'uwaa & fa?uwaa & 'hiccup' \\
fak'u & fa?u & 'suffocate' \\
\end{array}
\]

The labialized and palatalized velar ejectives of the Kano dialect also do not occur in Guddiri as the result of debuccalization; however, the labialization and palatalization are preserved on the glottal stop:

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Guddiri Hausa thus presents us with another case of individual place delinking. And, as the theory predicts that secondary articulation (under Vocalic) is independent of individual primary place features, we do find what is expected. In addition, both palatalization and labialization are preserved—the actual specification for V-place is irrelevant, since the Vocalic node as a whole is preserved in individual place feature delinking. Guddiri also provides telling evidence against the Articulator-based model of feature geometry, which will be discussed next.

5.3.4. A Critique of Halle’s Theory of Debuccalization

Halle (1995:14) has claimed that ‘formally debuccalization renders the part of the feature tree that is dominated by the Place node invisible’. This claim entails that there is no debuccalization which deletes individual place features, but as we have seen synchronically in Irish, and diachronically in Circassian, Yuman, and Guddiri Hausa, debuccalization (as I have defined it), may delete individual place features. Therefore, the definition of debuccalization needs to be broadened to include these cases.

Guddiri Hausa’s palatalized velars demonstrate the failure of the articulator-based model of feature geometry (Sagey 1986, Halle 1992, 1995). As we have seen in (5), secondary articulation features are represented as terminal features under one of the Place features. Palatalization is commonly thought to be represented as [-back], which is dependent from the Dorsal node; if one were to use [+high], as in Chomsky and Halle (1968), this feature is also under Dorsal. Thus if the Articulator theory permits Individual Place Feature Delinking, then delinking of Dorsal entails loss of [-back]. Thus there is no way that palatalization may be preserved on a ‘Placeless’ segment. In Halle’s system, loss of a major articulator requires a new one, usually Larynx, to be invoked. Here I adopt Kenstowicz’s notation of an asterisk to mark the designated articulator in lieu of the Sagey/Halle pointer arrow. I illustrate the failure of the Articulator model to capture
Guddiri debuccalization, even allowing Individual Place Feature Debuccalization, in (22), and the success of the Constriction model in (23):

(22) Guddiranci Debuccalization in Articulator Geometry

\[
\begin{array}{ccc}
\text{Root} & \rightarrow & \text{Root} \\
\text{Place} \downarrow & & \text{Place} \\
\text{Guttural} & \neq & \text{Guttural} \\
*\text{Dors} & \downarrow & *\text{Larynx} \\
\text{[\[-back\]}} & \downarrow & \text{[c.g.]} \\
\end{array}
\]

Since loss of Dorsal entails loss of [-back], debuccalization in Articulator Geometry yields the incorrect output of plain glottal stop instead of palatalized glottal stop.

(23) Guddiri Debuccalization in Constriction Geometry

\[
\begin{array}{ccc}
\text{Root} & \rightarrow & \text{Root} \\
\text{Lar} \downarrow & & \text{Lar} \\
\text{Oral Cavity} & \neq & \text{Oral Cavity} \\
\text{C-place} & \downarrow & \text{C-place} \\
*[\text{dorsal}] & \downarrow & *\text{Vocalic} \\
\text{V-place} & \downarrow & \text{V-place} \\
\text{[coronal]} & \downarrow & \text{[coronal]} \\
\end{array}
\]

Recall that in the Constriction model, palatalization is represented with [coronal] under V-place (Hume 1992). Since it is under Vocalic, which is independent of individual place features (though not C-place), secondary articulation may remain, even after primary articulation is debuccalized. Although I do not have cases of rounding surviving the debuccalization of Labial (/p*/ \rightarrow [ʔʷ]), this change would be inexpressible under the Articulator model, but permitted under the Constriction model.

Another problem with Halle's account involves redesignation of the designated articulator. Halle's repair rule (6c) states that 'if the designated articulator is rendered inaccessible by the application of a rule, one of the articulators that remains accessible
assumes the function of designated articulator’. We saw such a principle shift the designated articulator from Dorsal to Larynx in the Articulator model. However, consider the Guddiri labialized velars. These sounds would be represented with Dorsal as the designated articulator, and also [round] under Labial, which, not being the designated articulator, acts as a secondary articulation. When Dorsal gets delinked, Labial is available to act as a designated articulator, yet it gets passed over, in Halle’s system, in favor of Larynx. This is necessary in order to show that the primary place of articulation is now the Larynx, while secondary articulation is Labial ([ʔʷ]). If Labial were to become designated articulator, the end result would be [pʷ'], which is incorrect. Examine the representation in (24):

(24)  

Likewise, in Irish, in this framework, when Coronal is delinked, although there is still the Dorsal node, which specifies [-back], it is passed over as a remaining, accessible articulator. In fact, in Irish, if we assume with Lombardi (1991) that voiceless stops have no Laryngeal node, then in Halle’s account, not only is an eligible articulator passed over, but new structure (Larynx) would have to be interpolated in order to become the designated articulator. Recall that it is unclear at what point Irish voiceless stops are specified for [spread glottis].

In Halle’s account, the reason such potentially eligible structure is passed over is due to a constraint:

(25) ‘The designated articulator for [+consonantal] phonemes must be one of the three Place articulators, Labial, Dorsal, or Coronal’. Conversely, if the designated articulator is the Soft Palate, Tongue Root, or Larynx, the phoneme must be [-consonantal]. (1995:7)

Recall Halle’s repair (6b), which states that ‘upon debuccalization a segment becomes [-consonantal] and its [Articulator-Free] dependent features are deleted.’ Halle defined consonantal as follows:
‘In producing a [+consonantal] phoneme, an articulator must make full or virtual contact with a stationary part of the vocal tract so as to create a cavity effectively closed at both ends; no such cavity must be created when [-consonantal] phonemes are produced.’ (Halle 1995:7).

For Halle, an articulator is part of the vocal tract anatomy ‘capable of changing the geometry of the cavity or determining the manner in which it is excited’ (1995:2). The vocal tract components that meet this condition are the six articulators encoded in Halle’s geometry: the lips, tongue blade, tongue body, soft palate, tongue root, and larynx. This definition is puzzling with its requirement that a cavity be effectively closed at both ends. For example, during production of [p], the lips make full contact with what Halle considers a stationary part of the vocal tract, the lips, yet at the other end of the oral and pharyngeal cavities, the glottis is open, and often spread. Where is the cavity closed at the other end? Only perhaps in [p’] would it be closed at both ends.

Counterevidence for (25) comes from consonantal segments that seem to be articulated in the pharynx, which require the distinction of stricture features. Chechen, for example, has a voiced pharyngeal fricative in contrast to what appears to be a pharyngeal (or perhaps epiglottal) stop (Catford 1983, Fallon 1991, and Ladefoged and Maddieson 1996). This also contrasts with glottal stop and a voiceless pharyngeal fricative. Compare:

(27) joʔ ‘daughter’ qaʔ ‘three’ tiʔ ‘save PRES’ loh ‘please give’
    maʔ ‘horn’ īsaʔ ‘one’ tæʔ ‘learn’ d-æh ‘fear not’
  (Fallon 1993)

Dahalo has a contrasting epiglottal fricative and stop: /pʰənina/ ‘hit’ vs. /pʰuʔu/ ‘pierce’ (Maddieson, Spajić, Sands, and Ladefoged 1993:31). And the Burkikhan dialect of Agul (data from Kodzasov, cited in Ladefoged and Maddieson 1996:38) has a similar contrast: /meʔ/ ‘whey’ vs. /jaʔ/ ‘centers’. Therefore there are: (1) obstruents which do not have either Labial, Coronal, or Dorsal as primary place; and (2) stricture distinctions among pharyngeal sounds, which would have to be represented in Halle’s system with Larynx (or Tongue Root) as the primary articulator. Halle’s constraint is not, therefore, universal, and should allow for glottal and pharyngeal consonants which are not glides.

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If these sounds were glides, then presumably they could not bear the stricture features which appear necessary to distinguish stop from homorganic fricative.

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Thus repair (6b), which deletes AF features like [cont] may not be justified for every language.

In sum, in Halle’s analysis the process of debuccalization requires a phoneme to change the feature specification of [consonantal] to [-cons], which by a constraint, automatically changes designated articulators in order to ensure the correct primary place. In the Constriction model of Clements and Hume, this somewhat baroque apparatus is unnecessary because secondary place features are encoded under V-place, while primary features are encoded under C-place.

A possible solution for the articulator model may come from Kenstowicz (1994), who proposes that complex segments (those segments with double articulation or secondary articulation) actually bear two Oral (Place) nodes. (28a) below is the representation given by Kenstowicz (1993:149) of a generic /kˤ/, in which he incorporates McCarthy’s (1988) suggestion for a separation between Oral and Pharyngeal Place features, and Halle’s (1992) suggestion (later revised) that voicing be expressed under the Glottal node. Now compare (28b), which is the representation he provides for Proto-Romance /kˤ/ a few pages later (1994:162) to illustrate the reflex of this sound in Romanian as [p].

(28) Two representations of the labialized velar [kˤ]

(a) Modified Sagey-type model

[+cons, -son] oral pharyngeal [-cont]

* dorsal labial glottal

[+round] [-voiced]

(b) Kenstowicz’s proposal

[+cons] oral oral [-cont]

* dorsal labial

Kenstowicz omits the Pharyngeal node from (28b), and analyzes loss of secondary (minor) articulation as deletion of the Oral node without an asterisk, which indicates primary (major) articulator. After such a process, the remaining Oral node is designated as primary (something which shouldn’t happen to describe /kˤ/ → [ʔʰ]. *[pʰ’]). He describes this process by saying that ‘complex segments with a primary and secondary articulation often reduce by loss of one of the two articulators’ (1994:161). In such a model, debuccalization could be expressed as the delinking of the Oral node which bears the primary articulator,
without reassigning the remaining Oral node as a primary articulator. The result would be (with other appropriate changes) a glottal stop with secondary articulation.

In referring to Sagey’s model, Kenstowicz (1993:455) seems to approvingly cite Sagey (1988), who claimed that the stricture features of secondary (or minor) articulations are never contrastive in a given language. A representation with branching (Oral) Place to Dorsal and Labial features could thus represent [kʷ], [k̑], or [k̑p], which are distinguished phonetically in her model by adding different stricture specifications under the Place features.

Sagey (1986) explicitly argued against representations such as (28b). She disallowed branching class nodes within a segment. Additional arguments she provides come from nasal assimilation data in Kpelle, Yoruba, and Dan (1986:100-105). In cases of nasal place assimilation to a following labiovelar stop, the nasal is also realized as a labiovelar. For example, in Yoruba / o m ñgbo/ ‘he is hearing’ is realized as [ó nm ñgbo]. In Kenstowicz’s model, there is no way to assimilate to both nodes without crossing Association Lines. Thus, in Kenstowicz’s system, if a preceding Labial nasal, as in Yoruba, assimilates to a following labiovelar nasal, there will be either incomplete assimilation of place if only one Oral node spreads, complete assimilation if the Root node spreads, or crossing of association lines if both Oral nodes spread:

(29)

Kenstowicz’s model is an improvement over Sagey’s (1986) and Halle’s (1995) models in that it can represent the preservation of secondary articulation even after debuccalization, though presumably there would need to be some suppression of the convention which assigns the asterisk in certain instances, perhaps with a concomitant change from [+consonantal] to [-consonantal]. However, a new problem with this model develops. Although the Place features themselves are presumably on different tiers, the creation of two Oral nodes creates problems with adjacency and crossing of association lines, as we have seen. Thus an Articulator-based model is descriptively inadequate, while a Constriction-based model is able to express various debuccalization processes. This reflects well on the Constriction-based model, with its descriptive superiority, and also

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illustrates its predictive power, since the Vocalic node as a dependent of C-place was designed for other reasons (Clements and Hume 1995).

Halle's assumption that glottals are [-consonantal] (glides) is controversial. Though they may be [-consonantal] according to Halle's definition (26), they do not always pattern with glides, as we have seen above. In fact, often they are treated as obstruents ([-sonorant]). They are assumed to be such by Bessell (1992) and Buckley (1994), for example. Kabardian provides evidence that the glottal stops pattern with the [-sonorant] segments and thus cannot be [-consonantal]. As we saw in Chapter Three on assimilation, the second person verbal index /w/ undergoes fortition to a stop which agrees in voicing (but not ejection) with the following consonant. Examples which illustrate the underlying form are shown in (30a), while fortition before voiced and voiceless stops are shown in (b), fricatives in (c), and glottals in (d). The failure of sonorants /m, w, j/ to induce fortition is shown in (e).

(30) a. Underlying glide

/ø-w-a-sɔ-t/ — [wozit]
‘May (might) I give it to you?’ (1992:111)

/ø-q’ɔ-w-a-d-ka-a-laãw-as-c/ — [q’uwëwësehɔwəsɔc]
‘We showed it to you’ (1992:139)

b. Fortition before stops

/ɔ w-pa-plɔ-a-n-w-c/ — [ɔppeplɔnux]
‘I will wait for you (at some definite time)’ (1992:98)

/ø-q’ɔ-w-t-j-a-s-ɔ-a-s-c/ — [q’ɛpbeesɔc]
‘I stole it from you’ (1989:287)

/ɔ-ø-w-da-k’w’-a-n-c/ — [sɔq’ɛb.dok’kw’ënc]
‘I shall go with him (some time)’ (1989:287)

/ɔ-ø-w-da-g’w’+fiə-a-s-c/ — [sɛbdog’ifiəc]
‘I was joking with you’ (1992:116)

/ø-q’-w-da-gha-c/ — [q’əbdəc] ‘you sewed it’ (Colarusso p.c.)

c. Fortition before fricatives

/ø-q’ɔ-w-t-laaãw-ə-as-c/ — [q’ɛpblaaãwəsɔc]
‘You saw him/her/it’ (1989:287)
/ø-wał-a-k’ə-sa-ma-a/c/ → [piek’əmii]

‘Even if you could do it...’ (1992:87)

/ø-w-c’ə-s-c’ə-ax-c/ → [pci’esc’dc]

‘I did it for your sake’ (1992:110)

/ø-q’ə-w-cha-pə-rə-k’ə-ax-c/ → [q’ærchemi:k’əz]

‘It went over your head’ (1992:103)

/ø-w-ʒə-a-s-a-a-pə-fə-n-w-c/ → [β3e:ksi:tefib\n]

‘I shall be able to make him retell it to you (at some definite time)’ (1992:121)

/ø-q’ə-z-a-rə-jə-wbə-a-tə-ʒə-n/ → [q’izeri:hek\n]

‘You should (must) make him give it back (to you)’ (1992:138)

/wasa-f’ ø-q’ə-w-hə-n-c/ → [q’æphinc]

‘you will be honored’ (1992:130)

d. Fortition before glottal stops

/ø-w-jə-c’ə-s-i-ha-ax-c/ → [pi’esc’sfh\n]

‘I laid it in your hands’ (1992:105)


/ø-q’ə-w-ja-c’ə-s-l-ha-ax-c/ → [q’ep’esc’sfh\n]

‘I laid (the baby) in your arms’ (1992:77)

/ø-q’ə-w-ja-wə-a-w-ha/ → [q’ep’w:\n:ha]

‘he is approaching you’ (1989:287-8)

e. Lack of fortition before sonorants

/ø-w-mə-gə-wa/ → [wumig’uwo] ‘your not learning it’ (1992:113)

/w-j-ax-c/ → [wu:d\n] ‘you plastered it’ (Colarusso p.c.)

/wə-j-ax-a-ə-o/ → [wezit] ‘Were I to give you to him (her)’ (1992:126)

10 This form is particularly interesting for Halle’s articulator model of feature geometry and its related assumptions. As mentioned above, Halle requires that the designated articulator for Soft Palate, Tongue Root, and Larynx be [-consonantal]. In his framework, pharyngeals are represented under the Guttural node, with Tongue Root as the designated articulator. They must therefore be [-consonantal]. Yet the pharyngeal fricative in Kabardian induces fortition and voicing agreement in the verbal index, suggesting that the pharyngeal fricative is [-sonorant] (an obstruent), and therefore [+consonantal]. This form thus provides additional evidence that Halle’s constraint on [-consonantal] for non-Place articulators must be revised.
The above data have shown that while sonorants do not trigger fortition, obstruents do. Even if one were to order a rule of epenthesis between /w/ and a following sonorant consonant, which appears to be the case, the fact that a following glottal stop does not induce epenthesis (unlike the sonorants /m, j/) shows that it acts as an obstruent. Since the glottal stops pattern with the obstruents, they must therefore be considered [-sonorant].

Halle’s definition of [sonorant] is as follows:

(31) In articulating [+sonorant] phonemes, no pressure must be allowed to build up inside the vocal tract; such pressure must be built up inside the vocal tract in articulating [-sonorant] phonemes. Pressure buildup is produced by an articulator making full or virtual contact with a stationary portion of the vocal tract while no side passage is opened in the vocal tract by dropping the tongue margins or lowering the Soft Palate. (1995:7)

Halle notes that ‘from an articulatory point of view [-sonorant] phonemes are a subset of [+consonantal] phonemes’ (7). Therefore, since the Kabardian glottal stops act as [-sonorant], they must necessarily be [+consonantal]. Yet if the designated articulator for

\[ \text{\textbackslash wa } \text{\textbackslash t\textbackslash e\textbackslash r } \text{\textbackslash q\textbackslash a } \text{\textbackslash w\textbackslash w\textbackslash e\textbackslash k\textbackslash e\textbackslash a } \text{\textbackslash a } \text{\textbackslash q\textbackslash o } \text{\textbackslash w\textbackslash y\textbackslash k\textbackslash i } \text{\textbackslash e\textbackslash 3\textbackslash \alpha \textbackslash c\textbackslash i } ] \]

you(obl) man-abs 3-hor-you-kill-illative-final-past-aff

‘You killed the man (my kinsman)’ (93)

The second remain unaccounted for:

\[ \text{\textbackslash \phi\textbackslash -\textbackslash w\textbackslash -\textbackslash w\textbackslash -\textbackslash w\textbackslash -\textbackslash w\textbackslash -\textbackslash w\textbackslash -\textbackslash w\textbackslash -\textbackslash w } \]

3-you-valence-broad-past-aff

‘you spread it out’ (115)

I believe what is at play in this instance is dissimilation of labiovelar glides such that the first undergoes fortition. This rule is optional for the 2nd person verbal index before the present progressive /a-w/. Perhaps this rule is lexically diffusing.
glottal stop is Larynx (recall that the larynx is explicitly considered part of the vocal tract), by (25) it must be [-consonantal]. This is obviously a contradiction. Halle's definitions and constraints must therefore be revised to allow glottals to pattern with obstruents. This could be done by abandoning the repair (6b) that makes glottals [-consonantal] glides. In addition, the definitions for [sonorant] and [consonantal] may need to be revised in order to permit glottals to be specified as [-sonorant], [-consonantal], as Schane (1973:27), for example, has suggested. If we accept Hume and Odden's (1996) arguments against the feature [consonantal], then the characterization of glottals as [-sonorant] becomes even more important.

Finally, Halle has proposed redundancy rules (6a), in which [-continuant]s are assigned the value [+constricted glottis] and fricatives, [+spread glottis]. They are implemented in an early stage of the derivation and appear 'to hold of obstruents in many languages'. While fricatives essentially debuccalize to [h], stops have other options. Halle recognizes that these redundancies are not universal, since stops debuccalize not only to [ʔ], but to [h] as well, as we saw in Irish, and which also occurs in Yucatec Maya, Icelandic, and Kashaya, discussed in §5.6. There is no apparent, principled basis in which these rules apply or not. It thus appears to be language-specific.

5.3.5. Debuccalization with Loss of Secondary Articulation
The model that I have proposed, which permits retention of secondary place features, while primary place features are delinked, entails a process in which both primary and secondary place features are lost and debuccalized to a glottal. (For more on the outcomes of secondary articulation in general, see Fallon (to appear a)). In the constriction model of feature geometry, this delinking may be expressed by delinking any class node higher than individual place features (or C-place or higher, if we introduce the Oral and Pharyngeal subplace nodes).

One such case may be found in Kashaya, a Penutian language (Buckley 1994), which will be discussed in more detail in section 5.6.2. Kashaya has a rich, rather symmetrical series of consonants, including underlyingly aspirated, ejective and voiceless stops, as well as aspirated and glottalized sonorants (nasals, laterals, and glides). Uvular debuccalization occurs whenever a uvular is at the end of the syllable. However, two rules feed debuccalization. One is the transfer of the glottalization of a glottalized sonorant in onset position to the preceding segment. This accounts for the fact that glottalized sonorants never appear in syllable-initial position; they are in complementary distribution.
with voiced stops. Furthermore, Glottal Transfer creates alternations between ejective and non-ejective segments:

(32) a. /mo-\imj\-i/ → [mob\imj\] ‘run away!’ (1994:195)
    /mo-\imj\-\ma/ [mob\imj\b\a] ‘after running away’ (1994:195)

b. /\na-\hju\-t\-w/ → [dah\hju\t\w] ‘break it once’ (1994:96)
    /\na-\hju\-\ma/ [dah\hju\b\a] ‘after breaking it’ (1994:81)

The second rule which feeds debuccalization is Coda Aspiration. There are no surface instances of plain unaspirated stops in the coda in Kashaya. Compare the following forms in (33), which use the same root as in (32b) above:

(33) /\na-\hju\-i/ → [dah\hju]\ ‘break it! (sg.)’
    /\na-\hju\-\me=/ [dah\hju\b\me?] ‘break it! (formal)’ (1994:88)

Now that Glottal Transfer and Coda Aspiration have been motivated, we will motivate the labialized uvular, and then examine Uvular Debuccalization.

The labialized uvular /\q\w/ is never realized on the surface; it conditions assimilation of a following vowel to /\o/, while plain uvulars condition lowering to /\a/. This can be seen with the suffix /-in/ ‘while’, whose underlying form is motivated in (34a). Uvular lowering is seen in (b), while rounding from the labialized uvular is seen in (c):

(34) a. /\t\j\-\a\-\a\j\-\in/ → [t\j\a\j\in] ‘while flying (pl.)’ (241)

b. /s\u\hlaq-\in/ → [s\uhlaq\an] ‘while getting a stomach ache’ (106)

c. /\t\j\-\e\-\aq\w\-\in/ → [t\j\e\q\an] ‘while opening out toward here’ (106)

There also must be a coda constraint against secondary articulations, since when the labialized uvular occurs in an environment in which debuccalization does not take place (before level 1 and 2 suffixes), the labialization is lost in coda position:

(35) /p\a-\t\j\-\o\w\-m\-w/ → [p\a\t\j\o\h\ma\w] ‘stab (pl.)’ (99)
    /p\a-\t\j\-\o\w-\t\j\-\w/ [p\a\t\j\o\h\ji\w] ‘stab once, leaving weapon behind’ (99)
Uvular Debuccalization deletes the place features (both primary and secondary) of plain and labialized uvulars in syllable-final position.

(36) /kʰunu'q-no/ → kʰunu'q'do → [kʰunu?do] ‘they say it spoiled’
    /l'oqʷ-fe/    hloqʷʰfe    [ləhfe] ‘I wonder if it fell off’
    /qaJo'qʷ-ŋo/  qaJo'qʷ'do  [qaJo?do] ‘they say he’s getting well’

Since the uvular place of articulation is lost along with the labialization, debuccalization must take place at a node which dominates both Vocalic and either Pharyngeal or C-place. In the Constriction-based model, this could be delinking of C-place, Oral Cavity, or even the Root node, if glottal stop is assumed to be a default consonant. It is also conceivable that debuccalization occurs at the level of individual place features, with secondary articulation preserved, which is then deleted by the coda constraint against labialized consonants. Both analyses yield the correct output. The important thing is that while some languages may (apparently) debuccalize segments with secondary articulation, others debuccalize only primary place, while secondary features are preserved on a glottal segment. A further study of languages with secondary articulation and which debuccalize may find an unambiguous case of debuccalization at either the O.C. or C-place node.

5.3.6. Summary
In this section, I have argued that debuccalization with preservation of secondary articulation should be recognized and taken into account by phonological theory. I have proposed that such debuccalization is expressed as the deletion of individual place features (or in some instances, as the deletion of subplace nodes like Pharyngeal). Although this phenomenon has generally gone unrecognized, it operates in the synchronic phonology of Irish, and diachronically in Circassian (with two types in Abdakh), Guddiri Hausa, and Yuman. I have also used this data to argue against the Articulator model of feature geometry, which incorrectly predicts that loss of Place features entails loss of secondary place features. Even if individual place delinking is allowed in this model, it cannot capture loss of dorsal with preservation of palatalization (k' ← ?l), as we saw in Guddiri. Therefore, following many other scholars, I have provided evidence supporting the independence of primary and secondary place features, though the evidence presented here has come from delinking, not spreading. A potential problem for the Constriction model regarding the delinking of uvulars which preserve secondary articulation was tentatively
solved by invoking McCarthy’s idea of Oral and Pharyngeal nodes under C-place. This allows uvulars, as Pharyngeal, to be distinguished from Oral consonants, and many of the predictions of this model appear to hold; the rest await verification from further data.

Finally, Halle’s formalization of debuccalization was critiqued on many grounds. First, as the data have shown, debuccalization is not simply loss of Place (or C-place), but also individual place features. As the Kashaya Uvular Debuccalization has shown, in which secondary articulation is lost, we must distinguish (at least) two types of debuccalization. Second, the assumption that debuccalization changes segments to [-consonantal] does not hold universally, as the Kabardian fortition data showed glottals acting as [-sonorant]. Such cases suggest a revision of the definitions of [sonorant] and [consonantal], and an abandonment of Halle’s constraint on the designated articulator being [-consonantal] for the Larynx node. Finally, the redundancy rules assigning [e.g.] to stops does not universally hold.

5.4. Indeterminacy

5.4.1. Tension Between Articulation and Acoustics

What I am proposing is that languages can choose among four parameters for debuccalization: Root Node Delinking, Oral Cavity Delinking, C-place Delinking, and Individual Place Feature Delinking. So far, I have motivated only Individual Place Feature Delinking, and have contrasted it with another type of debuccalization in which secondary place is lost. Empirically, Individual Place Feature Delinking is only detected in languages which preserve secondary articulations on the debuccalized glottals, such as Circassian, Guddiri Hausa, Irish, and Yuman. Predictions for the remaining types were reviewed in (9a-d). However, many of the processes of debuccalization are ambiguous—there is more than one possible analysis, and as a result, there is a certain amount of indeterminacy in assigning linguistic phenomena to the typology proposed here. Depending on various theoretical assumptions, the same data could be assigned to different categories. For example, when segments with Root-dependent features like [nasal] lose place features and end up as a glottal, that is a sure bet that Root Node Debuccalization has taken place (e.g. in Kasimov Tatar in §5.5). However, if only voiceless stops become glottal stop, then given rules like (6), several types of debuccalization become available.

Since speech is a combination of both articulatory and acoustic phenomena, we should not be surprised that one or the other of these elements could become phonologized in the process of debuccalization. Examine the following simplified grid:
As pointed out in §5.1.2, similar acoustic output can be the result of either laryngeal articulation, or stricture articulation. Stop gaps can be produced by making a stop, which is [-continuant], or a glottal stop, which is [constricted glottis]. Likewise, aperiodic noise in the acoustic signal could be the result of a spread glottis, or from turbulence produced by a fricative. Recall from §5.2.2 Browman and Goldstein’s (1989) analysis that the acoustic output of debuccalization is generally preserved. It is only natural that languages take advantage of one or the other; not every language must make the same choice. As mentioned in §5.2.2., most analysts simply assume that laryngeal features are what drive the results of debuccalization. Yet a similar acoustic output is gained by implementation of a stop gap, attributed to the feature [continuant].

Evidence for phonological rules relating to the output of debuccalization is slim to none. In part this is to be expected, since debuccalization is typically a postlexical process. Thus there seems to be no crucial evidence which hinges on the representation of the glottals which result from debuccalization. From the output of debuccalization, no firm claims may be made whether glottals bear the stricture feature [continuant], or, for that matter, the laryngeal features. Therefore all arguments center around the specification of the original segments, rules of the derivation, and constraints. By allowing so many analytical options with respect to debuccalization, as I do in this model, I believe linguists have more flexibility in choosing an analysis appropriate to the data.

In the next section, I examine the ambiguity of ejectives, and illustrate with an example from Tigre\(^1\).
5.4.2. The Ambiguity of Ejectives

Ejectives in many ways are not the ideal speech sounds with which to test a theory of debuccalization since phonetically, at least, both the laryngeal feature [e.g.] and the stricture feature [cont] are preserved. However, it is worth investigating whether both features are preserved, or whether debuccalization results in survival of laryngeal features only. As noted, in many cases it is difficult to tell, and I will illustrate this ambiguity with data from Tigre.

Tigre, an Ethiopian Semitic language (Raz 1983), shows a regular process of debuccalization of velar ejectives. Tigre has the following ejectives: /p/', t', tʃ', k', s', in which the labial ejective occurs in loanwords, and the fricative ejective seems to vary dialectally or idiosyncratically with the affricate [ʃs'] (see also Palmer 1965). In syllable-final position, all velar ejectives debuccalize, or, in Raz’s words, give ‘the acoustic impression of [?]’. Litmann’s p.c. to Ullendorff (1955:48) stated that the change was idiolectal in syllable-final position in Tigre. My own fieldwork with two informants from Eritrea shows this to be a regular process.

Raz states an additional condition that a consonant must follow, but this is often left implicit judging from the final consonant in ‘smeared’ in (38) below. Those ejectives in syllable-initial position maintain their ejection. Raz states that there is additional variation in that sometimes there is pharyngeal realization, which will not be addressed here (see Rose 1996). Debuccalization is illustrated by the following data from Raz (1983:5):

(38)  | UR          | PR     | Gloss
---:|:------------|:-------|:------
 1   | lək'luːk'    | loʔloʔ | ‘smeared’
 2   | mak'raːha    | maʔraːha | ‘her condition’
 3   | tak'bol    | taʔbol  | ‘she will return (jussive)’
 4   | aʃak'ba ?əb ?ak'rudu | aʃaʔba ?əʔaʔrudu | ‘the Aqba tree together with its roots’
 5   | lak'tolo    | (?əɡəl) laʔtolo  | ‘in order to kill him’

Phonological alternations also arise. Below I transcribe phonetically a glottal stop where it would occur following Raz’s description, and where I found it to occur in my fieldwork; page numbers refer to the data from Raz which I elicited. Nominal paradigms are in (39) and verbal alternations, in (40).
Debuccalization is of velars only and is syllable-final. Every instance of syllable-final /k'/ is thus realized as [ʔ].

Raz also notes that variation in the realization of /k'/ is not limited to final position in a syllable: it may occur in a stress unit...in medial position as a result of regressive assimilation’ (1983:5). He gives the following example: /tssahak'a ?ɔtm/ ‘he laughed at them’, phonetically realized as [tsaʔaʔɔt̪om]. However, Raz does not provide enough data to determine the potential prosodic influences or whether the ‘regressive assimilation’ is regular or sporadic. And I was unable to determine the prosodic conditions on this type of debuccalization.

Syllable-Final Velar Debuccalization could be analyzed as almost anything. It could be Root Node delinking which targets syllable-final velar ejectives, though I am unaware of any evidence that glottal stop acts as a default. Debuccalization of the Oral Cavity is a likely possibility, since the feature [c.g.] is preserved, and most analysts view glottals as not bearing stricture features. However since phonetically a glottal stop is by definition [-continuant] (‘in stops, the air flow through the mouth is effectively blocked’, SPE 317), C-place delinking is also conceivable. Though I know of no evidence for the phonological status of [-cont] on glottal stop in Tigre, some suggestive evidence for it from other languages is provided in §5.7.1. Since only the velars in Tigre undergo this debuccalization, it is also possible to view this as delinking of the C-place feature [dorsal]. I am not aware of empirical arguments for choosing among any of these solutions, and thus the answer is left to theory-internal considerations. With additional investigation, we may be able to rule out glottal stop (phonemic in Tigre) as a default segment, and thus eliminate Root Node Delinking. If for simplicity’s sake we wish to restrict Individual Place Feature Delinking to those cases in which secondary articulation survives, we could eliminate that...
as an option. And so we are left with the choice between Oral Cavity delinking, which preserves only Laryngeal features, and C-place delinking, which preserves [continuant] as well. Most analysts would opt for the former, on grounds that [cont] is not distinctive on glottals. (For more on this, see §5.7). We may also want to draw a distinction between underlying and surface glottals. Rose (1996) suggests that the [?] of debuccalized ejectives in Tigre ‘might indeed have a different representation than underlying laryngeals’ (107). Because Tigre, in her analysis, is a language with a Pharyngeal laryngeal, she predicts that debuccalization should leave a Placeless laryngeal. However, since gutturals are prohibited from coda position, she believes the underlying glottal stop may have a different representation in order to reflect this phonotactic restriction.

The point of this example was simply to illustrate the gap between what we can be sure of through data, and which options we rule out because of theoretical assumptions. It will be a point to keep in mind as we assess data for the following three types of debuccalization.

5.5. Root Node Delinking

In principle, Root node debuccalization is easy to detect. All segmental material and features are deleted by delinking the Root node, while only the timing slot is preserved. Then a default glottal segment, typically a glottal stop, must be inserted. This process is schematized below:

\[
\begin{array}{c}
\text{C V C} \\
\text{\#} \\
\text{Root} \\
\downarrow \\
\text{C V C} \\
\text{\#} \\
\text{Root} \\
\downarrow \\
\text{Lar} \\
\downarrow \\
\text{[e.g.]} \\
\hline
\text{Root Node Delinking} \\
\hline
\text{Glottal Stop Default}
\end{array}
\]

In certain other cases, of course, the empty timing slot is filled by compensatory lengthening (e.g., the papers in Wetzels and Sezer 1986). Not all cases of C-slot filling are replaced with a glottal default; for example, Broselow (1995) claims that Amharic inserts the coronal /t/ in the final slot of certain templates. The key to proving Root Node
Debuccalization is the strength of the two component parts: Root Node Delinking, and Glottal Stop Default.

One candidate for Root Node Debuccalization comes from the East New Guinea Highland language Usarufa, mentioned in Inkelas and Cho (1993) with data from Darlene Bee’s works, which appear in McKaughan (1973). Usarufa has as its consonants /p t k ?, m n, r, w j/ and permits only [?] as a singleton coda. Nasals (42a) or the rhotic (42b) in coda position undergo Root Node debuccalization, while geminates are permitted (42c) due to geminate inalterability (Hayes 1986).

(42) a. anon-e ‘big-indic’
    ano?-ko-ma ‘big-stat-indic’

b. kajar-e ‘two-indic’
    ka:ja?-ko-ma ‘two-stat-indic’

c. arumma ‘his liver’
    annama ‘vine’

Since both the features [nasal] and [lateral] are lost and replaced by a glottal stop, and both features are dominated by the Root Node, this argues for Root Node Debuccalization.

Another case of Root Node Debuccalization is the historical change in Kasimov Tatar (Western Turkic; Polivanov (1928:85-87), also cited in Jakobson and Waugh (1987:130); Thomsen (1959)). This dialect has regularly and almost with exception replaced its dorsal consonants /k, g, q, x, ɲ, nj/ with glottal stop in all positions of the word. Since [nasal] is dependent from the Root node, this suggests that the Root node of all dorsals was deleted and replaced by a (default) glottal stop. Some of Polivanov’s examples are provided here, though I am unable to read the examples in Arabic script:

(43) *kel > ?il ‘come!’ (Tatar kil)
*kel-gen > ?il?in ‘coming’ (Uzbek kelgæn)
*qal > ?al ‘remain!’ (Tašk. Uzbek qulq)
*qufaq > ?uqla? ‘ear’ (Tašk. Uzbek qirq)

Unfortunately, Polivanov does not give examples with the nasal. Nevertheless, this is exactly the type of change which Root Node Debuccalization can account for.
Another language which has a process suggestive of Root Node Debuccalization is Buginese (South Sulawesi—Western Malayo-Polynesian; Mills 1975, cited in Rose 1996; also cited in Blust 1980: 130-32). According to Rose, stem-final consonants /r s k/ all reduced to [ʔ]. Because the features [strident] and [lateral] are lost, and because these features are thought to link directly to the root, this appears to be Root Node Delinking. The only coda consonants licensed in the language are glottal stop, homorganic nasals, and geminates. Unfortunately, Rose’s examples are unclear; it is also unclear whether this is only a historical change, or whether it is part of the synchronic phonology of the language. One alternation between [r] and [ʔ] suggests it may still be synchronic: /mattikirri/ ‘to watch over’ vs. /tikiʔ/ ‘vigilant’. Clearly these examples merit further investigation.

One other candidate for Root Node Debuccalization is Biggs’ report of the change from Proto-Eastern-Polynesian *r to Marquesan /ʔ/ (1971:499), though unfortunately no specific data are provided. (Reference is, however, made to Dordillon 1904, 1931-32).

In practice, however, Root Node Debuccalization seems quite difficult to prove incontrovertibly. A major reason for this is because debuccalization tends to be restricted only to obstruents. (This is another argument for specifying glottals as [-sonorant], since it helps explain why true sonorants do not easily change major class features and lose their place features.) Another problem is that if the analyst accepts the use of redundancy rules of the type [-cont] « [e.g.] and [+cont] « [s.g.] (e.g. Halle 1995 and (6a) above), then it becomes difficult to tell whether a given change of /p t k/ « [ʔ] is the delinking of Root nodes specified for [cont], with glottal stop inserted as a default, or whether, in the course of debuccalization of, say, Oral Cavity Delinking, voiceless stops acquire the feature [e.g.]. If glottal stop acts as a default consonant, then even if only stops are targeted for debuccalization, theoretical parsimony favors the Root Node Debuccalization analysis, ceteris paribus, since the default is required anyway, and thus no reference to the redundancy rule is required. If both voiced and voiceless stops debuccalize, however, this gives added plausibility to the analysis invoking the redundancy rule [-cont] « [e.g.], since [voice] is also affected. It should be borne in mind, however, that this rule is language-specific, since in Irish, for example, /t s/ « [h], as we saw in §5.3.1.

One possible strike against both Root Node and Oral Cavity Debuccalization occurs if we assume a privative theory of laryngeal features in which voiceless stops have no Laryngeal node. If /p t k/ « [ʔ], but not /b d g/ (as in English), then it is difficult to target the voiceless stops, since phonological theory cannot honestly permit reference to lack of structure, e.g. ‘delink the Root nodes of those stops without a Laryngeal node’. Perhaps
the redundancy rule acts in a feature-filling manner in which [-cont] stops with no Laryngeal node receive [e.g.] as default, then have their relevant node delinked. (See also Kashaya Word-Final Debuccalization in (59) below).

Root Node Debuccalization may be ruled out easily if different types of segments debuccalize in different ways. For example, if a language has /p t k/ \(\rightarrow\) [?] and /s/ \(\rightarrow\) [h], then we would not expect two different default consonants. Therefore such cases are either Oral Cavity Delinking or C-place Delinking. Two such cases will be discussed below in §5.7, in Guininaang Kalinga and Kelantan Malay. In addition, if the laryngeal features seem to determine the output of the segment, then Root Node Debuccalization may be ruled out. One such case is Kashaya, examined briefly in §5.3.5 above, and in more detail in §5.6.2. below. Kashaya has the same phoneme debuccalize in different ways, with its laryngeal features dependent upon the following sound.

Glottal stop is well known as a default consonant Selayarese is an Austronesian language whose consonant inventory includes /p t k ?, b d ð ɡ, mb nd ɲ ɡ, m n ɲ ŋ, s h, l ɾ/ (Goldsmith 1990 and Mithun and Basri 1986). Coda consonants underlyingly license only [nasal], e.g. /pekan/ ‘hook’; otherwise the coda slot is totally unspecified, and filled in by glottal stop, e.g. /ataʔ/ ‘roof’. Voiceless consonants which follow glottal stop spread to completely assimilate the glottal stop. Compare /taʔ-ataʔ/ ‘to be roofed’ with /taʔ-pelaʔ/ \(\rightarrow\) [tappela?] ‘get lost’. Perhaps a better analysis would have consonant onsets fill in the empty C-slot in the coda by spreading their roots; if no consonant assigns the coda place features, then glottal stop is inserted as the default. Smith (1985) has also suggested that /ʔ/ is a default consonant in Sierra Miwok since it appears in the C-position of certain templates.

French has been analyzed as having certain words with an empty C-slot in order to account for words which seem to start with a vowel, but which behave phonologically as if they had an initial consonant—the so-called \textit{h aspiré} words (Clements and Keyser 1983). For example, the word \textit{héros} /lero/ truncates final oral and nasal consonants, e.g. \textit{petit héros} [poti ero] ‘little hero’, just as consonant-initial forms do, and the vowel of the article is not elided [lə ero], as it would were the word truly vowel-initial. Finally, irregular adjectival forms take their preconsonantal form before the \textit{h aspiré} words, e.g. \textit{beau héros}. Obligatory for some speakers, and optionally in others, the empty C-slot is implemented as glottal stop, e.g. \textit{il hache} is [ilʔaʃ]; compare \textit{il est} [ile] vs. \textit{il hait} [ilʔe] (Jakobson and Waugh 1987:154, citing Dell (1973:256). It is unclear from their description of Dell
whether glottal stop is only inserted for *h aspiré* or whether it is used more generally to break up hiatus.

Glottal stop is also found phonetically in many languages. Spencer (1996) notes that in Czech, a word may not begin with a vowel phonetically; instead glottal stop is inserted, e.g. 'to operate' is [ʔoperovat]. Benware (1986:28) notes that glottal stop in German, which is not phonemic, occurs before word-initial vowels, as in [ʔoːft], but also 'before any vowel-initial morpheme which carries some degree of stress' e.g. Verein [feəʔɪn], and 'even in the middle of a morpheme before a stressed vowel', e.g. Theater [teʔaːtə]. Benware also alludes to a number of linguistic and nonlinguistic factors which he does not detail. See Kohler (1994) for a detailed phonetic study of its occurrence.

Likewise, glottal stop is epenthetic in Misantla Totonac (MacKay 1994) in onsetless syllable-initial position, e.g. /ik-an/ [Pîkân] 'I go'. And the list could go on.

Now, the question is, do languages have both debuccalization and glottal stop as a default? One language that immediately comes to mind is English. Several facts in English suggest that glottal stop may be the default, a fact to which Iverson (1989) alluded but did not elaborate on. First, [ʔ] serves in careful speech as a marker of syllable boundaries when the second syllable is onsetless (Gimson and Cruttenden 1994:155); it thus fills an otherwise empty onset position. Similarly, glottal stop may be inserted before any accented vowel to place emphasis on the word or morpheme. Second, glottal stop may be inserted before or coinciding with a voiceless stop or affricate in syllable-final position as a 'reinforcement of voiceless plosives' (Gimson and Cruttenden 1994). Third, as is well known, voiceless stops may debuccalize to glottal stop in many dialects. Often overlooked, however, are dialects that debuccalize not only /t/ before syllabic nasals, as in *kitten*, but /d/ as well, in words like *couldn't*. (Such dialects are not reported to have voiced stop devoicing.) This process entails an overriding of the feature specification for [voice] with [e.g.], something redundancy rules do not do (Kiparsky 1982:55). Thus I find it plausible that debuccalization in at least some dialects of English is at the level of the Root node, and not simply the Oral Cavity node, though it may be motivated by an OCP violation of sequences of coronal place. If such a change is delinking of the Oral Cavity, and not the Root node, then debuccalization involves not only loss of place features, but an override of the Laryngeal feature [voice] as well. Thus a Root node delinking analysis involves a simpler derivation and is thus to be preferred, *ceteris paribus*.

Of course the facts of glottalization and debuccalization are quite complex and variable in English; for a few references, see Lass (1976), Roach (1979), Wells (1982),
Shuken (1984), Jensen (1993), Harris (1995), and Milroy et al. (1995). It is often assumed that glottal reinforcement feeds the rule of debuccalization, and thus laryngeal features are preserved. However, Harris (1995:284) notes that in West Yorkshire, voiceless stops which are not debuccalized are not glottalized, and are often preaspirated. Milroy et al. (1995) have shown for Tyneside English, not only the different sociolinguistic patterns in co-variation with extralinguistic variables and the different social evaluation of debuccalization and of glottal reinforcement, but their different linguistic variation as well. For example, /h/ is most likely to be debuccalized to glottal stop, but least likely to be glottalized, even accounting for debuccalized tokens. These and additional data cause them to doubt that the lenition hierarchy [t] > [ʔ] > [ʔ] is applicable to all dialects of English. In short, there are some reasons not to assume glottalization always feeds debuccalization.

And let us not forget the languages with debuccalization which do not have (reported) glottalized variants such as Toba Batak (Hayes 1986). The suggestion made here regarding some English debuccalization as Root delinking merits further investigation. The variability of debuccalization, coupled with the different possible debuccalizations proposed here, may help to account for the different facts of debuccalization in English.

Root Node Debuccalization is suggested when the laryngeal features are changed, as well as place features lost. There are two such cases that will be presented here: Lafourche Cajun French, and Motu. Because Kagoshima Japanese appears to involve the retention of the feature nasal, but changes both voiced and voiceless obstruents to glottal stop, it cannot be considered Root Node Debuccalization and will be discussed in the section on Oral Cavity Delinking (§5.6.7).

Papen and Rotlet (1997) note that in Cajun French as spoken in Lafourche and Terrebonne Parishes, 'the two alveopalatal continuants /ʃ, ʒ/ alternate freely (and variably) with /h/'. Intervocally, [h] is voiced to [ɦ].

(44) /kuʃe/ —> [kufɛ] ~ [kufie]  ‘lie down’
    /ruʃ/     [ruʃ] ~ [ruh]      ‘red’
    /ʃamɛ/   [ʃamɛ] ~ [hɔmɛ]  ‘road’

For some speakers, /z/ can debuccalize:

(45) /nuzɔt/ —> [nuzɔt] ~ [nuhɔt]  ‘we’
For some speakers, due to hypercorrection, /h/ alternates freely and variably with /z/: *J'ai
tonte* 'I'm ashamed' may be realized as *[3afɪt]* ~ *[3aʒɪt]* ~ *[haʃɪt]* ~ *[haʒɪt]*.

Because the *[voice]* feature is lost in the process of debuccalization, it appears that
the Laryngeal node is also lost in debuccalization. Although the redundancy rule [+cont] →
[spread glottis] is often invoked on voiceless fricatives for phonetic reasons, I do not
believe any phonetician would find voiced fricatives to be made with a spread glottis. In
Allophonically, however, in Lafourche Cajun French, we saw the glottal fricative voiced
intervocally, which I take to be the regressive spread of *[voice]* from a following vowel.
This would make the glottal fricative bear both [spread glottis] and [voice], which may well
be permitted at the postlexical level.

Another correspondence between a voiced fricative and *[h]* is found in Motu
(Central Province, Papua New Guinea; Crowley 1992). A historically earlier form of Motu
shows *v*, where Motu now shows /h/. While this correspondence is suggestive of a
change from voiced fricative to /h/, the reconstruction could be incorrect, or devoicing
could have been an intermediate step. Motu also has the correspondence of *p > h.*

(46) *tiavu* siahu 'sweat'
*vui* hui 'hair'
*vavine* hahine 'woman'

In sum, I have proposed that Root Node Debuccalization occurs in Usarufa.
Phenomena of this type have also been reported in Kasimov Tatar and Buginese, though
data is limited. Root Node Debuccalization has applied when the Root node is deleted, and
glottal stop is inserted as a default. It is easiest to detect if features such as [nasal] and
[lateral] are debuccalized, along with obstruents. Many languages, even English, could
have Root Node Debuccalization as well, but this depends on the theoretical assumptions of
the analyst. Such assumptions center around whether redundancy rules such as
[-continuant] → [c.g.] may be invoked, and if so whether they may change lexical feature
specifications on the Laryngeal node, such as [voice]. Next we will examine Oral Cavity
Delinking.

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5.6. Oral Cavity Delinking

5.6.1. The Oral Cavity Node

Before moving to the new data, let us review some of the reasons the Oral Cavity, which dominates C-place and [continuant], was proposed. Clements (1987) and Clements and Hume (1995) discuss phenomena like Intrusive Stop Formation in English, a process in which a phonetically shorter, excrescent stop arises between a nasal and following fricative. The stop is homorganic to the preceding nasal, but voiceless like the following fricative. Some examples are given below:

(47) Intrusive Stop Formation

<table>
<thead>
<tr>
<th>warm[p]th</th>
<th>den[t]se (vs. dents)</th>
<th>leng[k]th</th>
</tr>
</thead>
<tbody>
<tr>
<td>ham[p]ster</td>
<td>men[t]sch</td>
<td>young[k]ster</td>
</tr>
</tbody>
</table>

The epenthetic velar stop common in some pronunciations in the word *strength* is represented below as the spreading of the nasal's Oral Cavity features, which contain both place and stricture, onto the Root node of the following fricative, creating a contour segment. The epenthetic stop is measurably shorter than underlying stops (cf. *prince* vs. *prints*) and this is shown in the representation since the [k] has no Root node of its own.

(48) *strength*

\[
\begin{align*}
&\text{eta} & & \theta \\
\text{root} & & \text{root} \\
\text{Lar [+nas]} & & \text{Lar} \\
& \text{O.C.} & & \text{O.C. [-nas]} \\
\text{[-cont]} & & \text{[+cont]} \\
\text{C-place} & & \text{C-place} \\
\text{[dorsal]} & & \text{[coronal]}
\end{align*}
\]

Additional evidence for such processes is found in Kihungan (Clements 1987).

Oral Cavity Delinking predicts that segments will retain their laryngeal features, but lose all features dominated by the Oral Cavity node (which include C-place and its dependents, including secondary articulations, as well as the feature [continuant]). This type of delinking is what most analysts probably have in mind when they think of debuccalization: loss of features in the oral cavity. Since it appears fairly often that laryngeal features are preserved, there are many examples. Evidence will be presented...
from several rules in Kashaya which show preservation of both contrastive laryngeal features, [e.g.] and [s.g.], acquired from both underlying and derived representations. In §5.6.3, Yucatec Maya's process of debuccalization will be analyzed, and in the next section, we review Amharic data. The last few sections briefly cover data from Amharic, Klamath, and Kagoshima Japanese, which all illustrate various apparent Oral Cavity Debuccalizations, since Laryngeal features are preserved.

5.6.2. Four Rules of Debuccalization in Kashaya

Evidence for synchronic Oral Cavity debuccalization is provided by Buckley's (1994) study of Kashaya, a Southern Pomo language with several debuccalization processes. Kashaya has underlying plain, aspirated, and ejective stops; phonetically voiced stops are derived from glottalized sonorants. The language also has voiceless fricatives, ejective [s'], phonemic /ɬ/ and /h/, and plain aspirated and glottalized resonants. As the following data show, when a noncontinuant coronal occurs before another coronal, the first coronal debuccalizes. The debuccalization occurs before dentals, alveolars, alveopalatals, and the palatal glide, which are all specified as [coronal]. The rule affects all stops, affricates, and nasals (non-continuants) before coronals, leaving the original laryngeal features [c.g.] and [s.g.], resulting in /ɬ/ (in 48a, b, and c) and /h/ (in d). (Glottalized, i.e. phonetically laryngealized, sonorants are transcribed in the IPA with a tilde underneath the segment, except here for the palatal glide [j], where it is transcribed as a following apostrophe [j'] for typographic clarity). The rule does not apply before certain suffixes, as shown in the first example of (49a).

Buckley does not always motivate the underlying forms, but I have provided alternating forms where possible, and placed them before the debuccalizing examples. Data are from Buckley (1994:91) unless otherwise indicated by page numbers after the gloss.

13 Buckley’s proposed inventory is /p t tʃ k q qʷ ɬ, pʰ tʰ tʰ ɬʰ kʰ qʰ, pʰ tʰ tʰ ɬʰ kʰ qʰ, s sʰ m n mʰ nʰ, m ɡ, w l j, wʰ lʰ jʰ, w, j j'/ plus long and short /i e a o u/.

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Kashaya Coronal Debuccalization

<table>
<thead>
<tr>
<th>UR</th>
<th>PR</th>
<th>Gloss</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. si-\text{hwa}t'-\text{t} \text{-w}</td>
<td>sihw\text{át}' \text{\text{t}j}{\text{w}}</td>
<td>'sag (sg.)' (96)\text{14}.</td>
</tr>
<tr>
<td>si-\text{hwa}t'-\text{t} \text{h}</td>
<td>sihw\text{át}{\text{h}}</td>
<td>'didn’t sag’</td>
</tr>
<tr>
<td>si-\text{hwa}t'-\text{t} \text{-g}o</td>
<td>sihwå?do</td>
<td>'they say it sagged’</td>
</tr>
<tr>
<td>si-\text{hwa}t'-\text{t} \text{-fe}</td>
<td>sihwâ?{\text{f}}e</td>
<td>'I wonder if it sagged’</td>
</tr>
<tr>
<td>si-\text{hwa}t'-\text{t} \text{-j}</td>
<td>sihwâ{j}</td>
<td>'I saw it sag’\text{15}</td>
</tr>
<tr>
<td>b. jumili\text{t}'-\text{t} \text{h}</td>
<td>jubil\text{ít}{\text{h}}</td>
<td>'didn’t blaze up’\text{16} (138)</td>
</tr>
<tr>
<td>jumili\text{t}'-\text{t} \text{-g}o</td>
<td>jubili?do</td>
<td>'they say it blazed up’</td>
</tr>
<tr>
<td>jumili\text{t}'-\text{t} \text{-fe}</td>
<td>jubili?{\text{f}}e</td>
<td>'I wonder if it blazed up’</td>
</tr>
<tr>
<td>jumili\text{t}'-\text{t} \text{-s} \text{h}</td>
<td>jubili\text{s}{\text{h}}i</td>
<td>'it blazes up’</td>
</tr>
<tr>
<td>jumili\text{t}'-\text{t} \text{-j}</td>
<td>jubilîj</td>
<td>'I saw it blaze up’</td>
</tr>
<tr>
<td>c. tja-n-\text{p} \text{h}i</td>
<td>tja\text{n-p}{\text{h}}i</td>
<td>'if he sees’ (48) (cf. also [\text{i}\text{ja.dú}] ‘look!’)</td>
</tr>
<tr>
<td>tja-n \text{t} \text{h}</td>
<td>tja\text{t}{\text{h}}</td>
<td>'didn’t look’</td>
</tr>
<tr>
<td>tja-n \text{-g}o</td>
<td>tja?do</td>
<td>'they say he looked’</td>
</tr>
<tr>
<td>tja-n \text{-fe}</td>
<td>tja?{\text{f}}e</td>
<td>'I wonder if he looked’</td>
</tr>
<tr>
<td>tja-n \text{-j}</td>
<td>tja{j}</td>
<td>'I saw him look’</td>
</tr>
<tr>
<td>d. hot \text{h}</td>
<td>hot \text{h}</td>
<td>‘warm’ (100)</td>
</tr>
<tr>
<td>hot \text{h} \text{-t} \text{h}</td>
<td>hot\text{t}{\text{h}}</td>
<td>‘it wasn’t warm’</td>
</tr>
</tbody>
</table>

Examples like the ones below do not trigger Coronal Debuccalization because a coronal suffix does not follow. Each example pair contains an example of the same morpheme which does undergo debuccalization when followed by a coronal-initial suffix.

\text{14} This suffix fails to trigger the rule.

\text{15} With subsequent glottalization of the glide due to merger between the palatal glide and glottal stop.

\text{16} Glottalized sonorants become voiced stops syllable-initially. Compare, for example, [mah.sa.dún] ‘while taking it away’ with [mah.sâńq{\text{h}}] ‘must have taken it away’ (Buckley 1994:48). For the UR cf. /jubilit\text{í}p{\text{i}}/ ‘if it blazes up’ (Buckley p.c.).
The first forms in (a) and (b) above also illustrate that debuccalization does not occur more generally in the coda.

Additional examples of debuccalization with preservation of aspiration, as in (49d), come from the plural act infix /t/t/. Its underlying form can be seen in words like /n/a-\^ha\^t\^li/ → [dahj^at^li] ‘grab them!’ and /s/is\^a\^t\^la\^q-\^i/ → [sis\^at\^a\^du] ‘leach (pl.)’ (350).

When the infix occurs in coda position, it undergoes Coda Aspiration (recall (33) above):

(51) /p^h-?\a^\^t\^l\^q-w/ → [p\^hj^at\^hqw] ‘recognize (pl.)’ (350)
/p^h-a-n\^\^t\^l\^m-w/ → [p\^han\^\^t\^maw] ‘hit with fist (pl.)’ (350).

However, when the infix occurs before coronals, in coda position, Coda Aspiration feeds Coronal Debuccalization.

(52) /\u^\\^t\^l\^w/ → [\u\^\^t\^hiw] ‘twist (pl.)’ (351)
/q\^a-h\^\^t\^l\^\^t-w/ → [q\^al\^\^t\^hiw] ‘fail to bite off (pl.)’ (351)
/q\^a-m\^h\^\^t\^j-w/ → [q\^ab\^\^h\^jiw] ‘cheeks be puffed up’ (351)
/m\^a\^h\^\^t\^j-w/ → [m\^ab\^\^h\^jiw] ‘make a face (pl.)’ (351)

Other underlying plain coronal stops are fed by Coda Aspiration, and debuccalize to [h], as the plural infix did, or are fed by Glottal Transfer and debuccalize to [?]:

(53) /n/a-\^h\^\^t\^\^t/ → [dah\^h\^\^t\^\^t] → [dah\^h\^\^t\^\^t] ‘didn’t break it’ (91)
/n/a-\^h\^\^t\^\^l\^\^t/ → [dah\^\^t\^\^t\'\^\^t] → [dah\^\^t\^\^t\'\^\^t] ‘they say he broke it’ (91)

The coronal continuants do not undergo debuccalization.
The last form above shows that even the ejective fricative does not debuccalize. (Indeed, I have not found any cases of any fricatives debuccalizing in a language with ejectives.

Ejective fricatives often affricate, and then deglottalize). Labial consonants do not occur root-finally in Kashaya and so are not subject to debuccalization. Root-final velars are rare and only /k/' occurs, but this segment does not debuccalize either, as shown by the form /qa-mort-tn/' 'doesn't have swollen cheeks' which is realized as [qabok't*'], without debuccalization. (Buckley lists no velar-initial suffixes to test whether velars might have been subject to a similar OCP violation of Place). Uvulars undergo different types of debuccalization, as will be shown in (56). Thus the rule is restricted to coronal noncontinuants.

It seems quite clear that only the laryngeal features of the segment are preserved. The aspirated stops in (49d) and (52) retain only their aspiration, while ejectives and the glottalized nasal preserve their glottalization—the feature [c.g.]. The feature [continuant] cannot be preserved because of the segments which change from aspirated stop ([continuant]) to glottal fricative ([+continuant], if at all). The ejective strident affricate /tJ'/ maintains only its glottal constriction, like the other ejectives, along with the root features; the loss of [strident], if it is even required in the representation since the sound is palatal and could be distinguished from other coronals by features like [anterior] and [distributed], would have to be delinked as a repair. The debuccalization rule is formalized by Buckley as Coronal Debuccalization—the delinking of Place of the first of two coronals; I have modified it slightly to conform to the Constriction-based model of Clements and Hume (1995). RC stands for the Root node of a consonant, and OC for Oral Cavity node.

17 The one possible exception I have encountered is in Leslau’s (1952) article in which the Chaha word 'close' is atf’am, which corresponds in Ennemor and Endegeh to efa. Leslau lists the root as hs’w and thus there is a correspondence between the Ethiopian Semitic ejective fricative and Ennemore and Endegeh glottal stop. However, it is unclear if this is the actual phonetic trajectory of this sound change. It could be possible that the fricative affricated (and palatalized) like Chaha, and then debuccalized. This problem merits further investigation.
Coronal Debuccalization delinks the Oral Cavity node of a noncontinuant specified for Coronal if a Coronal follows. This is the result of an OCP-driven Place Dissimilation rule, a point Buckley mentions (1994:160; 165).

Another analysis may view this as another example of Individual Place Feature Delinking and simply delink [cor]. This would leave C-place with no dependents, and the feature [-cont]. As mentioned above, [-cont] would have to change for all those aspirated stops which become [h]. An empty C-place node is unmotivated and would also need to be pruned. Individual Place Feature Delinking is only unambiguously observable when Vocalic is preserved, and a more constrained theory would limit it to such occurrences, all things being equal.

Next we turn to Uvular Debuccalization.

Uvular Debuccalization, which was introduced briefly in §5.3.5 in order to motivate the loss of secondary articulation in debuccalization, is another rule which illustrates the preservation of laryngeal features, even derived ones, in debuccalization. Uvulars undergo debuccalization 'not simply when they precede another Dorsal consonant: they lose their place node whenever they occur in coda position' (Buckley 1994: 97-98), though Uvular Debuccalization does not apply in Buckley’s levels 1 and 2 of the lexicon. Note that in the following cases other rules, which Buckley terms Glottal Transfer and Coda Aspiration, apply. Recall that Coda Aspiration aspirates voiceless stops and affricates in the coda, e.g. /s’uwâfǔ/-i/ ‘dry it! (sg.)’ vs. /s’uwâfǔ-th/-me?/ ‘dry it! (formal)’ (1994:88). Examples of Coda Aspiration feeding debuccalization are shown in (56a). Glottal Transfer takes the [c.g.] feature from syllable-initial sonorants and transfers it to a preceding stop with no laryngeal features (plain voiceless stops). These examples are shown in (56b). (See also Chapter 8 on fusion and fission). Buckley (p.c.) did not observe any instances of final underlying /q’/ in verbs.
(56) | UR | Intermediate | PR | Gloss |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>a.</td>
<td>sima:q-\textit{me}?</td>
<td>sima:q$h^\text{h}$me?</td>
<td>simah\textit{me}?</td>
</tr>
<tr>
<td></td>
<td>sima:q-\textit{ti}</td>
<td>sima:q$h^\text{h}$ti</td>
<td>sima\textit{ti}</td>
</tr>
<tr>
<td></td>
<td>mitj$^h$a:q-p$^i$</td>
<td>mitj$^h$a:q$h^p$\textit{i}</td>
<td>mitjah$^p$i</td>
</tr>
<tr>
<td></td>
<td>hloq$^w$-\textit{je}</td>
<td>hloq$^w$h$^p$\textit{je}</td>
<td>löh\textit{je}</td>
</tr>
<tr>
<td>b.</td>
<td>sima:q-\textit{ma}</td>
<td>sima:q$'^b$ba</td>
<td>sima$'^b$\textit{ba}</td>
</tr>
<tr>
<td></td>
<td>k$^h$unu:q-\textit{no}</td>
<td>k$^h$unu:q$'^b$do</td>
<td>k$^h$unu$'^b$do</td>
</tr>
<tr>
<td></td>
<td>qa$^h$\textit{foq}$'^w$-\textit{no}</td>
<td>qa$^h$\textit{foq}$'^w$\textit{do}</td>
<td>qa$^h$\textit{foq}$'^w$do</td>
</tr>
</tbody>
</table>

Note that the underlying uvular in /sima:q-/ 'sleep' debuccalizes differently, according to the following segment. If a glottalized sonorant follows, then Glottal Transfer will take place, and a uvular ejective will be created; the end result is debuccalization to glottal stop, as in (b) [sima$'^b$ba] 'having fallen asleep'. If any other consonant follows, then by Coda Aspiration, the uvular will become aspirated and the end result will be debuccalization to /h/, as in (a) [sima\textit{ti}] 'about to fall asleep'.

The generalization to be captured is summarized by Buckley as follows: 'descriptively, this amounts to saying that uvulars debuccalize when followed by another consonant, since stem-final tokens are shielded by extraprosodicity during the derivation and retain their place features' (1994: 98). (Compare underlying /mo-h$^h$-a$^h$]q$^a$/ → [mó$^h$a$^h$q$^a$] 'must have run'). There are additional details regarding the level in which this rule applies (it is a 'lexical structure-changing rule that applies only in derived environments' (1994:99)).

As mentioned above, Uvular Debuccalization does not apply in levels one and two in the lexicon, thus the above rule is not surface-transparent.

Compare the following forms, which preserve a uvular in coda position:

(57) /\textit{ni-moq}-\textit{tj}-w/ → [di$^h$bôq$^a$\textit{tj}$^w$] 'fall hard'
/\textit{ni-moq}-m-w/ → [di$^h$bôq$^a$\textit{maw}] 'fall hard (pl.)'
/\textit{na-h\textit{joq}}-m-w/ → [dahjôq$^a$\textit{maw}] 'stir objects around'

The main point is that the laryngeal features of uvulars are preserved, though the process has applied to an intermediate derived form. I formalize the rule of Uvular Debuccalization as follows:
In Buckley’s formulation, uvulars are represented with Dorsal place, and the feature [-high] is dependent from the place feature. Here, however, I have modified the representation to conform to the representation of uvulars as a complex segment (see the arguments in §5.3.2.2). Thus two rules of Kashaya make clear that laryngeal features are preserved. The case is made stronger by the fact that there are [h] ~ [ʔ] alternations with final coronal and uvular consonants, depending on the phonetic environment. This shows that since some stops become [h], preservation of [continuant] is ruled out and thus C-place Delinking is implausible, especially since many would argue that glottals cannot bear [cont]. Furthermore, the so-called redundancy rule [-cont] → [c.g.] does not come in to play, since otherwise all stops would become glottal stop. Kashaya is thus an important case, since two rules involve apparent debuccalization of the Oral Cavity node, preserving both laryngeal features. (There is no evidence from Coronal and Uvular Debuccalization for C-place delinking since the feature [cont] does not seem to be phonologically active). We turn next to Kashaya’s two other debuccalization rules, Word-Final Plain Stop Debuccalization and Verb-final Debuccalization.

There is another process of debuccalization in Kashaya in which all word-final plain stops (those without a Laryngeal node) undergo debuccalization to become [ʔ]. (This process occurs when the words are in isolation – without the assertive /=ʔ/, with which they merge to form ejectives; see Chapter 8). The assertive clitic is a glottal stop (=ʔ, where the equals sign indicates the clitic boundary) which attaches to nouns and adjectives to give the meaning ‘it’s (a) ____’. For example:

(59)  haju ‘dog’       haju=ʔ     ‘it’s a dog’
      k’ili ‘black’    k’ili=ʔ     ‘it’s black’ (68)
When the ejective comes in contact with a stop or affricate which does not bear a Laryngeal node, the glottal stop of the assertive (and many glottal stop-initial suffixes) fuses with the stem-final consonant to produce an ejective. Take, for example, the Future suffix /-ʔkʰe/, as in /na-ʔjuʔ-ʔkʰe/ → [dahjuṭ'kʰe] ‘will rub’ (68). Likewise, the glottal stop merges with plain sonorants to form a glottalized sonorant, e.g. /tʰunun-ʔkʰe/ → [tunūwktʰe] ‘would get tired’ (69). The Assertive combines with sonorants to form a glottalized sonorant, as in /ʔjahaw=ʔ/ → [ʔjahaw] ‘it’s a boil’, and /ʔɪʃkan=ʔ/ → [ʔɪʃkan] ‘it’s pretty’ (69).

Buckley (1994:99-100) gives the following examples of Word-Final Debuccalization. The first column shows the underlying form, as determined by the assertive form in the second column, in which the /ʔ/ assertive clitic has merged with the voiceless stop or affricate to produce an ejective. The assertive thus shows the place of articulation of the final stop or affricate. The column labelled ‘Isolation’ shows the effects of Word-Final Debuccalization, in which the word-final plain voiceless stop or affricate is debuccalized to glottal stop when the form occurs in isolation, without any suffixes.

(60) Kashaya Word-Final Debuccalization

<table>
<thead>
<tr>
<th>UR</th>
<th>Assertive /ʔ/</th>
<th>Gloss</th>
<th>Isolation (PR)</th>
<th>Gloss</th>
</tr>
</thead>
<tbody>
<tr>
<td>qahmaʔ</td>
<td>qahmaʔ'</td>
<td>‘he is angry’</td>
<td>qahmaʔ</td>
<td>‘angry’</td>
</tr>
<tr>
<td>feʔet</td>
<td>feʔet'</td>
<td>‘it’s a basket’</td>
<td>feʔet</td>
<td>‘basket’</td>
</tr>
<tr>
<td>siqʰot</td>
<td>siqʰot'</td>
<td>‘it’s acorn grounds’</td>
<td>siqʰoʔ</td>
<td>‘acorn grounds’</td>
</tr>
<tr>
<td>sulemat</td>
<td>sulemat'</td>
<td>‘it’s a rope’</td>
<td>sulemat'</td>
<td>‘rope’</td>
</tr>
<tr>
<td>wataʔf</td>
<td>wataʔf'</td>
<td>‘it’s a frog’</td>
<td>wataʔf</td>
<td>‘frog’</td>
</tr>
<tr>
<td>maʔʃaʔʃ</td>
<td>maʔʃaʔʃ'</td>
<td>‘it’s them’</td>
<td>maʔʃaʔ</td>
<td>‘they’</td>
</tr>
<tr>
<td>mihjoq</td>
<td>mihjoq'</td>
<td>‘it’s a woodrat’</td>
<td>mihjoq'</td>
<td>‘woodrat’</td>
</tr>
<tr>
<td>mítṣaʔq</td>
<td>mítṣaʔq'</td>
<td>‘it’s sweat’</td>
<td>mítṣaʔq</td>
<td>‘sweat’</td>
</tr>
</tbody>
</table>

(Buckley 1994: 68-69, 99-100)

Ejectives and aspirates, because they do have Laryngeal nodes, do not debuccalize in this position in nonverbs, as the following forms show (Buckley 1994:100):
Since plain voiceless stops do not have Laryngeal nodes, they are not preserved, nor is primary place. Nor is there evidence that the plain stops become glottalized before debuccalization. Buckley formalizes the word-final plain stop debuccalization rule as the delinking of Place features among word-final stops with no Laryngeal node. Buckley indicates this with a tick mark perpendicular to the line which associates the Laryngeal node to the Root. Adapting this to the Clements and Hume framework, I formalize this rule as follows:

(62) Kashaya Word-Final Debuccalization

\[ RO_l^w \]
\[ \downarrow \]
\[ OC \quad (\text{no Lar}) \]
\[ \quad | \]
\[ [-\text{cont}] \]

The fact that plain stops debuccalize to glottal stop, in a language in which marked laryngeal features debuccalize to either [?] or [h] is quite interesting for the formalization of debuccalization. Buckley describes how a Laryngeal node is assigned the feature [c.g.] ([glottal]):

'When the Place node is deleted, a Laryngeal node dominating [gl] must be provided. I assume that a placeless consonant with the feature [-cont], which characterizes all stops, receives the feature [gl] and (as a path) a Laryngeal node.'
(Note Buckley’s assumption that glottal stops are specified for [cont]).

Kashaya Word-Final Debuccalization could provide evidence for one of two analyses. First, it could confirm the utility of a rule like [-cont] → [e.g.], especially for stops which seem not to bear any glottal features, i.e. plain voiceless stops. Second, it could give credibility to those analyses which emphasize the preservation of [-cont], since the output is a (glottal) stop. In the Constriction-based analysis, preservation of [continuant] would be attributed to C-place delinking. (This will be discussed in more detail below). Recall that such representations are supported in works like Lass (1976), and for /h/ with a [±continuant] specification, for Iverson (1989) and Bessell (1992). However, such an analysis must either also supply [e.g.] to the Laryngeal node, which is essentially what the above rule does, or accept the representation of glottals without laryngeal features. Most analysts would prefer the first choice, but the matter is not unanimously settled.

Yet another Kashaya rule of debuccalization seems specific to verbs. The absolutive suffix attaches to verbs, with a general infinitival meaning (1994:61); it is thus not to be confused with the nominal absolutive in ergative languages. The normal allomorph is /-ʔ/ after a consonant; after vowels, it is /-w/, e.g. /kehł-imiq-ʔ-ʔ/ ‘peer up (pl.)’ vs. /kehł-ala-w/ ‘peer down (pl.)’ (1994:62). Do not confuse this with the assertive clitic /=ʔ/, which attaches to nouns, pronouns, and adjectives, and which means ‘it’s a ___’.

When the absolutive suffix follows a voiceless or ejective fricative, it appears to delete (63a). When it follows sonorants, it triggers Glottal Merger (63b):

<table>
<thead>
<tr>
<th>(63)</th>
<th>UR</th>
<th>PR</th>
<th>Gloss</th>
</tr>
</thead>
<tbody>
<tr>
<td>a.</td>
<td>ṅu-k’-is-ʔ</td>
<td>duk’is</td>
<td>‘scratch’ (70)</td>
</tr>
<tr>
<td></td>
<td>ḫumūj-ʔ</td>
<td>ḫubūj</td>
<td>‘sprout’ (70)</td>
</tr>
<tr>
<td></td>
<td>ṅa-hqos’-ʔ</td>
<td>daqhos’</td>
<td>‘knead’ (70)</td>
</tr>
<tr>
<td>b.</td>
<td>mo-m-ʔ</td>
<td>môm</td>
<td>‘run across’ (70)</td>
</tr>
<tr>
<td></td>
<td>mî-laqhâlalm-ʔ</td>
<td>bilaqhâlamm</td>
<td>‘feed (pl.)’ (65)</td>
</tr>
<tr>
<td></td>
<td>ṙa-hal-ʔ</td>
<td>dahâl</td>
<td>‘dig (a hole)’ (70)</td>
</tr>
<tr>
<td></td>
<td>mu-hkhuq-ʔ</td>
<td>muhkhùq</td>
<td>‘burn up’ (70)</td>
</tr>
</tbody>
</table>

When the absolutive is added to a plain stop-final verb stem, the result is a glottal stop, not an ejective, as expected in the Assertive and in the nouns (see the data for Word-Final Debuccalization above).
An alternative analysis could be one in which there is no fusion process; instead, the stem-final consonant is deleted, and the glottal stop which remains is the absolutive suffix, not the result of debuccalization. However, this account could not capture the behavior of the final non-stop sounds like fricatives, which are ineligible for fusion, and surface unchanged (note that there is a fricative ejective /s'/) (62a). For example, if C → ø / __?/, it would not apply to fricatives or sonorants, only stops or affricates, as the data in (62) illustrate. In addition, the deletion of one consonant before another is not seen elsewhere in the phonology. First, Epenthesis can apply, e.g. /mo-hṭ-w/ → [mōṭiw] 'run (pl.)' (45). Second, a rule like Glottal Transfer can apply, e.g. /mo-m-ʔ/ → [mōm] 'run across' (70) or /joq'oò]-mà/ → [joq’òi]’ba] ‘after keeping’ (53). Third, we have seen various debuccalizations as a possible outcome, e.g. /na-*' Jut-tl*'/ — *  [dahjiiht’] ‘didn’t break it’ (91). Fourth, other combinations of stops may surface, e.g. /nu-se:k'-t*'/ — »  [dusék’t*’]  ‘doesn’t pleat’. In addition, this rule cannot apply as Word-Final Debuccalization did, since in Verb-Final Debuccalization, /ṭ/ → [?] as in /ṭa∫'-ʔ/ → [ṭaʔ] ‘see (pl)’, while nouns ending in /-ṭ'/ do not debuccalize, as in /heṭ'/ ‘nail’. Instead, Buckley proposes that there occurs the by now familiar process of Glottal Merger, followed by Verb-final Debuccalization.

Ejectives, Buckley claims, undergo Glottal Transfer vacuously:

Aspirated stops apparently do not occur in coda position underlyingly in verbs. However, an aspirated sonorant may, and Glottal Transfer overrides the underlying feature specification:
Given that Glottal Transfer applies to many segment classes, and is not just feature-filling, but can change features on sonorants, it would be highly unusual to delete plain stops, which are the most likely target of a rule like Glottal Merger (See Steriade 1994 for more on laryngeals fusing with plain stops). Therefore I agree with Buckley that an intermediate stage of Glottal Merger feeds Verb-Final Debuccalization.

Note also that verbs do not undergo a general process of coda debuccalization

\[(67) \quad /\text{tj.a-aû"-qà/} \rightarrow [\text{dj.aû"qû}] \quad \text{‘must have flown (pl.)’} \quad (241)\]
\[ /\text{qa.:hjut-qa/} \rightarrow [\text{dahjùf'qû}] \quad \text{‘must have broken it’} \quad (94)\]
\[ /\text{qa-mo'k'-t*}$/ \rightarrow [\text{qabòk'tû}] \quad \text{‘doesn’t have swollen cheeks’} \quad (95)\]

I propose to formalize this rule as follows:

\[(68) \quad \text{Verb-final Debuccalization} \quad \]
\[ RO \quad I_{\text{verb}} \quad \]
\[ \pm \quad \text{OC} \quad \]
\[ \quad | \quad \text{[-cont]} \quad \]

Given Buckley’s analysis that Glottal Merger takes place, then Verb-final Debuccalization is clearly an instance of Laryngeal node preservation, since (derived) ejectives debuccalize to glottal stop.

In sum, Buckley has proposed four different processes of debuccalization in Kashaya. Coronal Debuccalization and Uvular Debuccalization provide very clear evidence that Laryngeal features are preserved, and hence that Debuccalization is formalized as Oral Cavity delinking, since final stops alternate between underlying ejectives and glottal stop, and underlying aspirates and glottal fricative. Even laryngeal features acquired during a derivation through Coda Aspiration or Glottal Merger affect the output of debuccalization. The rule of Word-Final Debuccalization was interesting in showing what happens when a plain stop, with no underlying laryngeal features, debuccalizes: it becomes [?]. This could be analyzed as the result of a rule like Halle’s in which [-cont] \( \rightarrow [\text{e.g.}] \). Verb-final
Debuccalization debuccalized the final consonant of verbs via an intermediate process of fusion.

5.6.3. Yucatec Maya

Straight (1976) examined the acquisition of Yucatec Mayan phonology, which has two types of debuccalization. The first type of pulmonic debuccalization has two related parts: it involves the change of /k/ → [h] and /t/ → [h] before homorganic stops and affricates (debuccalization proper, shown in (69a)), and the change from /ts/ → [s] and /tʃ/ → [ʃ] before homorganic stops and affricates (deaffrication, shown in (69b)). Data are repeated from (3) for convenience:

(69) a. /tun kolik k’aaj/ → [tun kolih k’aaj] ‘he’s clearing brush’
"/taŋ k pak’ik k kool/ → [taŋ k pak’ik h kool] ‘we’re planting our clearing’
"/leʔ iŋ w ot iʃo/ → [leʔ iŋ w oh iʃo] ‘that house of mine/my house there’

b. /ʔuts t iŋ w iʃ]/ → [ʔus t iŋ w iʃ] ‘I like it’ (lit. ‘goodness is at my eye’)
/ʃ’s’ u hoʔoʃ tik/ → [ʃ’s’ u hoʔoʃ tik] ‘he scratched it’
/haʃ iʃʃan/ → [haʃ iʃʃan] ‘very little’ (Goldsmith 1990:72)
(Lombardi 1990:383, citing Straight 1976)

Lombardi has analyzed this as a single process: dissimilatory delinking of [-cont] when Root nodes share place features. In her account, when an affricate loses [-cont], it still preserves the [+cont] part, and place as well—a straightforward account of deaffrication. When a stop loses [-cont], however, the segment has place but no specification for stricture—an ill formed segment. Thus repairing the representation causes place features to be lost as well, leaving only the laryngeal feature [spread glottis]. (Yucatec Mayan stops are phonetically aspirated). In Lombardi’s view, then, debuccalization is a by-product of the loss of [continuant].

In the Constriction-based model, it is difficult to assume a unified account for these two processes. The constriction-based model would treat the stops to [h] change as simple Oral Cavity Delinking, assuming that the stops are specified for [s.g.], if not underlyingly, then during the derivation. Evidence for this is that [cont] is lost, place features are lost, and the Laryngeal feature is preserved. This is straightforward, just as Lombardi’s deaffrication account was. However, in describing the change from affricate to fricative,
the constriction model could not easily appeal to Oral Cavity Delinking, since the crucial feature \([\text{cont}]\) as well as place would be lost on the underlying affricate, yielding a presumed \(*[h]\). One possible solution is to appeal to the specification of \([\text{strident}]\), which is under the Root node. Deaffrication is thus Oral Cavity Delinking, but since \([\text{strident}]\) remains, the process might treat /s/ as the default strident, and repair structure accordingly.

The problem with this idea, however, is that it could not also account for the change /tʃ/ → \([ʃ]\), with two default stridents. Perhaps this is actually an argument in favor of treating these phenomena as two different processes. After all, what do debuccalization and deaffrication have in common, except that both are weakening processes? The change of /t, k/ → [h] is prototypical of debuccalization—loss of place, while /sʃ, tʃ/ → [s, ʃ] is prototypical deaffrication. Both phenomena do share a homorganicity trigger; however, they could well be the result of two different but similar constraints on different classes of segments. One constraint says roughly ‘Two stops may not share place features’ and is repaired by debuccalization. The other says that ‘Affricates may not occur before homorganic plosives’, and is repaired by deaffrication. Let us now examine the debuccalization of ejectives, which Lombardi (1990) does not discuss.

In the following example, the underlying velar ejective debuccalizes before another consonant:

\[(70) \quad /t\text{ tán a lik}' sik'/ → [t\text{ tán a li}ʔsik'] \quad \text{‘You're raising it’}\]

Obstruents and nonobstruents ‘function equally with other nonvocalic segments to condition deobstruentization [(debuccalization)] of ejectives’ (Straight 1976: 60), so the conditioning environment must simply be any consonant. (Recall that the debuccalization of voiceless stops to [h] required a following homorganic place feature of a stop or affricate, and was thus more specific.) The so-called prevoiced stops also undergo this same phenomenon, though no examples are given. Straight notes:

‘There must therefore be some feature or feature-complex which differentiates ejectives and the prevoiced series of stops, as a group, from the plain plosives, if we are able to handle this change to glottal stop as a unitary phenomenon. The most likely candidate here is the feature [glottal constriction], although the syllable-initial prevoiced stops are not accompanied by the simultaneous glottal closure found in the ejectives’ (1976:60).
Straight's account is marred by lack of examples. He implies all ejectives turn to glottal stop before another consonant, and all ‘prevoiced’ stops do so as well. These could well be implosives. Clearly more data are needed. One solution is that if the plain stops are not specified for [s.g.] underlyingly, then debuccalization is simply the result of the failure to license a Laryngeal node before another consonant. Since the ejectives, specified for [e.g.] and the ‘prevoiced stops’, perhaps specified for [voice], have the only Laryngeal nodes, these segments would not be licensed in preconsonantal position, given Lombardi’s Laryngeal Constraint (Chapter 3). These segments would be deleted and then filled in with glottal stop, which acts as default. (Root node debuccalization). Those stops with place but no Laryngeal node would then be assigned [s.g.] redundantly, accounting both for the surface aspiration, as well as the end product of debuccalization.

One possible way to unify all three lenition phenomena was adumbrated by Besell (1992) in her reading of Straight (1976). She observed that what all three features have in common is preservation of release features: \( C^b \rightarrow h, C' \rightarrow ?, \tilde{t}s \rightarrow s \). Given Steriade’s (1993, 1994) work on aperture nodes (see §2.3.3), there might be a kernel of a solution. Unfortunately, Steriade’s aperture nodes are not well integrated into feature geometry. Often, features are put where it is typographically convenient, and there is an implicit acceptance of the Bottlebrush model of feature organization, in which aperture nodes take the place of the root. Given wide latitude in relating aperture nodes to feature organization, the generalization is that \( A_0 \) nodes (the closure portion) are delinked under homorganic (or preconsonantal) conditions. Given that laryngeal features are best realized upon release of a segment, or \( A_{\text{max}} \) for released stops, then loss of \( A_0 \) could mean loss of every feature but release (or the feature [spread], attached to \( A_{\text{max}} \)). Affricates are encoded as \( A_0A_{\text{fr}} \), and loss of closure results in only the fricative component. Finally, for the ejectives (and possible implosives), since \([\text{c.g.}]\) is usually assigned to release of \( A_{\text{max}} \), loss of closure preconsonantally would yield debuccalization (though one might normally expect loss of release, which would be deglottalization). Akin to the idea of the loss of closure is loss of oral closure, which is what debuccalization is.

The importance of Yucatec Maya lies in showing that debuccalization of the ejectives yields glottal stop, and debuccalization of apparently redundantly aspirated pulmonic stops yields [h]. This seems like fairly solid evidence that Laryngeal features are preserved, and that debuccalization is of the Oral Cavity. In addition, no appeal need be made to Halle’s redundancy rules. Yet behavior of the prevoiced stops could suggest Root
Node Delinking for those and for the ejectives. The issue of indeterminacy haunts many an analysis.

5.6.4. Amharic

Cowley et al. (1976: 93) discuss Amharic and observe that

\[ \text{in the dialect of Menz, generally, } /k'/ \text{ is replaced by } /h/, \text{ and } /k/ \text{ by } /h/ \text{ respectively when these stops occur ungeminated and in non-initial positions. This phonetic process is not recorded as occurring either in Gojjam or Wello.} \]

Examples of simple voiceless velar stop debuccalization are given in (71a), while ejective debuccalization is shown in (b), and lack of debuccalization initially is shown in (c). Note below the synchronic phonological alternation in Menz Amharic between /k'irebu/ 'Come closer!' and /jik'rebu/ 'Let them come closer!', realized as [jiʔrebu].

(71)

<table>
<thead>
<tr>
<th>Menz</th>
<th>Others</th>
<th>Gloss</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) jehebbebe</td>
<td>jekebbebe</td>
<td>'that which has become heavy'</td>
</tr>
<tr>
<td>negeso</td>
<td>nekso</td>
<td>'he having bitten'</td>
</tr>
<tr>
<td>(b) lεʔen</td>
<td>lek'εn</td>
<td>'for a day'</td>
</tr>
<tr>
<td>jiʔrebu</td>
<td>jik'εbu</td>
<td>'let them come closer'</td>
</tr>
<tr>
<td>awweʔε</td>
<td>awwek'ε</td>
<td>'he knew'</td>
</tr>
<tr>
<td>(c) k'εn</td>
<td>k'εn</td>
<td>'day'</td>
</tr>
<tr>
<td>k'irebu</td>
<td>k'irebu</td>
<td>'Come closer!' (2nd pl.)</td>
</tr>
</tbody>
</table>

Ejectives are clearly specified for [e.g.]. It could well be that the only rule which reveals the Laryngeal feature of the plain stops is debuccalization, which shows them to be specified for [s.g.]. Compare this case in (a) to Kashaya Word-final Debuccalization, in which voiceless stops debuccalized to glottal stop. A similar case of stops becoming [h] is found in KiRundi (Goldsmith 1990:283). Padgett (1995) claims that phonetically even unaspirated stops are produced with glottal spreading, as in Italian Gorgia Toscana (Nespor and Vogel 1986), in which /k/ → [h] (but /p. t/ spirantize to [φ. θ]).

5.6.5. Icelandic

There are several other cases which illustrate the preservation of laryngeal features and loss of oral cavity features, including Icelandic, Klamath marked sonorants, and Kagoshima.
Japanese. Since they do not deal with ejectives, they will be dealt with briefly, but are included in order to illustrate the parameter of Oral Cavity delinking in another class of segments.

In Icelandic, there is another type of debuccalization which has been widely analyzed in the literature; see Thrainsson (1978), Clements (1985:233), Iverson (1989), Goldsmith (1990), Hayes (1990), and Roca (1994). The basic idea is that the first half of an underlying voiceless (aspirated) geminate is realized phonetically as preaspiration. Only the laryngeal feature [spread glottis] is preserved from the first half of the geminate. Examples of this preaspiration are given below:

(72)

\[
\begin{array}{ccc}
\text{PR} & \text{UR} \\
\text{tʰapʰpʰi} & \text{tʰahpi} & \text{‘top’} \\
\text{hatʰhvr} & \text{hahhvr} & \text{‘hat’} \quad \text{(cf. /hattvr/ [hattvr] ‘hair’)} \\
\text{pekʰkʰyɾ} & \text{pehkyɾ} & \text{‘bench’} \\
\end{array}
\]

I propose that in Icelandic the first half of the geminate delinks its Oral Cavity node, leaving only its Laryngeal node intact with the feature [e.g.], especially since the value of continuancy changes from a stop to a fricative (the pre-aspirated component). Icelandic thus fits into the cases of Oral Cavity debuccalization, since Laryngeal features are preserved.

Garnes (1974, p.c.) has found that the preaspirated component is a voiceless counterpart to the preceding vowel. This fact can be accounted for by a rule which spreads the vowel place features onto the following stop. Since the stop bears [s.e.], the vowels will be interpreted as voiceless. This rule undoes debuccalization in a sense, since the segment is given new phonetic place features.

5.6.6. Klamath Marked Sonorants

Klamath, in addition to its extensive rules of delaryngealization discussed in Chapter 4, has a process of sonorant debuccalization. Sequences of plain sonorant followed by laryngeally marked sonorant give rise to sonorant plus [h] or [ʔ]. (There are no examples of underlying or derived sequences of marked sonorant followed by plain sonorant). Here are some examples from Blevin (1993:268), citing work from Barker (1963a, 1964):
When the sequence of sonorants reflects an identical geminate, the normal rule of sonorant deglottalization applies: /w-pul-jq-a/ → [wpullqa] ‘falls on the stomach’ (Blevins 1993:248).

The behavior of sonorants appears to reflect a type of debuccalization of sonorants in which the laryngeal features are preserved. This appears to be Oral Cavity Delinking. What is unusual is that the fact that sonorants are involved. Blevins views the Klamath glottalized sonorants as phonologically [+son] (1993:239), and she follows the SPE classification of /h, ʔ/ as [+sonorant], so in her analysis no major class features are changed. In her definition, [+sonorant] sounds ‘are produced with a vocal tract configuration sufficiently open so that the air pressure inside and outside the mouth is approximately equal’, while [-sonorant] sounds are obstruents which ‘are produced with a vocal tract constriction sufficient to increase the air pressure inside the mouth significantly over that of the ambient air’ (239). Other evidence, as we have seen, has treated glottals as obstruents, so there again appears to be contradictory evidence on their specification.

Lightner (1976) proposed treating the marked sonorants as phonologically [-sonorant], in part on the grounds that it simplified the statements for deglottalization. This would also simplify the debuccalization statement. On the other hand, perhaps Klamath debuccalization gives some credence to Urbanczyk’s (1992) proposal of treating glottalized sonorants as a contour segment:

(74) \[ [+cons] \]
    \[ [-son] \quad [+son] \]
    \[ ʔ \quad l, r, n, j \]

The second specification of [+son], along with the place features would be deleted, leaving only the glottal stop component of the laryngealized sounds. Presumably aspirated sonorants would be represented in the same way, but with a [-son] [h] as the initial component. Clearly the varying treatments of glottals affects the formalization of Klamath.
debuccalization. Of importance to this section, however, is that the Laryngeal features are preserved, while the Oral Cavity features, both place and [continuant], are lost.

5.6.7. Kagoshima Japanese
In the Kagoshima dialect of Japanese (Haraguchi 1984, Trigo Ferré 1988:34-5), high vowels are dropped in word-final or morpheme-final position after, in Trigo’s terms, a non-strident consonant (though $\text{d}3$ is included among the triggers). The now syllable-final stops debuccalize to glottal stop, as shown in (75a). What is unusual is that even voiced stops debuccalize, as does the flap (b) in verbs. Nasals also debuccalize, becoming /n/ (c) (more on this below), and in (d), the sibilant fricative and palatal glide do not debuccalize.

(75) Kagoshima Japanese

<table>
<thead>
<tr>
<th></th>
<th>matu</th>
<th>mat</th>
<th>maʔ</th>
<th>‘pine tree’</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>katu</td>
<td>kat</td>
<td>kaʔ</td>
<td>‘to win’</td>
</tr>
<tr>
<td></td>
<td>oku</td>
<td>ok</td>
<td>oʔ</td>
<td>‘to put’</td>
</tr>
<tr>
<td></td>
<td>doku</td>
<td>dok</td>
<td>doʔ</td>
<td>‘poison’</td>
</tr>
<tr>
<td>b</td>
<td>obi</td>
<td>ob</td>
<td>oʔ</td>
<td>‘belt’</td>
</tr>
<tr>
<td></td>
<td>hidʒi</td>
<td>hidʒ</td>
<td>hiʔ</td>
<td>‘god’</td>
</tr>
<tr>
<td></td>
<td>kagi</td>
<td>kag</td>
<td>kaʔ</td>
<td>‘key’</td>
</tr>
<tr>
<td></td>
<td>karu</td>
<td>kar</td>
<td>kaʔ</td>
<td>‘to cut’</td>
</tr>
<tr>
<td>c</td>
<td>kami</td>
<td>kam</td>
<td>kan</td>
<td>‘god’</td>
</tr>
<tr>
<td></td>
<td>umu</td>
<td>um</td>
<td>un</td>
<td>‘to give birth’</td>
</tr>
<tr>
<td></td>
<td>inu</td>
<td>in</td>
<td>in</td>
<td>‘dog’</td>
</tr>
<tr>
<td>d</td>
<td>tuju</td>
<td>tuju</td>
<td>tuju</td>
<td>‘dew’</td>
</tr>
<tr>
<td></td>
<td>osu</td>
<td>osu</td>
<td>osu</td>
<td>‘to push’</td>
</tr>
<tr>
<td></td>
<td>kasu</td>
<td>kas</td>
<td>kasu</td>
<td>‘draft’ 18</td>
</tr>
<tr>
<td></td>
<td>kiji</td>
<td>kiz</td>
<td>kizj</td>
<td>‘bell’ 19</td>
</tr>
</tbody>
</table>

It is unclear why Trigo posits vowel deletion and then reinsertion in these last two forms, but not in the previous one.

Trigo Ferré uses the symbol $<\text{d}2>$ for IPA /\text{d}3/, but in the examples on p. 35, the symbol $<\text{z}>$ appears alone. I do not know if this is a typographic error, since /s/ is not phonemic; given the debuccalization of /\text{d}3/ in /hidʒi/ ‘elbow’, I am not sure of what to make of this.
Unfortunately neither source provides evidence which motivates the proposed underlying forms, such as alternations between the final consonant and glottal stop.

The first problem is how to capture the class of segments which debuccalize: the voiced and voiceless stops, nasals, and flap, but not glides or stridents. If we view the rhotic flap as a noncontinuant, then this could simply be the class of [-cont] as the target of debuccalization. Trigo Ferré argues that [+continuant] [r] and [-continuant] [t] are both replaced by [?] in the verbal paradigm. I point this out as evidence that [?] does not in any way "inherit" the continuancy value of the debuccalized segment" (36). Trigo Ferré has provided no evidence that the Japanese /r/ is [-continuant]. Bloch (1950/1995:151) notes that /r/ in its allophones is either a short voiced alveolar flap or a voiced alveolar lateral flap; (see also Jones 1950:205-6). Shimizu and Dantsuji (1987:17, cited in Ladefoged and Maddieson 1996) note that some speakers have a lateral approximant [l] and a flap [r] as free variants, while in other speakers, they are in complementary distribution with [l] initially and the flap intervocally. Other speakers use the lateral approximant everywhere, while still others use the retroflex voiced stop [d]. Therefore, given the phonetic facts, /r/ is at least as often [-continuant], and so Trigo Ferré's claim may be incorrect. However, /r/ is unusual in other ways in the phonology.

Trigo Ferré attempts to unite the debuccalization account by assuming that [n] is a placeless nasal glide, just as the glottal stop is placeless and so in her analysis, the process of debuccalization is delinking of Place. (Other languages which have true debuccalization and 'nasal depletion' include Middle Chinese (Chen 1973), and Malay (Onn 1980). However, in terms of phonetic realization, Japanese /r/ is a 'uvular nasal consonant, ranging from stop to approximant in manner of articulation' (Poser 1983:7-8, cited in Trigo Ferré 1988:32; there are other descriptions of this sound as well). Thus if this sound,

---

20 In non-verbal stems with /r/, there is a change to a palatal glide, e.g. /turu/ → [tuj] 'vine, runner', and /ari-gatoo/ → [aj-gatoo] 'thank you'.

Japanese /r/ does however, seem to pattern as a sonorant. Lyman's Law states that morphemes contain at most one voiced obstruent: witness morphemes such as /ringo/ 'apple', originally a loanword but now virtually nativized (Itô and Mester 1986, 1995). Compare also /goru-goru/ 'goggle-eyed' or /zara/ 'coarse'. Because these are not violations of Lyman’s Law, it seems that /r/ is not an obstruent specified for [voice]. The phoneme /r/ is exceptional in other ways: it never occurs initially in Yamato vocabulary, though it does in loanwords – see Itô and Mester (1995). Although phonetically it is coronal, it does not undergo mimetic palatalization. Mester and Itô (1989) analyze /r/ as the only underspecified sonorant, they view it as ephenthetic in verbal paradigms, and observe that it is the only consonant which cannot be geminated during a derivation.
while variable, does have place, to call it a placeless nasal glide is a somewhat abstract phonological account which is not in accord with the phonetic facts.

This process of debuccalization strongly implies that laryngeal features are lost or overridden, since \textit{[voice]} is changed to \textit{[c.g.]}, as seen in (75b). However, if we must unify the behavior of nasals, then the feature \textit{[nasal]} is preserved and thus this cannot be Root Node Debuccalization with glottal stop default. Instead, I propose that this is a case in which Halle’s redundancy rule (6a) is well justified: all oral stops (or affricates) are assigned \textit{[c.g.]} in a feature-changing manner. Then the Oral Cavity Node is debuccalized for all sounds classed as [-continuant] (assuming the nasals to be so specified). True debuccalization occurs for the stops, which as placeless \textit{[c.g.]}, become glottal stop. The nasals may undergo Oral Cavity Delinking, but according to my definition in §5.1, because the end result is not glottal, the nasals do not undergo true debuccalization, especially since there is some obstruction in the oral cavity, as a uvular stop or approximant. Their loss of place, however, is a result of Oral Cavity Delinking. In this case, though, because of the preservation of \textit{[nasal]}, what would normally have been analyzed as Root Node Delinking must make reference to feature-changing rule assigning \textit{[c.g.]} to oral stops.

5.6.8. Summary
In this section we have seen several examples in which it appears that the laryngeal features of a stop are preserved, while place and continuancy features are deleted. The highest node which covers both these features in the Clements and Hume model is the Oral Cavity node. Examples of OC Delinking were shown of both underlying and derived aspirated and glottalized consonants in Kashaya’s rule of Coronal Debuccalization, and for derived aspirated and ejective consonants in Uvular Debuccalization. The debuccalization of plain stops suggested, in addition to the preservation of laryngeal features, the need for a feature-filling application of a rule like (6a). In Yucatec Mayan and Amharic, ejectives debuccalized as expected to glottal stop. In addition, the ‘voiceless’ consonants debuccalized to [h], suggesting that although there is only one series of voiceless sounds in these languages, they may be specified as aspirated underlyingly. No rule like (6a) applies in Yucatec. The laryngeal features of complex sonorants in Klamath debuccalized in different ways, depending on the laryngeal specification, as OC Delinking predicts. Finally, in Kagoshima Japanese, the laryngeal feature \textit{[c.g.]} must be assigned by a rule like (6a).
5.7. C-place Delinking

How glottals are represented in underlying and phonetic representations becomes important when formalizing debuccalization. While it is generally acknowledged that languages with laryngeal transparency represent glottals without place features (and usually only with laryngeal features), languages like Semitic, in which glottals participate in a guttural class, must bear some kind of place features (McCarthy 1991, 1994). Given such variable representations, it is at least theoretically plausible that some glottals may bear stricture features, while others do not.

In this section, I will review the evidence on whether glottals bear [continuant]. The Constriction-based model of Clements and Hume (1995) predicts that in addition to spreading C-place, C-place may be delinked, but [continuant] is preserved. This is schematized as follows:

(76) C-place delinking

```
Root
| Oral Cavity
≠ C-place [continuant]
```

In the first section, I review proposals on the representation of glottals, as well as the arguments on whether or not they bear stricture features. In the next section, proposals for C-place debuccalization will be presented. I conclude that the evidence is not compelling, but such an option could be predicted, and therefore the possibility of C-place debuccalization should not be ruled out a priori.

5.7.1. The Representation of Stricture on Glottals

Kenstowicz (1993:489) has claimed that there is little independent evidence that phonological processes group [?] with oral stops and [h] with oral fricatives, and generally he is correct. In addition, voiceless fricatives are produced with an open glottis phonetically, hence use of the feature [+spread] is appropriate for (most) fricatives, which is relevant for debuccalization of fricatives to [h] (Kenstowicz 1993:489, citing Clements 1985 and McCarthy 1988; see also Rice 1994, Steriade 1994, Vaux 1996). Some scholars have argued that the soft palate (nasal) and laryngeal sounds cannot make stricture distinctions and thus [continuant] is irrelevant to glottals (e.g. McCarthy 1988, Trigo Ferré
1988) on articulatory or definitional grounds. Trigo Ferré has argued that glottal stop is
never subject to spirantization, nor does [h] undergo stopping to glottal stop. She argues
inheritance of [cont] isn't necessary, since it can be recovered from laryngeal properties, as
we saw for many languages in the preceding section.

While I generally acknowledge Trigo Ferré's observations that glottal fricative does
not undergo fortition and that glottal stop does not generally lenite (except to delete), I have
found a few examples which suggest that this is not a universal, though the examples
below generally do not include this process along with obstruent lenition. Furthermore,
these examples are diachronic, not synchronic. The first case comes from the history of
Palauan, a Micronesian language. Here earlier forms with *h appear to have undergone
fortition to glottal stop:

(77) Palauan *h > ?
*hataj > ?að ‘liver’
*hujo > ?ull ‘rain’ (Crowley 1992:313)

It is possible that historically this correspondence was not one shift, but involved deletion
of /h/, followed by epenthesis of glottal stop to create an onset. Clearly more work needs
to be done, especially since this change involves a shift in what are typically considered
end-points in lenition, and the 'last stop' before complete deletion (Hock 1986, Harris
1995).

There are a few examples of apparent glottal stop lenition. The first occurred in the
history of Lakalai, a language spoken in West New Britain, Papua New Guinea (Crowley

(78) *?ate hate ‘liver’
*?unsan hura ‘rain’
*?anso haro ‘sun’
*pa?a vaha ‘leg’

Note that both initial and intervocalic glottal stop has changed to [h]. Note also in ‘leg’ and
other examples not shown here, *p spirantized to [v]. *k apparently deleted, *d > 1, but *t
remained unchanged.

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Dyen (1971) contains a wealth of interesting but difficult correspondences in Austronesian.

Parker (1994:117) also mentions the historical change of glottal stop in Proto-Panoan to glottal fricative in Huariapano:

<table>
<thead>
<tr>
<th>Proto-Panoan</th>
<th>Modern Huariapano</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>*baʔkiʔi</td>
<td>bạhkiʃ</td>
<td>‘tomorrow’</td>
</tr>
<tr>
<td>*wiʔtaʔu</td>
<td>wihtas</td>
<td>‘shin’</td>
</tr>
<tr>
<td>*paʔtsaʔ-</td>
<td>pahʦæjni</td>
<td>‘wash clothes’</td>
</tr>
<tr>
<td>*muʔʔaʔ-</td>
<td>muhʔʔaki</td>
<td>‘(get) wet’</td>
</tr>
</tbody>
</table>

In Miami-Illinois (Costa 1991) the reflexes of Proto-Algonquian obstruent clusters all apply debuccalization to the first member of the cluster so that the result is always /h/. This includes glottal stop. Thus *h, *ʔ, *ç, *ʃ, *x, *θ, *tʃ plus obstruent all yield [h] plus obstruent, e.g. *efpesiwa > /iihpisita/ ‘he is high, tall’, and *keθpiθe:wa > /kihipilaka ‘I bind him’. Change of the glottal stop to [h] is shown in the following forms: *paʔtewi > paahteewi ‘it is dry’, *niʔtawawa > /nihttaawa/ ‘my (man’s) brother-in-law’ (1991:376), and *aʔjikan(w)a > /ahʃikana - ahsikana/ ‘bass’ (371). Miami-Illinois did not have a phonemic glottal stop, though Costa notes that it shares with the ‘Eastern Great Lakes’ group of Algonquian the merger of all glottals (*h and *ʔ) before obstruents’ (389). This seems like fairly clear evidence that glottal stop patterned as an obstruent, and can itself undergo debuccalization. If such changes were synchronic at one point in Eastern Great Lakes Algonquian, it would be formally simplest to assume Root Node Debuccalization with [h] as the default consonant. However, except for *ʔ, all the sounds which underwent debuccalization are fricatives or affricates, which could easily bear [spread glottis] features, which are preserved. The puzzle is how to change *ʔ to [h]. Perhaps, since the language now has no glottal stop, another placeless glottal is the best available option, if the language imposes a constraint against obstruent clusters but doesn’t delete them altogether. At least the output avoids sequences of Place features for consonants.

Glottal stop and fricative sometimes alternate as well, but this may be due more to laryngeal dissimilation than due to lenition or fortition. For example, in Nez Perce (Aoki

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21 Bloomfield’s (1933:§20.8) discussion of Primitive Central Algonquian suggests a process of Root Node debuccalization since *nk > hŋk and *xk > hŋk in Menomini. The debuccalization of the nasal also took place in Plains Cree. Clearly this proposal deserves further investigation.

Bessell (1992) has shown that glottal stop in Nlakapmxcin (and other Pacific Northwest Coast languages) patterns with the voiceless stops in undergoing an allophonically rule of aspiration. This was confirmed through spectrographic analysis. In addition, Henton et al. (1992:77) affirm the physiological possibility of aspirated glottal stops, though they are not aware of any phonemic contrast between glottal stops based on aspiration. Bessell’s data are repeated here:

(80)  
<table>
<thead>
<tr>
<th>glottal stop</th>
<th>phonetic form</th>
<th>meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>/tʔapʰ</td>
<td>‘she got smeared with blood’</td>
<td></td>
</tr>
<tr>
<td>/ʔistʰkʰ</td>
<td>‘winter’</td>
<td></td>
</tr>
<tr>
<td>/tʔaqʰ</td>
<td>‘tame’</td>
<td></td>
</tr>
<tr>
<td>/ʔaʔaʔʰ</td>
<td>‘crow’ (60).</td>
<td></td>
</tr>
</tbody>
</table>

Since the language has both stops and fricatives at the same places of articulation, and thus [cont] is contrastive, these data are strong evidence that glottal stop is specified for [-continuant], since the aspiration rule seems to target [-son, -continuant].

The existence of even an allophonically aspirated glottal stop poses interesting questions for feature theory. Generally, segments which are [constricted glottis] cannot by definition be [spread glottis], and this seems correct, since there is no attested phonemic contrast. Yet how would positional aspiration on a glottal stop be represented? Here I believe Steriade’s aperture nodes could help show the difference. Regular glottal stop is glottalized during the closure portion, with [c.g.] attached to A₀ (81a). With an aspirated release, we simply add the feature [s.g.] to an A_max release node (81b). In my view, the ban on [c.g.], [s.g.] segments applies to a single A position, not the segment as a whole (81c):

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Such a segment as (c) violates Steriade’s (1994) conditions for monosegmentality, since the features, even on different A positions, are said to be incompatible. Steriade’s example of an ill-formed segment is ‘t’ (218). In Mazateco, there is an onset [hts?], which Steriade analyzes as bisegmental, but which is derived from /sts?/. The issue of conflicting feature specifications, the definitions of monosegments, and the allophonic representation of aspiration on glottal stops deserve further study, especially since such a combination may generate sounds not attested, such as ejective aspirates, and therefore may not be fully motivated.

Additional evidence for the [-continuant] specification of glottal stop comes from Adzera, an Oceanic language spoken in NE New Guinea (Holzknecht 1973, cited by Bessell 1992:65). In this language, with stops /p b t d k g ?/ and affricates /ts dz/, along with fricatives /f s h/, all the obstruents which bear [-continuant] (stops and affricates) have prenasalized counterparts, including glottal stop: /mp, mb, “t, “d, “ts, “dz, ik, og, o?/. The [+continuant] sounds are not prenasalized. This generalization is difficult to state if glottal stop does not bear [-continuant].

We should also recall the definition of the feature [continuant]. Halle (1992:208) proposed the following definitions:

(82) ‘Continuant sounds are produced without interruption in the air flow through the oral cavity; non-continuant sounds are produced with a total blockage of the air flow through the oral cavity.’

Certainly glottal stop interrupts the air flow through the oral cavity, as evidenced by the stop gap of glottal stops (Ladeshoged and Maddieson 1996:75-77). And the glottal fricative certainly permits uninterrupted airflow through the oral cavity. Therefore, by definition, we expect glottals to bear these features, at least phonetically.

Iverson (1989) argued on the basis of underspecification theory that in languages in which glottal constriction seems to play a role, such as Korean, /h/ should be specified as [+continuant] and /n/ should be specified as [-continuant], in addition to their respective laryngeal features. Evidence for this view comes from alternations in which the eight
Korean coronal obstruents /tʰ t* ɾʰ ĵʰ ŋʰ s s*/, with glottally tense (but non-ejective) consonants represented by an asterisk\(^{22}\), neutralize to plain unreleased \([t']\) in syllable-final position. The laryngeal features for labial and velar stops also neutralize to their plain unreleased counterparts. An unusual fact, however, is that /h/ neutralizes to \([t']\) as well. These alternations are adapted from Iverson (1989:288), who in turn adapted the data from Kim-Renaud (1986).

(83) a. \(/\text{ap}^\text{h}-\text{i}/ [\text{a.p}^\text{h}i] \quad \text{‘front (subjective)’}\
   /\text{ap}^\text{h}/ \rightarrow [\text{ap}'] \quad \text{‘front’}\
   /\text{ap}^\text{h}-\text{to}/ [\text{a.p}.t^\text{*}o] \quad \text{‘front also’}\
   b. \(/\text{k}^\text{*o}\text{t}^\text{h}-\text{i}/ [\text{k}.o.t^\text{h}i] \quad \text{‘flower (subjective)’}\
   /\text{k}^\text{*o}\text{t}^\text{h}/ [\text{k}.ot'] \quad \text{‘flower’}\
   c. \(/\text{os-un}/ [\text{o}.sun] \quad \text{‘as for the clothes’}\
   /\text{os}/ [\text{ot'}] \quad \text{‘clothes’}\
   d. \(/\text{k}^\text{*ok}^\text{*}-\text{o}/ [\text{k}.ok'.o] \quad \text{‘break off (imperative)’}\
   /\text{k}^\text{*ok}^\text{*}-\text{ta}/ [\text{k}.ok'.t'a] \quad \text{‘break off (declarative)’}\
   e. \(/\text{ţ}^\text{oj}-\text{uni}/ [\text{ţ}.o.hu.ni] \quad \text{‘as (it is) good’}\
   /\text{ţ}^\text{oj}-\text{ko}/ [\text{ţ}.ot'.k'o] \quad \text{‘good and’}\
   /\text{ţ}^\text{oj}-\text{ta}/ [\text{ţ}.ot'.t'a] \quad \text{‘good (declarative)’}\

In Korean, the consonant /t/ is also epenthetic in several compounds, as in /ţ^to-pul/ \(\rightarrow [\text{ţ}.ot'p^*ul] \quad ‘candlelight’. Thus because of its epenthetic status and because /h/ neutralizes to [t], Iverson argues that the most parsimonious lexical representation of Korean obstruents will leave the plain /t/ as completely unspecified; this is Coronal Underspecification (see Paradis and Prunet 1991) in the framework of radical underspecification (e.g. Archangeli 1988). The aspirated coronal stop /tʰ/ will thus be represented simply as [+spread glottis], and /t*/* will be represented as [+constricted

\(\ldots\)

\(^{22}\) I believe the phonetic realization of the glottalized consonants in Korean is not found in other languages of the world. Phonologically, these sounds may well be represented with the feature [constricted glottis], given their small glottal opening, as Iverson and others assume, and thus may be phonologically identical to ejectives in underlying representation, especially since no language seems to contrast these sounds with ejectives. However, I hesitate to call the Korean fortis consonants ejectives because although they lack the distinct laryngeal raising, compression, and glottalic airstream characteristic of ejectives. See Ladefoged and Maddieson (1996:55-57) and references therein for a more detailed phonetic description.

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The problem, then, is how to specify /h/ underlyingly. Iverson's solution is to represent it with the laryngeal feature [+spread glottis] and the stricture feature [+continuant]. This is summarized as follows:

(84) Korean (Radical) Underspecification

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>/t/</td>
<td>completely unspecified</td>
</tr>
<tr>
<td>/tʰ/</td>
<td>[+spread glottis]</td>
</tr>
<tr>
<td>/t*/</td>
<td>[+constricted glottis]</td>
</tr>
<tr>
<td>/h/</td>
<td>[+spread glottis] and [+continuant]</td>
</tr>
</tbody>
</table>

Korean obstruent neutralization is thus the delinking of terminal features (but not place features), with defaults supplied. In sum, because of his assumptions on lexical representation, Iverson argues that since coronals are the default consonant, they are unspecified for place, and since the aspirated coronal takes the feature [+spread], /h/ must be specified as distinct, with the manner feature [+continuant]. Iverson did, however, allow for language-specific differences in the specification of segments, suggesting that in English, perhaps [?] is completely unspecified, with a rule [ ] → [+constricted glottis] as a default. In short, the arguments are theory-driven, not data-driven.

5.7.2. C-Place Debuccalization

The last major argument in favor of glottals bearing [continuant] is that of debuccalization. There is a strong, but not universal correlation between stops debuccalizing to glottal stop, and fricatives debuccalizing to glottal fricative. For example, the Kashaya Word-Final Debuccalization synchronically changed noncontinuants to [?], where there were no laryngeal features suggesting an ejective. Harris (1990) points out that debuccalization is not restricted to consonants that are already glottalized, as exemplified by Burmese (Lass 1976), Toba Batak (Hayes 1986), and Malay (Onn 1980). Other synchronic debuccalizations seemingly without reported underlying or intermediate glottalization include Chukchi (Bogoras 1922) /q/ → [?], Indonesian and Javanese /k/ → [?] (Clark and Yallop 1990), etc. Similar changes have occurred diachronically in Middle Chinese *p, t, k > ? (with nasal weakening as well) (Chen 1973), Top End *k > ? (Harvey 1991), Samoan and Hawaiian *k > ? (Crowley 1992), and Boumaa Fijian k > ? (Dixon 1988). Careful

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23 Iverson's points have been criticized. Padgett (1995), for example, does not believe that there are compelling arguments for underspecifying Coronal, and he claims that Korean phonology does not make reference to /h/ as [+continuant], thereby undermining in part Iverson's arguments.
laboratory phonology of the realization and variation of the stops in these languages may help answer the question whether all debuccalization requires an intermediate stage of glottalization. Data from Kashaya Word-Final Debuccalization suggest that it is not necessary in all cases.

Languages in which fricatives debuccalize to [h] include various Spanish dialects, various dialects of Eskimo-Aleut (Woodbury 1984), Yakut (Krueger 1962), Hawaiian (Foulkes 1997), Mazateco (Steriade 1994), Mistantla Totonac (MacKay 1994) and many others. Languages which have both stops debuccalizing to [?] and fricatives to [h] include Malay (Onn 1980) and Guininaang Kalinga (Gieser 1970).

A related argument is more tentative in nature. If in some languages glottal stop clearly patterns with [-continuant], then it must bear that feature in at least some languages. And if we allow parametric variation in feature geometric representations, then it is also conceivable that some languages may debuccalize to a glottal stop which bears [-cont]. I admit, though, I have no such strong evidence, but would like to leave open the possibility. (It is also conceivable that underlying and derived representations for laryngeals are different. See Shaw (1991, cited in Rose 1996) for such a proposal for Nisgha, and Rose (1996) for Tigre. And even if C-place delinking takes place, it is still possible to remove a [continuant] value by repair rule, though this would be very difficult to distinguish from Oral Cavity Delinking.

If C-place delinks, leaving the sister feature [continuant] intact, how can we end up with a glottal, especially when no laryngeal feature is specified? Bessell (1992) proposed that /h/ is represented simply as [+consonantal] with [continuant] dependent from the root. (In the feature framework assumed here [continuant] entails an Oral Cavity node as well). Bessell’s representation of glottal stop is the most minimal to date: simply the feature [+consonantal]. (Taylor 1996 makes similar assumptions to account for the behavior of glottal stop vis-à-vis various glottal dissimilations in Shuswap, but specifies it for [-cont], but not [c.g.]–see more in Chapter Six). However, if some languages make reference to the [continuant] value of glottal stop, then it too must have an Oral Cavity node in Constriction-based geometry. One advantage to these representations is that in languages in which [c.g.] never plays a role except in debuccalization, a Laryngeal node with that specification does not need to be introduced on the output of voiceless stop debuccalization; debuccalization is simply delinking, period. In more conventional representations, debuccalization is delinking of a node, followed by default fill-in. The
implications of representing glottals like this remains to be worked out, but it cannot hold of all languages, since some must refer to [c.g.] on glottal stops (e.g. Seri, Yip 1988).

Given the possibility of C-place delinking, it is quite natural to assume that a representation with [-continuant] but no place features be interpreted as a glottal stop, a stop with no oral articulation. The same reasoning applies to the interpretation of [h] as a glottal fricative. In fact, since few if any rules refer to the output of debuccalization, there is little evidence that derived glottal stops must be represented with the feature [c.g.]. It could be implemented in the phonetics, if full specification is required, but at the same time, the phonetics could simply interpret a placeless noncontinuant as a glottal stop. (Recall the point raised in §5.4.1 about achieving the same acoustic output by different means).

As Padgett (1995) has pointed out, a theory which posits that [continuant] is irrelevant for glottals makes the prediction that the glottal output of debuccalization crucially depends on the laryngeal features of the debuccalizing segment. However, as we have seen, this theory often must introduce laryngeal features by the brute force of rules like (6a). In addition, it often makes use of phonetic facts such as the phonetic (but not phonological) aspiration of stops which debuccalize to [h], and the presumed spread glottis of voiceless fricatives to support this view; at other times, it ignores lack of glottalization on stops, as in Toba Batak, Malay, Javanese, plain stops in Kashaya, and West Yorkshire English (Harris 1990) in order to achieve the correct output. But as mentioned above, this assumes a representation in which glottal stop is specified for [c.g.]. If, as some authors have suggested, glottal stop is [-cont], and glottal fricative [+cont], then C-place delinking may work quite economically, especially for debuccalization of voiceless stops.

Bessell (1992) argued that in debuccalization in Indonesian languages (/p t k/ → [ʔ], /s/ → [h]), targets are not specified for a Laryngeal Node. Bessell’s analysis is maximally economical if glottals have no laryngeal features, just [consonantal]. Delinking of Place leaves just a consonantal Root node. Delinking of place from [+cont] /s/ leaves a consonantal Root node still specified for [+cont], which is the representation for which she argues. If it is assumed that these sounds must bear a Laryngeal node, then they, along with the appropriate laryngeal features may be added, with a logical phonetic interpretation as I have suggested above.

Malay is a language which has played an important role in the literature on glottals and debuccalization (Hassan 1976; Onn 1976, 1980; Durand 1987, 1990; Teoh (1987), Trigo 1988, 1991; Halle 1995). Let us examine Jahore Malay (Onn 1980) in more detail. The underlying inventory that Onn proposes is /p t k, b d g, tʃ dʒ, s h, l r, m n n ŋ, j w/.
The voiceless velar stop undergoes debuccalization syllable-finally (‘in word-final position or when another stop follows’ (9)). The voiced velar stop occurs in loans like rugby as [ra?bi]. Since no native words end in /g/ and the loans which end in the velar stop are nouns, it is impossible to see this sound before vowel-initial suffixes.

(85) /masak/  $\rightarrow$ [masa?] ‘to cook’
     /masak-an/ [masakan] ‘the cooking’
     /di-masak-i/ [dimasaki] ‘to cause to be cooked for’
     /masak-kan/ [masakan] ‘to cause to cook for’ (Onn 1980:9).

For some speakers of Jahore Malay, /masak-an/ is realized as [masakan], with a glottal stop; cf. also /di-masak-i/  $\rightarrow$ [dimasa?ki] (1980:10). To explain the forms of these speakers, Onn posits a ‘synchronic low-level rule of gemination in the language which geminates only stem-final velar stop when the stem takes a vowel-initial suffix’ (10). This move allows debuccalization to apply in the coda, creating glottal stop before a velar stop. Onn speculates that all stops might undergo gemination, and then degemination; note that no geminates appear on the surface. As support for this possibility, Onn cites data from Kelantan Malay, which shows broader debuccalization and intervocalic ?C sequences.

In Kelantan Malay, all final stops debuccalize, along with /s/:

(86) a. /hadap/ [hada?] ‘to face’
     /hadap-an/ [hada?pë] ‘front’
 b. /ikat-an/ [ika?të] ‘the tying’
     /ikat/ [ika?] ‘to tie’
 c. /sepak/ [sepa?] ‘to kick’
     /sepak-an/ [sepa?kë] ‘kick’
 c. /balas-an/ [balahsë] ‘the reply’
     /balas/ [balah] ‘to reply’ (Onn 1980:10-12)

Onn proposes a low-level rule of gemination of obstruents, followed by debuccalization of the first half of the geminate to account for the presence of glottal before an obstruent. Debuccalization takes place, since the first half of the geminate is syllable-final and thus a target for the rule.

The debuccalization of /s/ is obligatory in Kelantan, but optional in Jahore:
In addition, the final nasals in Kelantan delete after causing vowel nasalization, e.g. /kotam/ → [kɔtɛ] ‘crab’, /ikan/ → [ikɛ] ‘fish’, /dʒuliq/ → [dʒuli] ‘cross-eye’ (Onn 1980:73). Trigo Ferré considers this process the creation of a nasal placeless segment, and believes it results from the same process as deubuccalization.

Durand (1990) argues that in Malay, the two glottals pattern /ʔ, h/ with the obstruents and not with the glides (though Durand does not specify the status of the feature [continuant]). For example, a prefix ending in a nasal consonant assimilates in place to the following consonant, which is then deleted if it is a voiceless obstruent. The stem beginning with /h/ behaves like the other voiceless obstruents /p, t, k, s/, as the following data (from Durand 1990) show in (88a). Place assimilation takes place vacuously, since the glottal has no Place to spread. In (b) the voiced stops fail to delete. (Durand does not illustrate the complete obstruent inventory):

(88a) /məŋ-adsar/ [məŋadsa] ‘to teach (active)’
/məŋ-pukul/ [məŋũkol] ‘to beat (active)’
/məŋ-tulis/ [məŋũles] ‘to write (active)’
/məŋ-kawal/ [məŋなぁwal] ‘to guard (active)’
/məŋ-salin/ [məŋalɛn] ‘to copy (active)’
→ /məŋ-hakis/ [məŋakes] ‘to erode (active)’

b. /pəŋ-boroŋ/ [pəmboroŋ] ‘wholesaler’
/məŋ-baja/ [məmbaja] ‘to pay (active)’
/məŋ-daki/ [məndaki] ‘to climb (active)’
(Durand 1990:106, 1987:83; see also Onn 1980:14)

For some reason, the voiceless affricate does not delete, e.g. /məŋ-ʃatu/ → [məŋʃatu] ‘to ration (active)’. Otherwise, all the underlying voiceless obstruents delete, including /h/.

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Since Malay has debuccalization of /s/ to /h/, and /h/ is phonemic and acts as a voiceless obstruent, then it is at least possible that /h/ should be represented with the feature [continuant], perhaps in addition to [spread glottis]. (Recall the proposal for Korean that /h/ was specified with both laryngeal features and the feature [+continuant].) And if [continuant] is preserved in debuccalization, then C-place delinking takes place, since otherwise there would be two different representations of [h]. Glottal stop is not phonemic. If we accept a modified version of Bessell's proposal, then debuccalization in Malay is accounted for by assuming C-place delinking, and assuming that glottals are represented with [continuant], but not necessarily Laryngeal features.

Another example in which a stop reduced to [?] and a fricative to [s] is in Guininaang, a subdialect of Kalinga, a South-Central Cordilleran language of the Philippines (Gieser 1970). Data are limited, but 'fluctuation between k and the glottal stop' is reported (53). The phoneme [s] also has an alternation with [h] in syllable-initial position. Recent influxes of loanwords from Ilocano and Spanish do not make these debuccalizations synchronically transparent, may have made at least [h] a phoneme, and have also created apparent hypercorrections, such as Spanish cajón > [kahún] ~ [kasún] 'wooden box'.

Finally, in the Scots of Fife and Lothian, Lass (1976) reports that /p t k/ before word boundary debuccalize to [?] (and they do so in a number of other contexts as well) (89a). However, the voiced stop /d/ may also debuccalize intervocically (b). It is possible that final obstruent devoicing feeds the rule of debuccalization, but the fact is that the voiced alveolar stop is realized as a glottal stop. Finally, the fairly frequent substitution of /θ/ with /h/ shows fricative debuccalization as well.

(89) a. to?  'top'
    kā?  'cat'
    bā?  'back'

b. bre? an bəʔər 'bread and butter'

c. aeʔɪŋk  'I think'
    'evrəŋŋ  'everything'

The Scots example could be analyzed along similar lines as Malay, with C-place delinking leaving the feature [continuant] with no place features. This structure is then interpreted as a glottal. (The only trouble is in repairing [voice] if we do not assume final devoicing).
It is possible to view other alternations as C-place Delinking, depending on the theoretical assumptions made. For example, Kagoshima Japanese (§5.6.7) turned noncontinuants to glottal stop, in which there could have been an inheritance of [continuant] given C-place delinking and the assumptions of glottals issued here. The same would apply to Lafourche Cajun French in which voiced and voiceless sibilant fricatives debuccalized, possibly as the result of preserving [continuant].

In conclusion, the evidence for C-place delinking is admittedly weaker than for Oral Cavity Delinking and Place Feature delinking, since it depends on other assumptions made by the analyst. We must balance the lack of conclusive evidence for delinking of C-place and preservation of [cont], with the utility of the Oral Cavity node, which organizes C-place and [cont] as one constituent, especially as seen in spreading rules summarized in §5.6.1. We must also re-examine assumptions of why glottals are often represented with laryngeal features, and not stricture, as the defining features. Finally, given the assumptions sketched above, we may have a principled way for predicting the rules (6a) which relate stricture to laryngeal features, and accounting for the different debuccalization outcome for stops. I propose that those glottals which clearly yield laryngeal features unambiguously inherited from the segments before debuccalization must be analyzed as Oral Cavity Delinking. Segments with no apparent laryngeal feature specification (as in Kashaya word-final debuccalization (previously discussed under Oral Cavity Delinking, or Malay), will debuccalize via C-place delinking, which leaves glottals as minimally understood placeless (non)continuants. I believe that the phonetic component can then interpret the two different representations (one without stricture, and one without laryngeal features) as the appropriate glottal.

5.8. Diachronic Change and Dialectal and Free Variation
For expository purposes, much of the historical and dialectal data on debuccalization has been incorporated in the various sections above. For example, data on Yuman and Guddiri Hausa were explored under Individual Place Feature Debuccalization. In this section, I will briefly explore the residue which did not fit neatly under one of the above categories. Recall from §5.4.2 that because ejective debuccalization involves preservation of laryngeal features and possibly [continuant], it is often difficult to decide which type of debuccalization took place. Also in this section, because dialects or sister languages may differ in that one has an oral segment while the other, a glottal, there is strong evidence that debuccalization has taken place. However, because of the often elusive phonemic nature of
glottal stop, it is often difficult to decide whether the dialectal differences reflect a synchronic phonological rule or whether such a debuccalization rule has applied in the past and now the lexical items have undergone reanalysis as potentially contrastive glottal stops. In addition, I will include here some reports of the free or stylistic variation of debuccalization.

Given the relative commonness of debuccalization synchronically and dialectally, we would expect to find several cases diachronically, and this is confirmed. However, I should point out that much work needs to be done on specifying precise sound change laws in many of the underdocumented languages with ejectives. Some of the sources used here simply assert a fact without supplying adequate examples. Clearly this situation is not desirable, but lacking more detailed materials, I repeat what has been claimed in the literature until more adequate data is amassed.

5.8.1. Languages of Africa

We will begin examining dialectal variation involving debuccalization by drawing upon the wealth of examples found in Afro-Asiatic. Bender and Fulass (1978: 9) cite Leslau (1959b), who notes that among the purported Sidamo features in South Ethiopian is the alternation between an ejective and a glottal stop: C' ~ ?. Ullendorff cites Cohen (1939:45 and 108) for the view that Sidamo is responsible for the weakening of glottalized ejectives in Semitic Ethiopian, a view reflected by Leslau (1952). But Ullendorff thinks that could happen spontaneously, and as we have seen, and will see, there is supporting evidence to view this as an independent, natural phonological process, and not necessarily the result of language contact.

Bender and Fulass note that a glottal stop occurs as a dialectal variant of /k'/? in the Amharic of Shewa Province e.g. /bək'lo ~ bə?lo/ ‘mule’. (See also Ullendorff (1955), Fleming (1990:509), and Leslau (1995:7)). The Menz dialect (Cowley et al. 1976 was reported in §5.6.4 to have velar debuccalization in which the ejective debuccalized to [?], and the stop, to [h]. In addition in Amharic, before another consonant, the ejective affricate /tʃ'/ can also be debuccalized, or in some cases vocalized to /j/. For example, [af'awatʃ'awal ~ af'awatʃ'awal ~ af'awatʃ'awal] ‘he has whistled’; [tägaʃ'tawal ~ tägaʃ'tawal] ‘it collided’; [näg'ʃ'jankurt ~ nāʃ'jankurt] ‘garlic’ (Leslau 1995:7).

Ullendorff 1955 reports that the change [k'] > [?] is found in some cases in Harari, sporadically in Gurage, in some examples in Gafat, and even idiolectally in syllable-final position in Tigre (see §5.4.2). Leslau (1968:6) reports a similar alternation in Soddo.
where glottal stop is a variant of /k'/, as in the following example: /t'ək'ur/ ~ t'əʔur/ ‘black’.

Leslau (1952:68-9) documents several other cases of dialectal variation of debuccalization in the languages of Ethiopia:

‘In Gurage, the change of k’ to a glottal stop is found in many dialects; to judge from the material at hand, it occurs in Ennemor, Endegen, Gogot, Wolane, Aymallal, and perhaps Muher. But t’ and i]’ become a glottal stop only in Ennemor, Endegen, and Gyeto – dialects belonging to the same group.’

Compare Leslau (1963:8) who notes that Harari /sâk’âla/ ‘hang up against the wall’
corresponds to En. /sâʔârâ/, Ed. /sâʔânâ/; Har. /k’âbaʔa/ ‘anoint’, En. /ʔâpâ/. Compare also Harari /t’afa/ ‘be satiated’. En. /ʔâfâ/.

Also Har. /mêf’â/ ‘wash clothes’, En., Ed. /meʔâ/. (See also Leslau 1957).

This is echoed by Hetzron (1972:65), who reports that

‘Except in Gyeto, glottal stops may also come from the partial (apparently unsystematic) “debuccalization” of the ejectives [k’, t’, i]’], e.g. Gyeto24 daak’â ‘he laughed’, wât’a ‘he went out’ vs. other PWG [Peripheral West Gurage] daaʔâ / waʔa. While the change k’ ~ ʔ is also attested elsewhere in Ethiopian: Soddo, Gogot, Muxar, Wälläne and dialectal Amharic (see Cohen, 1939, pp. 40-1 and Leslau 1959[b], pp. 4-5), other ejectives occasionally become glottal stops in PWG only.’

Leslau (1952) provides the following examples of correspondences which show debuccalization (see also Leslau 1979). We will begin with cases of initial and medial /t’/ going to glottal stop. I include only a few examples of each type; consult the original for more25.

(90) ‘applaud’ Amh t’âfât’t’âfâ, S t’ifât’âfâ, En ?âfâ
‘claw’ Amh t’əfər, C t’əfər, En ?əmfər
‘come’ Amh mât’t’a, A mêt’t’am, En Ed maʔa
‘disappear’ Amh t’âffa, M t’âffam, Ed Gt ?âfa

24 Hetzron apparently contradicts Leslau’s claims of debuccalization in Gyeto.

25 The following abbreviations are used: A = Aymallal, Amh = Amharic, C = Chaha, En = Ennemor, Ed = Endegen, G = Gurage, Gt = Gogot, M = Muher, S = Sidamo, and W = Wolane.

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Leslau’s examples of ū” > glottal stop are given in (91):

(91) ‘fiber’ Amh k’atʃ’a, Gurgage k’antʃ’a, Ed keʔá
‘grind’ Amh fætʃ’tʃ’ä, C fætʃ’äm, En Ed feʔäm
‘nasal mucous’ C En omʃafʃ’a, Ed òomfeʔa, Amh naʃt
‘tree’ C ãtʃ’ã, En eʔã, Ed jàʔã. (68-9).

Finally, I illustrate in (92) some of Leslau’s data regarding the debuccalization of /k'/ to glottal stop:

(92) ‘accept’ Amh tük’abbālā, C and other dialects with k’, En teʔepārā, Ed tāʔeppārā, G tāʔebbeām
‘armful’ Amh ak’of, C ank’āfat, En uʔumfād
‘awake’ Amh nāk’k’a, S nāk’ū, W nāʔā
‘belt’ A dāk’ot and dāʔot
‘bean’ Amh bak’ela, G baʔela, W baʔella

Dresel (1977:30, citing data from Abraham 1946) notes that in Azare (East Hausa) ‘a glottal stop is used in place of a glottalized consonant’ in standard Hausa, indicating debuccalization. Dresel’s examples are given in (93):

(93) Std. Hausa Azare Gloss
k’ofà òofà ‘door’
k’òfì òfì ‘replete’
dèbe òbe ‘draw (out)’

However, Paul Newman (p.c., 8 Aug. 1995) notes that only initial /k’/ is replaced by glottal stop in some dialects at the eastern end of Hausaland. The affricate ejective /tsʔ/ is not affected, and the only implosive to undergo debuccalization occurs in the single lexical item given by Dresel.

Ullendorff (1955:154-5) (cf Leslau 1952) notes that in Cushitic, all glottalized consonants, including implosives, occasionally become glottal stop:

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Sasse (1979: 47) reconstructs *k' for Proto-Eastern-Cushitic. The reflex of a glottal stop, showing debuccalization, is found in Boni (initially), Dasenech (finally), Elmolo (initially), in Sao-Afar, and in Sidamo, in contrast to velar or uvular stop or fricative in Somali, Rendille, Gidole, and other languages. Arvanites (1991) reconstructed Highland East Cushitic (HEC) and found that there is variability between zero, glottal stop, and /k'/ medially across HEC languages.

Moving on to the Omotic family, we can find several examples of debuccalization, though from the sources I found, it was unclear how regular a process debuccalization was. Fleming (1976) discusses various correspondences in Omotic. He provides the following examples involving apparent debuccalization in Sheko for the word ‘bone’, and in Galila for the word for ‘darkness’ (317):

(95) Dime Nao Sheko Dizi Chara, Kefa Galila Gloss
k'us k'us ?us us us ‘bone’
t'um dfum/t'um ?um ‘darkness; evening’

Another case involves Bako, which has debuccalized its word for ‘know’:

(96) Dime Hamer Dizi Nao Bako
des/t'es des t'us t'us ?es (319)

See Fleming (1988) for more such examples.

Fleming (1976:370) gives another example, this time from the consonant cluster /-?r-/ in Kefa, which derives from an etymologically underlying ejective plus plosive cluster. Citing work from Bender, he gives an example of */ek'+ta/ ‘stand’ yielding

---

26 Janjero is now considered Omotic, but Ullendust be referring to another variety since Bender has shown that Janjero lost is velar ejective (§4.7.1).
[eːt̚ra] in which the ejective has debuccalized and the alveolar plosive has become the rhotic [r]. For more on South Omotic correspondences, see Fleming (1988).

Bender (1987) notes that the reflexes of Proto-Omotic *kʰ* in Janjero include deglottalization to /k/ in initial position, voicing to /g/ medially and either voicing to /g/ or debuccalization to /ʔ/ in final position. For example, Proto-Omotic *zokʰ* ‘red’ (Bender 1988) varies as /zokʔ/ ~ /zoʔ/ in North Omotic and is realized as /zeʔu/ in Janjero. PO *atšʰ* ‘tooth’ is /aaʔja/ in Janjero. Bender (1988) provides the following additional examples, in which the numbers correspond to his subgroupings; Bender has not provided reconstructions for all forms. Note that Ometo shows some variation, but has evidence of debuccalization both initially and finally. Mao and Ari show the word-final velar ejective in free variation with glottal stop, indicating debuccalization.

<table>
<thead>
<tr>
<th>(97)</th>
<th>Ometo</th>
<th>Gimira</th>
<th>Janjero</th>
<th>Kefa</th>
<th>Dizi</th>
<th>Mao</th>
<th>Ari</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>8</td>
<td>9</td>
<td>*P-O</td>
</tr>
<tr>
<td>doʔ</td>
<td>tok²</td>
<td>du-</td>
<td>(kot)</td>
<td>dook’, dok’.</td>
<td>‘sit/stand/</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>doʔ</td>
<td>doʔ</td>
<td>*dok’</td>
<td>live’</td>
</tr>
<tr>
<td>k’ur, ʔuro</td>
<td>orkn (k’ola) urum</td>
<td>‘bark’</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>bEʔ,  beʔ³</td>
<td>beʔ,  bAk’</td>
<td>‘see’</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(bek’)</td>
<td>biz</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>k’atʃ</td>
<td>kaʔ</td>
<td>k’uʃ</td>
<td>k’unšs’ k’oršs</td>
<td>‘scratch’</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

An interesting case is found in the Khoisan languages Nama and Korana. Beach (1938:223) notes that /kxʔ/ in Korana corresponds ‘in a great many (but not all) roots in place of Nama /ʔ/’. He lists some roots in Korana with the velar affricate ejective, but does not provide the cognate forms in Nama.

<table>
<thead>
<tr>
<th>(98)</th>
<th>Korana</th>
<th>Gloss</th>
</tr>
</thead>
<tbody>
<tr>
<td>kx’a</td>
<td>‘drink’</td>
<td></td>
</tr>
<tr>
<td>kx’ai</td>
<td>‘laugh’</td>
<td></td>
</tr>
<tr>
<td>kx’up</td>
<td>‘pus’</td>
<td></td>
</tr>
<tr>
<td>kx’aup</td>
<td>‘bitter’</td>
<td></td>
</tr>
<tr>
<td>kx’op</td>
<td>‘meat’</td>
<td></td>
</tr>
<tr>
<td>kx’om-i</td>
<td>‘house’</td>
<td></td>
</tr>
<tr>
<td>hãũ-kx’ũ</td>
<td>‘seven’</td>
<td></td>
</tr>
</tbody>
</table>

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I was able to corroborate the Nama form for ‘house’ /kõx/ in Hagman (1977:37) in the phrase ‘the man’s house / ámb/ (“man” is / ámb/). Hagman lists the naming form for ‘seven’ only as /hâu/. Nevertheless, there is some indication that debuccalization of /kõx/ has taken place in Nama. Furthermore, Beach notes that ‘with some Korana individuals the velar articulation disappears altogether, the result of being simply a glottal plosive efflux ?, exactly as in Nama’ (223). A midnineteenth century missionary, Wuras, recorded alternate pronunciations in many of the same roots, ‘sometimes attributing semantic difference to these alternates (e.g. face vs. countenance, look vs. seek)” (italics added).

Beach continues,

‘With some Korana speakers, the kõx efflux, while not yet entirely replaced by ?, seems to be in process [sic] of replacement. The Lucas sisters at Kimberley…for example, certainly used the kõx efflux, but they often made the velar articulation so lightly that it was hardly discernable. Sometimes they made the velar release silently, so that only a ? efflux was heard’ (233).

The debuccalization of /kõx/, which has occurred in Nama, seems to be creeping into Korana by means of a variable rule of realization.

5.8.2. Languages of the Caucasus

Colarusso (1988: 92) reports that in Northwest Caucasian, ‘many of the East Circassian dialects shift /q/ to /?/ in suffixes (Kuâseva 1969; Mamreöv 1969).’ (Recall the more general picture painted by Kuipers (1963, 1975) regarding Kabardian in our discussion of place feature debuccalization in §5.4). Other examples of diachronic debuccalization are found in the Caucasus. Colarusso (1989b) makes a preliminary reconstruction of Proto-Northwest Caucasian (PNWC), and, like Kuipers did for Proto-Circassian, postulates a PNWC uvular ejective which debuccalized in the daughter languages. Colarusso (1988) notes that ‘a similar shift [debuccalization] is frequent in the grammatical suffixes of Ubykh for many speakers. This appears to be a very natural weakening or slurring of /q/.’ It is also reported in Abkhaz that the dorso-uvular ejective /q/ is ‘sometimes realised as a glottal stop between vowels or word-initially if also pre-vocalic’ (Hewitt 1979:257). Chirikba (1996:75) observes that in the Sadz dialect of Abkhaz, the final consonant of the present dynamic suffix /-t/ is often realized as a glottal stop. Thus /jø-z-dar-wø-t/ → [udaru?] ‘I know’, and /lw-a-r wø-i-wø-t/ → [ušu?] ‘you (man) go’. Glottal stop is not phonemic. I could not determine whether other instances of /t/ debuccalize or whether the rule is
restricted to the present suffix. I also could not determine whether the uvular ejective /q'/ debuccalizes in this dialect.

Anderson (1997:989) reports that in the Balxar (Bartxi) dialects of Lak, a Daghestanian language, *q’ deleted in initial position and debuccalized in coda position. Initial deletion was probably also via a debuccalization stage.

(99) **Literary** | **Balxar** | **Gloss**
---|---|---
q’uqin | oin | ‘to cut’
q’anq’ | an? | ‘smell’

Džeranšvili (1967:587) notes that the present copulative in Rutul, a Daghestanian language of the Lezgian branch, originated from *q’a and now alternates between /?a/ and /a/, and the past imperfect *q’a-j shifted to /?aj/ and then /aj/.

Catford (1992) notes that debuccalization is common in the Daghestanian language Avar, ‘particularly in dialects and govors (sub-dialects) of the southern narečje (regional variety)’. Catford cites Mikailov (1958, 1959), who notes that ejective /t'/ is replaced by /ʔ/ in these dialects.

5.8.3. Languages of the Americas

England (1983) describes the Mayan language Mam, which, in addition to a voiceless series, has only one glottalized series that varies by place of articulation between implosive and ejective. The glottalized consonants often alternate freely with glottal stop in final position. For example:

(100) week’a ~ weej? ‘it’s mine’
ku6 ~ kuʔ ‘down (directional)’
ṣaq’ ~ ṣaʔ ‘underneath it’

England notes obligatory debuccalization (in pre-consonant position), in the suffix */-ee6/., which derives intransitive verbs from positional roots. For example:

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27 I was unable to determine from forms like /ik’/ ‘pass by’ and /ek’/ ‘chicken’ whether this apparent process of fission was regular.
These data provide additional evidence of debuccalization of any glottalized stop.

Lenca, a Chibchan language, shows some debuccalization in free variation. Campbell (1976) compared data he collected from the last speaker of El Salvadoran Lenca in the 1970s, with Honduran Lenca collected by Walter Lehmann in the 1920s. Campbell found variation in some forms such as /ʃok’iŋ/ – /ʃoʔiŋ/ ‘fish’, and /ʃik’a/ – /ʃiʔa/ ‘chile pepper’. Campbell assumes that the invariant forms Lehmann had recorded with velar ejectives are older, since Campbell’s informant showed free variation and Lehmann’s didn’t (and since such a sound change is natural). The debuccalization seems to have been irregular, since Campbell records forms such as /k’uwa/ ‘mouse’, /k’iq/ ‘road’, and /ik’âq/ ‘fire’ which did not alternate.

Debuccalization of ejectives is also reported in the shift from Proto-Jicaque-Tequistlateco to Tequistlateco: e.g. *p’ii > -ʔii ‘flea’ and *lik’ > (-ʔpu)laʔ ‘back (body part)’ (Oltrogge 1977:29-30). It is also reported among Jicaque dialects, as evidenced by correspondences between glottal and velar stop, e.g. Proto-Jicaque *k’as > Eastern Jicaque /ʔas/ vs. Western Jicaque /kat/ ‘blood’. These and Jicaque-related reconstructions will be discussed in more detail in §7.4.2.2.

Boas and Deloria (1941), in their discussion of Dakota, observe that in the most western Teton dialects, the glottalized /k’/ ‘tends to disappear and only the glottal stop remains.’ Two examples of this are found in Western Ogalala, which tends to debuccalize initial /k’/:

(102) /ʔû/ for /k’û/
/ʔéjaʔ/ for /k’éjaʔ/

Kari and Buck (1975) mention several dialectal variants involved in Ahtna. There are several variants on pronouncing the glottalized consonants at the end of a word, among which is debuccalization. (See also Kaisse’s 1992 analysis of Ahtna). While Central (C) and Western (W) dialects maintain the glottalized sounds /t’, ʰt’, ʰs’/, the Lower Ahtna dialect debuccalizes the sound to a glottal stop, generally preserving the continuant

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component of any affricate. (This process could also be considered a type of fission). For example, C and W dialects pronounce the word ‘mittens’ as /kei?z/, while the Lower (L) dialects use /ke?z/. Likewise, for ‘mink’, C and W have /tehîs’uus?i/ while L has /tehîs’uus?i/ (1975:xvi). Likewise, the other glottalized consonants are debuccalized in L:

<table>
<thead>
<tr>
<th>C</th>
<th>W</th>
<th>L</th>
<th>Gloss</th>
</tr>
</thead>
<tbody>
<tr>
<td>˛at</td>
<td>ı́’u</td>
<td>ı́’u</td>
<td>‘ball game’</td>
</tr>
<tr>
<td>˛t’i</td>
<td>ı́’</td>
<td>ı́’</td>
<td>‘potlach’</td>
</tr>
<tr>
<td>t’aa</td>
<td>ı́’</td>
<td>ı́’</td>
<td>‘three’</td>
</tr>
</tbody>
</table>

There is thus appears to be a regular process of coronal debuccalization in Lower Ahtna, though Kari and Buck indicate in their dictionary the specific occurrences of debuccalization for alveo-palatals and velars.

In Chipewyan, Scollon (1979:333) notes the occurrence of debuccalization, in variation with complete deletion, though perhaps only in the single form for ‘therefore’: /ejet’á ~ ?eji?á ~ ejía/. (More often, there is variation in the form of deglottalization – see Chapter Four). Finally, Dunn (1979:11) reports that in Coast Tsimshian the velar and uvular ejectives often debuccalize intervocally, as in /caq’aj/ ~ /ga?aj/ ‘wing’

5.8.4. Debuccalization and the Glottalic Theory

Now that we have seen that debuccalization of both pulmonic obstruents and ejectives is quite common, and found in many language families with ejectives, I find it unusual that the Glottalic Theory does not posit this change in at least one daughter language, in at least one place of articulation (most likely velar). Of course there may not be a justifiable correspondence set, but it is odd that one of the most common changes involving ejectives has not occurred in the history of any of the Indo-European languages, given the Ejective Model of the Glottalic Theory. This is one diachronic change we might have expected to see in several different families, as we did in Ethiopian Semitic and other Afro-Asiatic languages, Khoisan, various languages of the Caucasus, and in Californian and Central American Native American languages. This counts in a small way against the Glottalic Theory, though of course our knowledge of sound change is never predictive. This is the actuation problem of Weinreich, Labov, and Herzog (1968).
It has been argued, however, most forcefully by Kortlandt (1985) that Danish stød, for example, is a relic of the PIE ejectives, so perhaps IE has witnessed a form of debuccalization cum prosodicization after all.

5.9. Summary and Conclusion
In this chapter, I have examined the debuccalization of both glottalic and pulmonic sounds within the context of a constriction-based theory of feature geometry.

The triggering environment for debuccalization is quite often coda position (e.g. Kashaya) or intervocalic position, places we have seen other types of ejective lenition such as deglottalization. Indeed, coda position is a classic position of the syllable for laryngeal neutralization and loss of segment complexity (Kiparsky 1995:662). And intervocalic position is also common for stop spirantization and a host of other lenitions. There are, however, various instances of debuccalization in initial position, though this is most often witnessed in the diachronic data. Guddiri Hausa showed debuccalization of all types of velar ejectives in both initial and medial positions. Some of the debuccalization processes such as Kashaya Coronal Debuccalization appear to be triggered by OCP violations against homorganic consonants.

In this chapter, I have proposed a typology of different types of debuccalization which fall out from the representations of a constriction-based geometry. There is not just one type of debuccalization, as is commonly assumed.

Root Node Debuccalization is the loss of all phonemic content by delinking the Root Node. The slot on the skeletal tier is then replaced by a glottal segment, usually glottal stop. It is most easily recognized when segments with features dependent from the root like [nasal] and [lateral] are replaced with a single glottal sound. Two prototypical examples included Kasimov Tatar and Buginese (§5.5). It is also conceivable that there are other cases, including English, if it can be demonstrated that the Root Node is deleted and that a glottal acts as default.

Oral Cavity Debuccalization is probably the most common type (§5.6). It corresponds to the common notion that debuccalization is loss of place features, with preservation of laryngeal features. It is most clearly demonstrated when more than one laryngeal feature is involved, especially with the same morpheme. Several rule types in Kashaya involved what I analyze as Oral Cavity delinking, in which ejectives yielded glottal stops, while phonemically aspirated segments yielded [h]. If debuccalization yields both glottal types, then Root Node Debuccalization is ruled out, since languages cannot
have multiple default consonants. Other examples of Oral Cavity Debuccalization include Yucatec Maya and Amharic, as well as languages without ejectives such as Icelandic and Kagoshima Japanese.

C-place Debuccalization is a chimera (§5.7). The constriction-based model of feature geometry predicts such a case, but it is exceedingly difficult to prove. Indeed, I had no data which conclusively show that this even exists. However, I have argued that at least some glottals bear [continuant], and that if debuccalization yields a glottal, then it is theoretically possible for C-place Delinking to yield a glottal specified for stricture. Depending on the theoretical assumptions made, one might view a language like Malay as a case in which both stops and a fricative retain their stricture features and debuccalize to their respective [ʔ] and [h].

Finally, one of the most important contributions of this chapter has been the proposal that there are processes of debuccalization involving Individual Place Feature Debuccalization (§5.3). This is easily recognized when secondary place features are preserved, but primary place features are not. I predict that a language will employ Individual Place Feature Debuccalization at only one place of articulation, or at the most, at one sub-place node like Pharyngeal. We saw a synchronic example in Irish, and several diachronic examples including Circassian, Guddiri Hausa, and Yuman.

The Guddiri Hausa data provided another argument against the articulator-based model of feature geometry, in which secondary place features are dependent from primary place features. Such data argue in favor of a model like the constriction-based geometry in which secondary place is independent of primary place, (supporting Clements 1989, 1991, Odden 1991, Clements and Hume 1995 et al.). Halle’s assumptions about the formalization of debuccalization were also critiqued.

This typology of debuccalization helps to resolve the classic dilemma between debuccalization as a preservation of laryngeal features vs. that of continuancy. The potential ambiguity or indeterminacy gives linguists added flexibility in analysis so that a decision on which type of debuccalization occurs will harmonize with the facts of the language, taking into account the status of the laryngeal features and the feature [continuant].
Dissimilation, a phonological process which ensures that ‘differences between sounds are enhanced so that sounds become more auditorily distinct’ makes speech perception easier (Katamba 1989:94). And, I might add, speech production is often made easier. For example, nonstandard but common pronunciations of English words with liquids often change one of them, e.g. in library, the first rhotic is deleted. In the sequence of nasals in Latin *hominem* the alveolar nasal was ultimately changed to a rhotic, with a preceding epenthetic stop, in Spanish: *hombre*. Such changes often give the impression that dissimilation is chaotic and irregular, and it is true that many such changes are (Grammont 1933). However, dissimilation is often rule governed, as seen in the liquid dissimilations of Latin (Steriade 1987a), Sundanese (Cohn 1992), and Georgian (Fallon 1993).

Laryngeal features are also subject to dissimilation, as seen for voiced consonants in Japanese (Lyman’s Law), voiceless consonants in Kikuyu (Dahl’s Law), aspirates in Sanskrit and Ancient Greek (Grassmann’s Law), and either pharyngealized consonants or ejectives (the so-called ‘emphatics’) in Akkadian (Geers’ Law). Although not graced with the names of laws, ejective dissimilation is fairly common. Dissimilation of one or more ejectives in a root or word typically results in deglottalization or delaryngealization (Chapter 4), but can also result in voicing (Chapter Seven). The topic of this chapter is an inquiry into ejective dissimilation and its phonological characterization.

In this chapter I will examine the phonological effects of ejective dissimilation from a variety of languages. I review some of the theoretical background of dissimilation, including work on the Obligatory Contour Principle in Section 6.2. From the synchronic data, discussed in Section 6.3, I find that ejectives can dissimilate to both voiceless (aspirated) and voiced consonants. Dissimilations can be from contact with another ejective, or with intervening material. Dissimilation often takes place in the reduplicant, though rarely, the base can undergo dissimilation with a reduplicant suffix. I will then move on to examine diachronic data in Section 6.4, including loanword adaptation,
6.2. Theoretical Background

Nonlinear phonology has tried to constrain phonological rules to only a few operations such as spreading, delinking, and feature fill-in. Of these, spreading, an assimilatory phenomenon, has by far received the most attention. But recent literature such as Odden (1987), McCarthy (1988), Yip (1988), Cohn (1992), and Fallon (1993) have also examined dissimilation, which Clements and Hume define as 'the process by which one segment systematically fails to bear a feature present in a neighboring (or nearby) segment' (1995:261). Dissimilation is usually motivated by the Obligatory Contour Principle (OCP), which was formulated by Goldsmith (1976), drawing on Leben (1973), and later developed by McCarthy (1979, 1981, 1986). The OCP is usually formulated as follows:

(1) Obligatory Contour Principle
Adjacent identical elements are prohibited.

In other words, languages do not permit sequences of the same element (feature, segment, tone, etc.). There is some controversy about the OCP such as whether it is a universal or only a tendency, and whether it applies only to underlying forms, but Odden (1988) has shown that the OCP is language- and rule-specific in terms of its effects. Nevertheless, the generalization which the OCP captures can play a role in accounting for dissimilation.

Phonologists have analyzed dissimilation as delinking followed by default fill-in (Odden 1987, McCarthy 1988). If an OCP violation should occur, one means of repair is for one of the offending features, for example, to be delinked and then assigned a missing value through a default rule:

(2) Dissimilation as delinking

\[
\begin{array}{cccccc}
\cdot & \cdot & \rightarrow & \cdot & \cdot & \rightarrow \\
\cdot & \cdot & \rightarrow & \cdot & \cdot & \rightarrow \\
+F & +F & \rightarrow & \emptyset F & +F & \rightarrow \\
\end{array}
\]

Default: \([\emptyset F] \rightarrow [-F] \]

In (2), two binary features with the same specification are dissimilated by delinking one of the features and then filling in the opposite value as default. For privative features such as

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[labial], one of the two tokens is deleted and possibly filled in with some other feature such as [coronal] as a default (e.g. Yip's 1988 analysis of the Cantonese language game La-mi). As Clements and Hume (1995:263) point out, however, OCP violations can also be resolved by fusion (merger) of nodes, blocking of rules that would create OCP violations, and the insertion of material between the identical elements. I would also add that the violation can be eliminated by deletion of one of the segments (e.g. deletion of glottal stop in the coda if one is also in the onset in Seri; Yip 1988).

The OCP was originally motivated by tone, but has also been applied at the segmental level, e.g. prohibition on identical place of articulation in Arabic, and for features like [lateral] in Latin, Sundanese, and Georgian. Phonological theory predicts that laryngeal features also be subject to this constraint. The feature [voice] has been the subject of much discussion on the OCP, as well as issues of underspecification (Itô and Mester 1986; Mester and Itô 1989; Lombardi 1991; Itô, Mester, and Padgett 1995). In Japanese, for example, Lyman's Law prevents Rendaku voicing in compounds where the second member of the compound has an underlying voiced obstruent. For example, /ori - kami/ → [ori-gami] 'paper folding', but /ore-kuji/, not *ore-gugi ‘broken nail’. This implies a constraint against two voiced obstruents in a word.

Lombardi (1995) offers an analysis of Dahl's Law, which, in the traditional view, is the dissimilation of the feature [-voice], at least historically in Bantu, and synchronically in Kikuyu. For example, the prefixal /ko-/ when attached to a root with an initial voiceless consonant, dissimilates to [yo], as in [yo-teqera] 'to run' (compare [ko-ruya] 'to cook'). Lombardi analyses this as OCP blocking of the filling in of [voice] on the prefix due to specification of [voice] in the root.

In his analysis of Kashaya, Buckley (1994:83) proposes a rule of aspirate dissimilation. For example, underlying /kʰi-kʰi/-♦ [kikʰi] 'gill cover'. This shows that the

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1 Archangeli and Pulleyblank (1994:325-30) argue that the Well-formedness Principle ('which prohibits ill-formed representations at all stages of a derivation') prevents an OCP violation from taking place and thus blocks application of Rendaku voicing. The end result is avoidance of voiced obstruents, whether through prevention of application of a rule, or through enforcement of a constraint, and thus may be seen as dissimilation. Incidentally, Archangeli and Pulleyblank observe that in Japanese this phenomenon is referred to as 'dissimilation'. The existence of a constraint against voiced obstruents undermines Gamkrelidze and Ivanov's arguments against the traditional reconstruction of PIE regarding the absence of *DeG roots, since at least Japanese has a constraint against more than one occurrence of [voice] in a word. See below for more on this.
feature [spread glottis] ([aspirated] in Buckley’s account) can also dissimilate. And of course in the synchronic phonology of Ancient Greek and Sanskrit, Grassmann’s Law involves dissimilation of aspirated stops in the root as well; see Collinge (1985) for references and discussion.

Although not dissimilatory, MacEachern (1996) has analyzed in detail the co-occurrence constraints in Quechua and Aymara, including the features of aspiration and ejection. However, because these constraints are often characteristic of morpheme structure constraints, which describe the basic shape of lexical items, but are not always active in the phonology, they will be excluded from the scope of this chapter, which focuses on various dissimilatory effects which ejectives actively undergo. For more on laryngeal co-occurrence restraints in an Optimality Theoretic framework, see MacEachern (1997). Nevertheless, such constraints on co-occurrence of the feature [constricted glottis] have also played a role in the Glottalic Theory of Proto-Indo-European.

One of the points made by Gamkrelidze and Ivanov (1972, 1995) and Hopper (1973) has been that in Proto-Indo-European, the constraint against roots with two (traditionally) voiced stops such as *ged- is unlikely (though they do not address the case of Japanese, mentioned above). Instead, because there are languages such as Quechua, with morpheme structure constraints against two ejectives in a root, the Indo-European system is better reconstructed with ejectives instead of what were previously considered voiced stops. I should point out, however, that the cross-linguistic generality of such constraints is under dispute. However, as mentioned above, an exhaustive survey of morpheme structure constraints on ejectives is beyond the scope of this work. Instead, let me refer the reader to Hayward (1989), Wedekind (1991), Iverson and Salmons (1992), Salmons (1993 and references therein) and Job (1995). Certainly, though, constraints against ejectives appear to be much more common than constraints against voiced obstruents.

Much of the data we will examine in the next section involves deglottalization within the reduplicant, where ejectives often fail to appear. Despite the proposal of the Ejective Model that traditionally reconstructed voiced stops are ejectives, reduplication of this series in PIE yields no changes, e.g. traditional *dé-dorklé ‘he saw’, or *dé-deh₃-mi ‘to give’ (Beekes 1995), despite the root constraint. This is not damning evidence against the Ejective Model, since constraints often apply at the level of the root but not in derived forms. However, many ejectives in Salishan languages, for example, have constraints against ejectives in both roots and reduplicated forms, as we shall see in the next section.
6.3. Synchronic Dissimilations

Several languages spoken along the Pacific Northwest Coast, particularly in the Salishan family, show dissimilation of ejectives. Thompson and Thompson (1985:134) review evidence of dissimilation in Salish and find that four of the twenty-three languages in the family have a dissimilatory rule similar to Grassmann's Law, except that they involve the glottalic (ejective) series. In Thompson and Thompson's words, 'the glottalized elements are replaced by those unglottalized counterparts when there is a glottalized element later in the stem.'

Of the Salishan languages, Shuswap shows the most systematic process of deglottalization. The language has a voiceless and ejective series of obstruents (in addition to voiced and glottalized resonants). Shuswap has an active morpheme structure constraint. As Kuipers summarized it, where K = an obstruent, R = resonant, and V = vowel,

'if a root has the shape K₁VK₂, K₁VRK₂, K₁RVK₂, and K₂ is glottalized, then K₁ is never glottalized. In any type of reduplication, the first occurrence of a reduplicated obstruent is never glottalized. Thus ...p'... is reduplicated ...p...p'...'
(Kuipers 1974:23, ellipsis in the original).

Roots do permit ejectives tautomorphemic with glottalized sonorants (3a) and glottal stops (3b):

(3) a. 
   - tis'lijem  'all, whole'
   - kw'aj'ə  'aunt (parent's brother's wife)' 
   - qw'ow's  'wild animal'
   - p'um  'to smoke'

b. 
   - tsí?  'deer'
   - ?esís'wiq  'to squeal, scream'
   - k'tem  'put'  (Taylor 1996:32 and Kuipers 1974)

The following data were culled by Thompson and Thompson (1985:136) from Kuipers' grammar and dictionary:
The dissimilative constraint does not operate, however, between root and suffix. Thompson and Thompson (1985:136-7) note that the suffixes which do have glottalized obstruents are lexical, that is, they are bound compositional morphemes which have regular meanings. The following data show the retention of ejectives in both root and suffix:

(5) -its'e? ‘surface, hide’  t-k’m-its’e?  ‘surface, bark of root’
    -esq’t ‘day’  k’nx-esq’t  ‘how many days?’
    -ej’lek’ ‘skin, hide’  qʷ’ex-ej’lek’-m  ‘smoke buckskin’

The Thompsons note that there is one prefix with an ejective which provides relevant examples to test deglottalization. The prefix /kʷ’el-/ ‘under, below’ does not deglottalize in such words as /kʷ’el-k’ém-t/ ‘(space) under’, since the prefix is viewed as semantically distinct. In fact, the authors offer evidence that the lexical suffixes were once compounds. The basic consonantal structure of the semantically transparent affixes is unchanged, while ‘reduplicative elements are treated as integral parts of their stems, subject to the same dissimilation principle operating within the roots themselves’ (1985:137). As the Thompsons conclude, ‘Shuswap emerges as a language characterized by retention of glottalization of only the last stop in the root portion of words (including reduplications), deglottalizing any prior glottalized stops within that complex’ (1985:137).

I should point out that glottal stop and glottalized resonants have a transparent effect with respect to ejective dissimilation, as seen in the following forms (recall the fact that they also did not follow the root structure constraints of (3) above. (6) shows the failure of
Glottal stop to block dissimilation (and to trigger ejective dissimilation), while (7) shows that glottalized sonorants do not block ejective dissimilation.

(6) a. /ʔuqʷʔ’j/ 'sibling of same sex'
   /ʔəʔuqʷʔuqʷʔ’j/ 'siblings of same sex'

b. /p’έʔ-em/ 'to pack a child on one’s back'
   /p’eʔ-p’eʔ-em/ →
   [pə-p’έʔ-əm] 'to pack children on one’s back' (Taylor 1996:185)

(7) /s-k’əlminst/ 'goldenrod'
   /s-k’əl-k’əlminst/ → [skəlk’əlminst] 'goldenrod (pl.)' (Taylor 1996:176)

Glottal stop also does not undergo dissimilation when it is reduplicated: /ʔuʔpəkst/ 'ten' is reduplicated in the diminutive as [ʔuʔpəkst] (Taylor 1996:75), though it does dissimilate in coda position, where the first glottal stop is deleted (e.g. /ʔə-tʔék/ → [tə-tʔék] 'to go, come (pl.)' (1996:183). Glottalized sonorants undergo deglottalization in certain conditions, for which see Taylor (1996).

The southern dialect of Shuswap studied by Gibson (1973) also shows evidence of deglottalization, though /ʔ/ deglottalizes to [t]. For example:

(8) /ststs’-ststs’-em/ → [səststs’ə] 'blankets' (16)
   /qʷiʔ-qʷiʔ/ → [qʷiʔ-qʷiʔ] 'black' (47)
   /qʷʔ-ʔqʷ’ʔq/ → [qʷuqʷ’ʔq] 'squawfish' (16)
   /ʔ’k-ʔ’k-mín/ → [tktł’kmín] 'poles' (16)

The last example clearly shows that in southern Shuswap, deglottalization is clearly dissimilatory, and not simply preconsonantal deglottalization (which was examined in Chapter Four), since the lateral affricate is preserved as an ejective before the velar stop.

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2 The first glottal stop is deleted when it occurs in coda position and when another glottal stop follows. Data from (a) above, which shows glottal stop in onset position, illustrate that dissimilation of ejectives still occurs, despite the intervening glottal stop. Therefore one cannot explain the transparency of glottal stop by proposing an analysis which deletes glottal stop in coda before the rule of ejective dissimilation.
One controversial solution is that Shuswap ejective dissimilation is triggered by an OCP-motivated rule which delinks the Laryngeal node of the first [-son, c.g.] sound when another follows within the word:

(9) Shuswap Ejective Dissimilation

\[
\begin{array}{c|c}
\text{Root (X)} & \text{Root} \\
[-\text{son}] & [-\text{son}] \\
\text{\#} & \text{\#} \\
| & | \\
\text{Lar} & \text{Lar} \\
| & | \\
[c.g.] & [c.g.]
\end{array}
\]

The Root node must be specified for [-sonorant] to restrict the rule to ejectives. I presume that the glottalized resonants may intervene because they are [+sonorant], and thus do not fit the structural description of the rule. (However, note that there may be some variation in how languages classify complex sonorants, since I suggested that Klamath may specify them as [-sonorant]—see §5.6.6.). Taylor, in contrast, proposed an analysis involving planar segregation to account for the adjacency of ejectives with intervening glottalized sonorants. Following Taylor (1996), though, I also assume that glottal stop is unspecified for [c.g.] at this point, and thus it will not block dissimilation either. One might take this as evidence for representing glottal stop simply as [-continuant], as discussed in §5.7. (An alternative is to accept the parametric behavior of glottal stop and classify it, too, as [+sonorant].) I assume that Shuswap obstruents either bear a Laryngeal node marked for [c.g.], and thus are ejectives, or bear no Laryngeal node and are interpreted as plain voiceless consonants (Lombardi 1991). For this reason, rule involves the delinking of the Laryngeal node as a whole, not just the laryngeal feature, since otherwise there would be phonetically empty structure.

The above solution is unorthodox in that it allows an intervening feature specification ([c.g.] on glottalized resonants) to act as though it were transparent in permitting deglottalization. It permits this by allowing differences within the Root node such as [sonorant] to help determine whether a segment is adjacent.

A recently proposed alternative to viewing these processes as dissimilation can be found in the Correspondence Theory of McCarthy and Prince (1995). In Optimality Theory, ‘constraints of faithfulness demand that the output be as close as possible to the input, along all the dimensions upon which structures may vary’ (249). In reduplication,
however, ‘perfect identity cannot always be attained’. ‘The reduplicant obeys a constraint that is otherwise violated freely in the language as a whole – one that may even be violated in the base of reduplication’ (329). Thus even if a language like Shuswap routinely violates a constraint against the phonologically marked ejectives, phonologically unmarked structure emerges in the reduplicated forms – what McCarthy and Prince term ‘the emergence of the unmarked’. By ranking constraints of input/output identity above base/reduplicant identity for ejectives, a language may allow ejectives in a stem or base, but not in the reduplicant, where unmarked, non-glottalic voiceless stops appear instead of the expected ejectives. Languages which do allow ejectives in the reduplicant are analyzed as ranking constraints on base/reduplicant identity higher in the constraint hierarchy than those languages which do not allow reduplicant ejectives, and crucially interleaving the ejective markedness constraint between the two. The concept of the emergence of the unmarked would help to avoid the problems of glottal stop transparency to the ejective dissimilation rule.

Holton (1995) offers an OT analysis of liquid dissimilation in Sundanese, in which dissimilation does not involve reduplication, but infixation. The analysis revolves around the ranking of three constraints: No-Gap » OCP » IDENT. No-Gap accounts for similar [-lateral] specifications to dissimilate instead of fuse. The OCP prohibits identical adjacent specifications of [-lateral], and IDENT is faithfulness to the input, which of course is violable if dissimilatory effects are to be seen. A fuller, more general discussion of dissimilation in OT may be found in Meyers (1995).

Although all of Shuswap’s dissimilations take place in reduplicated forms, as Taylor (1996) points out, not all of the dissimilations are within the reduplicant. For this reason, Taylor argues that Shuswap dissimilation is a phonological rule, and not simply the failure to copy glottalization, or in McCarthy and Prince’s terms, the ‘emergence of the unmarked’. For example, in Diminutive Reduplication, the first consonant of the root preceding a stressed vowel is copied and infixed after the vowel. In addition to diminutives, this type of reduplication is used to show modesty in first person expressions, and in numbers that are used to count small animals (10).

3 An alternate analysis treats this as regular prefixal reduplication with unstressed vowel deletion and then stress reassignment.
However, when the base contains an ejective, the first ejective of the word is deglottalized, as predicted by the phonological rule, but not by the account which posits that constraints against glottalized consonants are found simply in the reduplicant.

Another example is in Stative Reduplication, in which the first vowel and following consonant are suffixed to the stem (12a). Here, too, the effects of dissimilation of the first (root) consonant occur, not in the reduplicant.

Because of the violable nature of constraints, in Optimality Theory this could be analyzed by ranking the constraint against two ejectives higher than faithfulness or identity constraints for both base and reduplicant. The emergence of the unmarked approach also permits us to avoid the complex problems of adjacency in the dissimilative rule-based approach, as illustrated above.

Nevertheless, as we saw in Chapter Four on Deglottalization, there is still a need for deglottalization processes, independent of reduplicative phenomena. That is, many
languages have deglottalization in contexts in which there is no reduplication, so that base/reduplicant identity constraints play no role there, though the same constraints against ejectives may be utilized in different contexts.

Let us examine some of the other Salish languages for evidence of ejective dissimilation. Kalispel (Vogt 1940:18-9; Thompson and Thompson 1985, and Sloat, Taylor, and Hoard 1978:119-20) contains a process of dissimilation of consecutive ejective stops and affricates which is resolved by deglottalizing the first ejective. Take the following examples, from Vogt (1940:18), reading across:

(13)  t'áq'on 'six'  tq'onjstá 'six days'
      est'its 'something long lies'  esonjtis 's.t long lies between'

This process is especially prominent in reduplications. First, when the final ejective in the root is reduplicated:

(14)a.  est'úk'  tk'úk'  ntk'w'étk'  
      'it lies'  'it falls'  'it falls in the water'

b.  essáq'  sąqq'əsón
      'it is split'  'he opens his mouth'

c.  níff'əm  níff'j'
      'he cuts something'  'it gets cut accidentally'  (Vogt 1940:18)

And next, when the first ejectives in the root are reduplicated:

(15)a.  iñáq'  
      'it is warm'
      iñiqi'áq'ən  'his feet are warm'

---

4 One Salishan language, the Colville dialect of Okanagan, has been reported to have dissimilative deglottalization in reduplication (Mattina 1973, which is also cited in Thompson and Thompson 1985). However, Mattina (p.c. 27 May 1998) now finds that his earlier observations were incorrect and there is no deglottalization in Colville.
b. \( \textit{esf} [\textit{f}] \text{q'} \text{a'i}\)  ‘lake’
\( \textit{esf} [\textit{f}] \text{q'q} \text{a'i}\)  ‘a little lake’  (Vogt 1940:18)

The examples in (13)-(15) suggest that deglottalization may be the result of being adjacent to the trigger. However, even when the two consonants are not in direct contact, but are still in preconsonantal position, perhaps due to the loss of an aperture node (Steriade 1993, 1994), dissimilation also occurs:

\(16\)a. \( \text{t} [\text{f}] \text{p} \text{t} \text{i}' \text{am} \text{étk}^w\)  ‘sea’
\( \text{t} [\text{f}] \text{p} \text{t} \text{i}' \text{am} \text{étk}^w\)  ‘seas’

\(16\)b. \( \text{t} [\text{f}] \text{k} \text{t} \text{u}' \text{ust} \text{étn}\)  ‘eye’
\( \text{t} [\text{f}] \text{k} \text{t} \text{u}' \text{ust} \text{étn}\)  ‘eyes’

c. \( \text{q} \text{i} \text{t} \text{'a} \text{q} \text{a} \text{n} \text{e} \)  ‘pocket’  (Vogt 1940:19)
\( \text{q} \text{i} \text{t} \text{'a} \text{q} \text{a} \text{n} \text{e} \)  ‘pockets’  (Thompson and Thompson 1985:138)

d. \( \text{s} \text{i} \text{q}^w \text{q} \text{emen} \)  ‘index finger(s)’  (1940:140)

e. \( \text{q}^w \text{e} \text{is} \)  ‘to be full’  \( \text{q}^w \text{e} \text{is} \text{étn} \)  ‘it is full’  \( \text{q}^w \text{e} \text{is} \text{étn} \text{étn} \)  (pl.)  (1940:162)

Compare also \( /t' \text{ú} \text{k}^w/ \)  ‘to lie; /\text{j} \text{in} \text{n} \text{t} \text{ú} \text{k}^w/ \)  ‘I am lying in something’, and
\( /\text{j} \text{in} \text{s} \text{ént} \text{k}^w \text{étk}^w/ \)  ‘I lie in the water’ and \( /\text{j} \text{in} \text{s} \text{ént} \text{k}^w \text{étk}^w/ \)  ‘I fall in the water’  (1940:171). However, there are forms such as \( /t' \text{ú} \text{k}^w/ \)  ‘it falls’  in which deglottalization of the velar ejective does not take place despite lack of adjacency (though cf. \( /\text{n} \text{t} \text{k}^w \text{étk}^w/ \)  ‘it falls in the water’) (Vogt 1940:18). It therefore appears that there are subtle morphological restrictions to some of the dissimilative deglottalization processes.

It is true that the deglottalized ejectives in (13) occur preconsonantally. However, Vogt (1940) lists a number of forms in which ejectives occur preconsonantally, including before other stops, thereby proving that deglottalization is dissimilative and not simply in any preconsonantal position. Display (17a) shows ejectives before fricatives, while (17b) shows ejectives before stops and affricates:

---

5 Thompson and Thompson (1985) have transcribed Vogt’s <\text{l}> and <\text{k}> as /\text{l}/, while I have retained Vogt’s transcription.
a. /sti'e[wet's]jan/ ‘snow shoes’ (140)
   /tineson]janami/ ‘I am tying something to my feet’ (148)
   /tinesap'sipi]jan/ ‘I wear moccasins’ (v'sip'i? ‘to wear moccasins’) (164)

b. /niqʷ\taqs/ ‘he lies on the road’
   (\niq ‘to lie in bed, lie flat on the ground’) (150)
   /sani\ekʷ\tin/ ‘a ford, place to cross the river’
   (/ni\ekʷ/ ‘to cross a river’) (154)
   /t'kʷ/ ‘to be blind’; /tinesant'kw'pūs/ ‘I get blind’;
   /tinesant'kʷt'kw'pūs/ ‘I get blind (pl.)’ (171)
   /t'qūif/ ‘sew something! (sg.)’ (40).
   /tjinsaq 'tən̪əm/ ‘I open my mouth’ (v'saq ‘to split’) (162)

In sum, in Kalispel, there is an active constraint against sequences of [c.g.]. The
first ejective is deglottalized before an adjacent ejective in a derived (but not reduplicated)
form, as we saw in (13) and (14a). The first ejective in reduplicated forms is deglottalized,
even if it appears to be part of the root, as we saw in (14) and (15). Finally, an ejective
within a reduplicated word may deglottalize before another ejective, even if another
consonant intervenes (16). Clearly more work needs to be done in defining the
morphological domains in which this dissimilation takes place. But Kalispel shows
evidence of ejective dissimilation in which the first (or first few) ejectives deglottalize
within the word.

Odden’s (1994) Adjacency Parameters provide some framework through which we
can view the different types of dissimilation in Salishan. The Locality Condition in
phonological theory states that ‘intervening material must lie on a distinct plane from that of
the target and trigger nodes’ (Odden 1994:298). In addition to this condition, Odden has
posited adjacency parameters which are further conditions on the separation of trigger and
target. For example, one parameter is that target and trigger must be in adjacent syllables
(syllable adjacency), while another parameter setting is that they be in adjacent Root nodes
(root adjacency). One type of ejective dissimilation in Kalispel must be consonant-
adjacent, while dissimilation in Shuswap is syllable-adjacent.
The Salishan language Thompson has sporadic cases of deglottalization, ‘especially in stems involving three or more glottalized obstruents or in cases where several obstruents are clustered’ (Thompson and Thompson 1985:140). For example:

(18) \(k^\prime \tilde{u} \acute{e}k' \sim k^\prime \tilde{u} \acute{e}k'\) ‘(of boil) burst and pus oozes out’
\(\chi \tilde{e}t\tilde{s}'q'\tilde{qins} \sim \chi \tilde{e}t\tilde{s}'qq\tilde{qins}\) ‘she snaps the tops off the (root) vegetables’

These cases, however, are optional, and do not seem to be rule-governed.

So far, deglottalization has meant the delinking of the Laryngeal node of the ejective, usually in the reduplicative element, but also adjacent to an ejective in the same root. This can be accomplished by the following general rule (ignoring the precise domain of deglottalization within reduplicative morphemes, but not involving other prefixes or suffixes), where RC stands for Root node of a consonant:

(19) \[
\begin{array}{c|c}
\text{RC} & \text{(X)} & \text{RC} \\
\hline
\text{Lar} & \hat{\text{Lar}} \\
\text{[c.g.]} & \text{[c.g.]}
\end{array}
\]

Following Lombardi (1991), I assume that obstruents with no Laryngeal node are interpreted as plain voiceless unaspirated consonants. These assumptions accurately account for the data, since the result of delinking the Laryngeal node in dissimilation results in a plain voiceless unaspirated consonant.

In certain cases, however, there is not only deglottalization but subsequent voicing on only that element which was deglottalized. This will be treated in more depth in the chapter on ejective voicing, but some examples will be provided here. Kinkade (1982:66) notes that in Columbian Salish, ‘the first of two glottalized obstruents juxtaposed by C2-reduplication may be optionally voiced and deglottalized, and then there is usually an epenthetic e between the consonants’. (See also Thompson and Thompson 1985:140).

For example:

(20) \(k^w'\acute{u}p'\acute{e}p'\) \(\sim [k^w'\text{obep}']\) ‘bent over with a cramp’
\(sp'eq''q''\acute{m}\acute{x}\) \(\sim [sp'eq''q''\acute{m}\acute{x}]\) ‘it’s spilling’
\(k^w'\acute{e}f\tilde{d}'\) \(\sim [k^w'\text{eftd}']\) ‘it showed up (of s.t. lost)’

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This pattern is also unusual in that it appears to be the final root consonant changing, with the suffixed reduplicative consonant maintaining the original laryngeal specification. If an epenthetic vowel is inserted, voicing appears to take place, as in the first two examples of (20). Where there is no epenthesis, simple deglottalization occurs. This suggests a two-part process of dissimilative deglottalization followed by intervocalic voicing.

In the Salishan language Tillamook, in reduplicative processes the first ejective dissimilates, but then the deglottalized consonants are regularly voiced before vowels. Plain voiceless consonants, analyzed by Thompson and Thompson as aspirates, are also voiced. First here are some examples from Reichard (1959):

(21) Non-finite | Gloss | Finite | Gloss
--- | --- | --- | ---
ka'dza? | ‘to lie on back’ | ts-ga'ka'dza?wisti | ‘I am lying on my back’
[au] | ‘to give away’ | d[au]awu | ‘he gives them away’
[au] | ‘to look for’ | ga-[au]'a-an | ‘they will search’
[fs]:q | ‘to split’ | s-[fs]:q-an | ‘he split them’

Here follow some examples from Thompson and Thompson’s own fieldnotes:

(22)
a. t'éni | ‘ear’ | den-t'éni | ‘ears’
b. [e]é?en | ‘he searched for it’ | [e]-[e]é?en | ‘he searched and searched for it’
c. súq'i | ‘younger sister’ | sq-súq'i | ‘younger sisters’
d. s-q'eléls | ‘earth-oven’ | ts-Ga'q'eléls | ‘I’m baking in the earth-oven’

The Thompsons note that before vowels only, Tillamook contrasts aspirated and voiced unaspirated stops and affricates. Unlike in Thompson and Thompson (1966), the Thompsons now find it preferable to consider these sounds as aspirated units instead of sequences (though this is not indicated in their transcriptions). In this view, voiceless aspirates do not occur before fricatives, and in final position are optionally unreleased. In reduplicative prefixes, the aspirated consonants are deaspirated and voiced, as in /tuq'úsu/.

---

6 Thompson and Thompson transcribe the deglottalized examples (b) and (c) as I have—with voiceless, not voiced members in the right column. The lateral affricate in (b) may not voice due to structure preservation. The uvular ejective in (c) probably does not further voice since it is before a voiceless fricative.
'beaver' and /du-tuq'úsú/ 'small beaver'. Despite the complicated phenomenon of voicing, the important point here is that ejectives dissimilate. (See also Chapter 7).

Sahaptin was discussed in §4.3.3 as a language which does not permit identical, adjacent labialized or ejective consonants in reduplicated forms. The first, reduplicated ejective was deglottalized, e.g. /t'áal/ 'noisy' vs. /tt'áal/ 'noisy ones'. Gitksan, a Tsimshian language is reported by Rigsby (1970:213) to have a so-called 'Nass-Gitksan Grassmann's Law' in which ejectives deglottalize and post-vocalic stops and affricates spirantize in reduplicated noun and verb themes. Rigsby (1986) has more details. This language is also discussed in more detail in Chapter Seven, though not with respect to voicing. Finally, let me note that Silverstein (1972) gives passing reference to ejective dissimilation in Coos.

We turn next to a putative case of dissimilation in the Pacific Northwest, this time in a Penutian language. Silverstein (1972), in his review of Aoki's (1970) grammar of Nez Perce, has claimed that the first of two glottalized consonants is deglottalized. For example, 'nine each' /llpe[k'+k'ujt/ is realized as /pek-k'újt/, where the first of the two adjacent velar ejectives becomes a plain voiceless stop. (Aoki's transcription uses <c> for the apico-alveolar stop). Close inspection of Aoki (1970), however, indicates that this phenomenon seems confined to one morpheme, /llpeHII 'each', where Aoki's IIH indicates a homorganic unglottalized stop before a glottalized stop (23a); the same consonant before a sonorant (/m, n, l/) (b); and zero elsewhere (c). For example:

(23) Nez Perce allomorphy of llpeHII (Aoki 1970:40, 57)

a. /k'újt/ 'nine' /peH-k'újt/ → /pek'újt/ 'nine each'
b. /lepít/ 'two' /peH-lepít/ → /pellepít/ 'two each; in twos'
c. /pútímt/ 'ten' /peH-pútímt/ → /pepútímt/ 'ten each' (p. 40)
   /hé:pej/ 'middle' /peH-hé:pej/ → /pehé:pej/ 'each of the middle ones'

/ʔuj-leqt-éhem/ '5-1-times' /peH-ʔuj-leqt-éhem/ →
   /paʔojlaqtáham/ 'six times each'

The only basic numeral which begins with an ejective was the form in (a) above for 'nine' /k'újt/. In Aoki's grammar, at least, this does not seem to be the regular process which Silverstein surmised. Without additional data involving llpeHII or other morphemes with llHII, I can only speculate, but it is possible that the suffix contains an empty C-slot.
(Clements and Keyser 1983) which is the target of a leftward-spreading Root node. If ejectives spread, the geminate could subsequently be deglottalized before another ejective (see Chapter 4 on Deglottalization). It is not obvious why non-ejective, non-sonorants do not spread, so perhaps one should simply list the allomorphs of this morpheme, and not consider it a phonological process.

In addition, Silverstein notes that deglottalization also occurs in Nez Perce: the 'reduplicated element for a glottalized stop is also unglottalized' (1972:66 fn 18), though this is not indicated in Aoki (1970) and is contradicted in Aoki (1963). For example, in C\text{\small i}-reduplication, both voiceless and ejective stops are reduplicated (Aoki 1963:42-43):

(24) Singular Distributive

\begin{tabular}{lll}
  kúh\text{\small et} & kikú:h\text{\small et} & 'long' \\
  k'ejíx & k'ik'ejíx & 'in plain sight' \\
  t'átni?n & t'it'atni?n & 'torn' \\
\end{tabular}

In such cases, Aoki clearly states that 'there are no special allomorphs' (42). In complete reduplication, ejectives are not deglottalized, e.g. /q'úpq'up/ 'back', /tís'ísítís'ísix/ 'grass'. In 'postposed reduplication', too, there is not dissimilation: /tejk'úmk'um/ 'icicle' (1963:44). Clearly Silverstein is wrong and there is not reduplicative deglottalization (and thus dissimilation) in Nez Perce. It is also possible, however, that the authors worked with rather different dialects.

Next, we will move from the Northwest to other languages which dissimilate ejectives. Lezgian (Trubetzkoy 1939/1969, Haspelmath 1993) provides examples of several types of laryngeal dissimilation. In this section, we will concentrate on what Haspelmath calls 'pre-ejective ejective aspiration'. When two ejectives are separated by an unstressed high vowel underlingly, there is a syncope rule which brings them in contact, transferring the vocalic articulation as a secondary articulation of the first consonant, and the result is deglottalization. (This phenomenon was also discussed in §4.4.1). There is no dissimilation if the root vowel is stressed, as in the absolute singular.
As we can see from the above examples, the initial ejective of the absolutive singular corresponds to the voiceless aspirated plosive in the plural. I infer that what Haspelmath calls aspiration is really the release of the stop before another stop. (There is no contrast between voiceless aspirates and unaspirates in preconsonantal position due to a rule of voiceless stop aspiration before voiceless obstruents). This process also occurs when plain consonants come in contact with an obstruent: /p'i:p/ 'wooden container' and /p'ik'er/ (plural). The syncope rule applies first, and then deglottalization occurs before another consonant. Another case of contact deglottalization may be seen in /k'ak'/ 'alley abs. sg.' and its plural form /kk'-ar/ (1993:62), where I presume the first /k/ has phonetically aspirated release.

Although Lezgian does not provide examples of ejectives preserved before non-ejective obstruents, ejectives are preserved before sonorant consonants such as /r/ in such forms as /luk'ra/ 'slave (obl.)' (Haspelmath 1993:76), [t'mil] (in variation with /t'imil/ 'a little' (38), and /k(i)k'lam/ 'tick, mite' (42). Note also that ejectives can occur in coda position before another ejective: /q'it'q'inun/ 'burst' (42). Therefore what is taking place is not simply preconsonantal deglottalization, but actual dissimilation.

Lomtatidze and Klychev (1989) note that in Abaza (Northwest Caucasian), 'the first element of an ejective complex tends towards de-ejectivisation' (96). For example, /šis'k'ə/ → [šskə] 'dress'. It is unclear whether this is a phonological rule or whether it is merely a fact of phonetic implementation in ejective clusters. The authors make no mention, however, of the fact that this takes place with ejectives in other non-ejective clusters, so this would seem to be a case of dissimilation (though the authors do not provide evidence for morphophonemic alternations to motivate the underlying form). Examples of ejectives in other clusters include /zak'qəj/ 'nothing' (103), /la-lomha-k'-la/ 'by' (123), /la-šis'χəjt/ 'comes out again', /kʷdər/ 'saddle' (127), and /šis'la/ 'tree' (123). Forms like /kʷdər/ in particular suggest dissimilative deglottalization, not simply pre-consonantal deglottalization.

In sum, we have seen dissimilative data from several different language families. There appear to be two basic types of ejective dissimilation: dissimilation at a distance, and...
contact dissimilation. In cases of dissimilation at a distance, it is generally the case that it is
the reduplicative element which dissimilates. However, in Columbian, it is the root which
dissimilates, and the reduplicative suffix which is unaffected.

The second type of dissimilation occurs when two ejectives are in contact. In these
situations, it seems it is always the first consonant which deglottalizes, and never the
second. Kingston's Binding Hypothesis, and Steriade's notion of aperture node capture
this generalization nicely. The thrust of these arguments is that consonants only acquire
release features in (pre-vocalic) onset position (or lose them in rime position, or
preconsonantal onsets). Assuming that the feature [c.g.] is associated with the release
portion of an ejective, when release is lost in rime position, the laryngeal feature is naturally
shed as well.

(26) Underlying Preconsonantal
\[
A_0A_{\text{max}} \quad A_0A_{\text{max}} \quad A_0A_{\text{max}} \\
\vert \quad \neq \quad \vert \\
[c.g.] \quad [c.g.] \quad [c.g.]
\]

This type of dissimilation seems to be what is happening, at least in part, in Kalispel,
Abaza, and Lezgian. What makes it unique is that ejective release is apparently preserved
before other consonants.

Next, we will examine dissimilation diachronically, including in loanword
phonology.

6.4.  Diachronic Dissimilations

6.4.1. Loanwords

Several examples of ejective dissimilation can be found in loanwords. In Svan, for
example, (Schmidt 1991, Rogava 1982, Topuria 1967), a language with voiced, voiceless,
and ejective stops, 'there is a strong tendency to dissimilating voicing of one of two
ejectives' (Schmidt 1991:480):
In the case of 'mare', Svan dissimilates the second consonant of the word. Svan does have a phonemic voiced palato-alveolar affricate, so dissimilation to /dj/ is not ruled out because of structure preservation. In the 'barberry' and 'mare' examples, the dissimilating ejectives do not share place of articulation, although it is interesting that in two cases, dissimilation occurred when the consonants were identical. It is not clear what the conditioning factors are which determine whether the first or second ejective gets dissimilated. Schmidt cites Topuria (1967), which gives only two examples, and Zhghenti (1949), which is not available to me, so I am unable to further probe this phenomenon.

Akhvlediani, mentioned in Rogava (1982), noted that of two ejectives or aspirates borrowed into Ossetian from Georgian, one became voiced in the third period of loans. For example, Georgian /t'ik'i/ became Ossetian /dUc'i/ 'wineskin'. These are discussed in more detail in the section on ejective voicing of loanwords in Chapter Seven.

Ejective to voice dissimilation is counter to the hypothesis that dissimilations do not result in the addition of marked features. As Odden has claimed, 'It is generally assumed that default rules introduce unmarked feature values.' He remarks:

'Since dissimilation rules are expressed as feature deletion rules, whose output is subject to the set of default feature specification rules, the output of a dissimilation rule should be a relatively less marked segment.' (Odden 1988:7)

In the case of loanword adaptation, we must either conclude that somehow in Svan (Kartvelian) and Ossetian (Indo-European), the voiced stops are less marked than ejectives, or that the hypothesis that defaults are less marked is wrong. Since I have shown in Fallon (1993, 1995) that defaults in languages such as [+lateral] in Georgian and Sundanese, and [voice] in Lezgian can be marked, I will assume this with respect to this data as well. Both voiced and ejective stops are 'marked' in the sense that they both bear privative features, and are thus marked compared to voiceless unaspirated stops (which are not in the language—it is unclear whether the voiceless aspirates are marked or not). However, in another sense of markedness pertaining to textual frequency, the voiced stops are less

<table>
<thead>
<tr>
<th>Source</th>
<th>Svan</th>
<th>Gloss</th>
</tr>
</thead>
<tbody>
<tr>
<td>Georgian</td>
<td>k'ak'-ali</td>
<td>gak'</td>
</tr>
<tr>
<td>Georgian</td>
<td>k'ots'aχur-i</td>
<td>got's'χir</td>
</tr>
<tr>
<td>Georgian</td>
<td>tj'ak'i</td>
<td>tj'ag</td>
</tr>
<tr>
<td>Mingrelian</td>
<td>p'ap'a</td>
<td>bap'</td>
</tr>
</tbody>
</table>
marked than ejectives. I do not have figures for Svan, but the similar Kartvelian language Georgian has the followed stop/affricate frequencies, as reported by Vogt (1958), based on a count of 11,000 phonemes:

\[
\begin{array}{ccc}
\text{Sound} & \text{Frequency} \\
\text{d} & 9.20 \\
\text{t} & 5.68 \\
\text{b} & 5.66 \\
\text{g} & 4.10 \\
\text{ts} & 2.75 \\
\text{k} & 1.93 \\
\text{k'} & 1.89 \\
\text{q'} & 1.71 \\
\text{t'} & 1.44 \\
\text{ts'} & 1.44 \\
\text{dz} & 1.20 \\
\text{p} & 1.00 \\
\text{p'} & 0.82 \\
\text{i} & 0.79 \\
\text{d} & 0.67 \\
\text{i'} & 0.34 \\
\end{array}
\]

Adding up the frequencies of each series shows that the voiced stops/affricates occur almost three times more frequently than do the ejectives (20.83 vs. 7.64). In another Kartvelian language, Laz, Ralph Anderson (1963) found in a text of 2408 phonemes that voiced stops and affricates occurred with a frequency of 7.43, while that of ejectives was 2.62, again nearly three times more often. Thordarson (1973) examined a text of approximately 2,500 phonemes in Iron Ossetic and found that the voiced noncontinuants were 36 times more frequent than the ejectives (10.58 vs. 0.29). Therefore, it is clear from the frequency and from their substitution in dissimilation that voiced stops are less marked than ejectives. We turn next to diachronic instances of dissimilation.

6.4.2. Historical Sound Change

In documenting historical examples of ejective dissimilation, it is necessary to return to the Northwest Coast. In Shuswap, "it appears that dissimilation operated only in weak roots containing no resonants" (Thompson and Thompson 1985:139). These authors note that it "seems likely that deglottalization operated only in obstruent clusters" since weak roots often had unstressed environments in which consonant clusters came together. Weak roots had only obstruents and a characteristic vowel *e. In strong roots, however, which take main stress, dissimilation did not occur in Okanagan or Kalispel, though it did in Shuswap.

We can observe that Shuswap deglottalizes by comparing Shuswap with the neighboring and closely related Thompson River Salish (Thompson and Thompson 1985:136):
In each case where Thompson preserves the ejection of the first consonant in words with two ejectives, the Shuswap cognate has deglottalized it. Historically, this is reminiscent of the synchronic reduplicative deglottalization, though the domain appears to have been within a root.

Further data may be gathered by comparing other Interior Salish languages. I illustrate with Thompson and Thompson’s reconstruction of Proto-Interior Salish (PIS):

(30)

<table>
<thead>
<tr>
<th>PIS</th>
<th>Okanagan</th>
<th>Kalispel</th>
<th>Shuswap</th>
<th>Thompson</th>
<th>Gloss</th>
</tr>
</thead>
<tbody>
<tr>
<td>*k’lp’</td>
<td>k’lp’-em</td>
<td>[k’lp]7</td>
<td>kip’-m</td>
<td>k’lp’-m</td>
<td>‘pinch’</td>
</tr>
<tr>
<td>*q’w’ats’</td>
<td>q’w’ts’-t</td>
<td>q’w’ets’-t</td>
<td>q’w’ets’-t</td>
<td>q’w’ets’-t</td>
<td>‘full’</td>
</tr>
<tr>
<td>*p’ut’</td>
<td>s-p’ut’-nt</td>
<td>s-p’ut’-t</td>
<td>s-p’ut’-t</td>
<td>s-p’ut’-t</td>
<td>‘fog’</td>
</tr>
<tr>
<td>*ts’ék’</td>
<td>√ts’ik’w’</td>
<td>ts’ék’w’</td>
<td>√seks’i-seks’i’-t</td>
<td>√seks’i-seks’i’-t</td>
<td>‘shine’; ‘bright’ in Shuswap</td>
</tr>
</tbody>
</table>

Thompson and Thompson (1985) paint the following picture of the development of deglottalization in Salish:

‘the loss of the deglottalization rule in Spokane dialect of Kalispel and the more limited application of the dissimilation in the history of that language and Okanagan suggest that the innovation began in Shuswap, probably first affecting sounds in clusters, later developing into a full dissimilatory process within stems’ (139-140).

According to their theory, the early rule then spread to Okanagan and eventually to Kalispel, but in additional environments. The Thompsons believe that analogy helped to restore dissimilation in Spokane.

7 From Vogt (1940:140). I do not know whether this is a true cognate or not. Compare also /-ip’/ ‘to pinch, squeeze’ (Vogt 1940:145).
The Thompsons also discuss an interesting pattern in which a stop deglottalizes after an earlier ejective in the stem. In Thompson, for example, 'mouse' is /kʷ*etnij/, which is likely cognate with Squamish /kʷ*át'æn/ 'mouse', Straits Klallam /kʷ*át'en/ 'rat', Shuswap /kʷ*ékʷ'tnel/, and Kalispel /kʷ*ékʷ'teneʔ/ 'mouse' (but Spokane /kʷ*ékʷ*teneʔ/). The apparent deglottalization of *t' is a pattern that is different from the deglottalization found in reduplicative elements. Spokane Kalispel shows several cases of deglottalization of the second ejective in a root. For example, /t's'qélp/ 'Douglas fir', Thompson /t's'qélp/. The Thompsons note that more study is necessary, but 'it seems likely that deglottalizing patterns may have developed independently at different times and places' (1985:140). It is also logically possible that some of the instances come from sporadic spreading of ejection, but clearly more investigation is needed.

Ohala (1993:249) cites one example of dissimilation, but gives no sources for his data. He notes the dissimilation of Proto-Quechumaran *t'ant'a to Quechua /t'anta/ 'bread'. In Quechua, the second of the ejective consonants is dissimilated, unlike many other languages. I am unsure whether this was a productive process or not. Furthermore, there is a great deal of controversy behind the relations between Quechua and Aymara, potentially casting doubt on this reconstruction (see Campbell 1995, 1997).

Finally, there is a possible case of ejective dissimilation from Proto-Semitic to Akkadian, an extinct Eastern Semitic language, whose phonology must be inferred from graphemic evidence. Geers (1945) discusses the case of dissimilation in Akkadian, which is a tentative candidate for ejective dissimilation. As he observed, 'an Akkadian consonantal base does not admit two different emphatic radicals; wherever the other Semitic languages exhibit two such sounds within a triconsonantal root, the Akkadian has changed one of them, according to strength, to the nearest nonemphatic sounds.' This phenomenon has come to be dubbed Geers' Law. He gives the following examples of the emphatics š q t (but provides no gloss):

(31) Geers' Law

<table>
<thead>
<tr>
<th>Correspondence</th>
<th>Reconstruction and Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sem.</td>
<td>Akk.</td>
</tr>
<tr>
<td>š, q</td>
<td>š, k/g</td>
</tr>
<tr>
<td>š, t</td>
<td>š, t/d</td>
</tr>
<tr>
<td>q, t</td>
<td>q, t</td>
</tr>
<tr>
<td>Proto-Sem.</td>
<td>&gt; Akk.</td>
</tr>
<tr>
<td>q r š</td>
<td>k r š</td>
</tr>
<tr>
<td>š r t</td>
<td>š r t</td>
</tr>
<tr>
<td>q t p</td>
<td>q t p</td>
</tr>
</tbody>
</table>

322
Geers also notes that ‘gemination and reduplication, as illustrated by the writings of the various forms dqq and qaqqadu, did not affect this principle’ (1945:66). Modern explanation for this comes from autosegmental theory, which posits that true geminates are doubly linked to the same feature, and thus the examples just quoted do not contain multiple separate tokens of the ‘emphatic’ consonant.

So far, we have only seen dissimilation of ‘emphatics’. The question is, what was the phonological representation of emphatics? Traditionally, it is thought that they are (or were) like the pharyngealized consonants of Arabic (e.g. Moscati 1964), but others contend that emphatics are like the glottalized (ejective) consonants of Ethiopian and Modern South Arabian (e.g. Dolgopolsky 1977, Bomhard 1988). (See the brief discussion in §4.5.1.) Other scholars have been accommodating of both positions. As Kaye (1986) notes:

‘Based on the graphemic evidence of Middle Assyrian and Middle Babylonian, Knudsen [1961] thinks that throughout their history, the Semitic languages had two types of emphatics, and that Akkadian emphatics were of the ejective type’.

Languages like Aramaic seem to have properties of both features (Hoberman 1988). Should there be a consensus that Proto-Semitic had ejectives, then Akkadian should be considered an example of ejective dissimilation. Otherwise, it should be considered in conjunction with other laryngeal-type dissimilations such as Lyman’s Law, Dahl’s Law, and Grassmann’s Law, which involve laryngeal features but not ejection.

In sum, there do not seem to be many cases of ejective dissimilation historically. But what cases there are seem to provide a variety of reflexes. For example, most dissimilations involve deglottalization, but we have also seen occasional voicing in Akkadian (Geers 1945). Next, we will examine sporadic cases of dissimilation.

6.4.3. Sporadic Dissimilation

Just as rule-governed instances of dissimilation are relatively rare, while sporadic dissimilation is relatively common (Grammont 1933, Hock 1986), we might expect the same for ejective dissimilation. With the exception of the careful documentation provided by Leslau, there are not many cases I have found of sporadic dissimilation.

Leslau (1956:27) mentions isolated cases of ejective dissimilation. The root which in Chaha and Muher is /tənkwur/ and in Masqan is /t'ank'ur/ ‘epiglottis’ yielded Gafat /tankw'arna/ ‘throat’ (27), in which the first ejective dissimilated by deglottalizing. In the Gafat word for ‘leopard’ there is some alternation which Leslau terms ‘reciprocal
dissimilation' between /k'ânt'awâtâ/ and /kântawâtâ/ from the probable primitive root /k'ant'awâtâ/ (cf. Geez /k^'ons'ol/ 'jackal'). Leslau (1952:67-8) discusses an alternation in Gurage dialects which in some cases can be explained as dissimilation with another ejective in the root (as /k't'/ becoming /kt'/), but in most of the examples it is independent of the neighboring phonemes. (See Chapter Four on Deglottalization).

Leslau (1938) is another rich source of examples of dissimilation in Soqotri (Modern South Arabian). For example, the voiceless ejective <q> (/k'/) dissimilates to voiced /g/ in the environment of a voiceless sound (often /f/) as in: /fegah/ 'to go out', alongside /tek'ah/ and in many forms of this root; /jege/ ‘to do’, /hadr jak’a/ ‘work’; /megrejeten/ and /mek’rejeten/ ‘écorchées [flayed; grazed f.pl.?]’; /geš -k’eš -kesf/ ‘to turn away’.

Leslau (1938:29) notes that /t'/ often loses its emphasis by dissimilation (in the environment of another emphatic), much like Geers' Law:

(32) /k’tn/ ‘mince; to make thin’, /k’êt’ehon/ ‘thin; mince’, Mehri /k’ot’ôn/, Hebrew /qâton/
/ḏejbet/ ‘to seize’, Mehri /ḏajbat/ Ṣhauri /ḏbet’/, Ar. /ḏabat’a/, Hebrew /š̄bat/ and /š̄bat’/
/nk’âšhneniten/ ‘speckled’, Arabic /nuqt’a/ ‘spot’

There are also a few instances of dissimilation in Amharic documented again by Leslau (1995:26-7). For example, what he calls contiguous dissimilation can be found in the variation between /ak’t’a t’a/ - /agt’a t’a/ ‘direction toward something’. Such dissimilation can also be discontiguous, as in /k’ärk’āha/ - /k’ärkāha/ ‘bamboo’, /k’awt’ - k’awt/ ‘kind of tree’, and /kw’ørmbat’ - k’ørombat’ ‘short’. Dissimilations can also involve voicing the dissimilating consonant, often in loanwords, as in /k’ant’a r’ - gant’ar/ ‘quintal’, /k’un’at’o - k’undodo/ ‘top of a tree or head’, /t’ārāp’eza - t’ārābbeza/ ‘table’, /aś’ā p’at’os - aś’ā bat’os/ ‘raspberry bush’, and /wāk’k’āt’ā - wāggāt’ā/ ‘pound’.

Finally, let me also mention Vogt (1940:40), who notes that in Squamish, ‘in a few cases glottalic consonants seem to have lost their glottal features when preceded by /ʔ/.’ Kuipers (1967:40) illustrates some examples. /fiʔ/ ‘be all around’ was recorded as /fīʃiʔ/ ‘round’. Cowlitz /miːʔ/ ‘blue grouse’ was recorded in Squamish as
/mu 'm̃tːm/, and Cowlitz /ewkʷ/ 'wealth, property' corresponds to Squamish /ʔəs-juʔkʷ/ 'stingy'. He notes that ‘it is not impossible that /ʔK/ and /ʔK'/ are in free variation in Squamish’, where K stands for a stop. The lack of general dissimilation in Squamish is witnessed by such reduplicative forms, from the root /kʷ'as/ ‘burn’, as /kʷ'as-ikʷ'as-tɑs/ ‘burn one’s mouth’ and by /s-τ'χɑʃjxʷ/ ‘limb of tree’ and its plural /s-τ'ɛχ-τ'χɑʃjxʷ/ (Kuipers 1967:99-100).

In sum, the sporadic cases, while interesting, do not shed much light on processes of sound change or phonological theory. The examples do not form regular patterns, and the conditioning environments are suspect and seemingly arbitrary. Nevertheless, I have presented them here in the interest of completeness.

6.5. Summary and Discussion

6.5.1. Summary
In the majority of cases of dissimilation, the first ejective (often in a reduplicative affix) is dissimilated (as in Shuswap, Columbian, and Lezgian) and the most frequent result is deglottalization (or delaryngealization), as in Shuswap. The frequency of deglottalization as the end result occurs because it is the simplest operation: delinking of the Laryngeal node. Obstruents with no laryngeal specifications are interpreted as plain voiceless consonants, following Lombardi (1991) and this data largely support her claims. In a few cases, however, there was concomitant voicing and/or aspiration of the segments. I have analyzed the voicing, especially in Tillamook, as part of a more general process of voicing prevocally; in Columbian voicing was intervocalic. And I have analyzed the aspiration, as in Lezgian, as a result of the release features remaining distinct before another consonant.

It is also often possible to analyze the dissimilation as delinking of the feature [e.g., leaving the Laryngeal node intact. However, in most languages with active dissimilation, there are often only two series, voiceless and ejective, making such a distinction impossible to test empirically. Where there is also a voiced series, as in the Caucasus, there is no contrast between voiced and voiceless consonants before an ejective (most likely due to sonority considerations) so again, the claim that individual delinking of [e.g.] takes place is impossible to test. Therefore, I assume the option of delinking the Laryngeal node so as to avoid leaving empty structure.

It is not the case that ejectives always lose their glottal features before any obstruent, as we might expect. Therefore, because of the similarity of original laryngeal
features in these processes, and the difference on the surface, we could consider contact dissimilation the result of both contact and dissimilation. Odden's (1994) Adjacency Parameters clearly also have analogues with respect to dissimilation, as I have shown elsewhere (Fallon 1993) for the feature [lateral]. That is, some languages require immediate segmental adjacency, while others require either adjacency at the level of the syllable, or perhaps at the level of tier-adjacency.

6.5.2. Discussion

In analyzing dissimilation, Ohala notes that there are no principles of speech production that predict dissimilative changes. Instead, he proposes that ‘dissimilation arises due to the listener’s mis-application of these corrective processes’ which ‘undo or reverse the predictable perturbations found in speech’ (1993:250). Ohala (1993:251) predicts that dissimilation is restricted to ‘stretched out features, features which manifest themselves over fairly long temporal intervals, that is, which can encroach on adjacent segments and thus create an ambiguity as to where the feature is distinctive and where fortuitous’. In this category he includes labialization, aspiration, retroflexion, pharyngealization, place of articulation, and ‘the voice quality called “glottalization”’. For example, in the dissimilation from Latin /kʰɪŋkʰe/ ‘five’ to *kɪŋkʰe: to Italian /ʧɪŋkwe/, Ohala notes that lip rounding influenced the intervening vowel. Listeners could then have been confused about whether the initial labialization was distinctive and ‘some listeners apparently guessed wrong’.

If we apply this theory to glottalization, in particular to ejectives, then the constricted nature of the glottis could be seen on adjacent segments, as evidenced by the fact that vowels are often glottalized next to ejectives (Greenberg 1970). This could then lead to misanalysis of an initial ejective as superfluously glottalized. However, I find it hard to accept Ohala’s analysis in this case. Ohala’s theory does not apply to features such as ‘stop’ and ‘affricate’, ‘which do not stretch over long temporal intervals’ (251). Many of the perceptually salient features of ejectives include a sudden stop burst, a quick period of silence, and then another slight burst marking release of the glottis. These quick timing features make ejectives unlikely candidates for dissimilation. However, in that ejectives involve constriction of the glottis, which could be a slow gesture, it could be that this does play a role. Ohala modifies his prediction such that ‘features requiring a long time window for their perception are more likely to be subject to dissimilation than are those requiring short time windows’ (252). In the case of segments which depend on both rapid and slow cues, Ohala predicts that ‘it will depend on which of these cues dominate the percept’.
(252). If dissimilation of ejectives involves a relatively slow feature like glottal constriction, then perhaps Ohala’s analysis is applicable here after all.

Nevertheless, it is important to keep in mind that whatever the phonetic basis of dissimilation, as Anderson (1981) put it, ‘phonology isn’t “natural”’. Although there may be a phonetic basis for much of the phonological component, cognitive structures ‘can be expected to have their own consequences for actual grammars’ (536). Salmons (1991:49) briefly examines dissimilatory laryngeal phenomena in several languages and, following Carenko, argues that glottal features often serve a demarcative function such as separating a root from suffixes. Burquest and Payne (1993:97) note that dissimilation ‘seems to have a psychological motivation, such that it enhances differences between segments’ and that if often prevents loss of contrast. In many of the Northwest Coast languages, with only two stop series, dissimilation certainly enhances contrast. Because many of the word formation processes involve reduplication, then dissimilation of ejectives helps to mark morpheme boundaries. It is ironic, however, that in cases involving lexical affixes, dissimilation does not occur. Instead, the preservation of the identity of the suffix seems more important, perhaps in line with the slogan ‘one meaning—one form’ (e.g. Hock 1986:168).

Unlike Ohala, Kiparsky (1995) claims that ‘only features which are contrastive in the language are subject to dissimilation’ (658). He agrees that dissimilation is not a natural articulatory process and so it must be due to perceptual reanalysis, a reanalysis which is a well-formed structure of the language.

It is somewhat unusual that there were no clear cases of ejective dissimilation involving the delinking of the feature [e.g.], as opposed to the whole Laryngeal node. In the Salishan languages, for example, since the stops have only a two-way phonation contrast between ejectives and voiceless stops and affricates, delinking is presumed to be on the Laryngeal node. In Lezgian, which does have a four-way stop contrast, the deglottalization of ejectives could also have been accomplished via Laryngeal node neutralization, since voiced stops do not occur adjacent to voiceless stops, and since the contrast between plain voiceless and aspirated consonants is neutralized pre-consonantally. Only in Svan and Ossetian, which have a triadic ejective, voiced, and voiceless series does it appear that there was a rule which specifically targeted the [e.g.] value of ejectives, as evidenced by loanword adaptation.

Finally, let me also mention the Obligatory Contour Principle, which prohibits adjacent identical elements. Clearly, what counts as adjacent depends on the language, as does what the tolerance for identity is. In some cases, consonants must share both place
and laryngeal features to be dissimilated, while in others, the laryngeal features alone are sufficient. The OCP remains a useful concept, but it is also true that each language decides when and where to invoke it.
THE SYNCHRONIC AND DIACHRONIC PHONOLOGY OF EJECTIVES

Volume II

DISSERTATION

Presented in Partial Fulfillment of the Requirements for
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* * * * *

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CHAPTER 7
EJECTIVE VOICING

7.1. Introduction
The voicing of voiceless stops is a well-known and well-understood phenomenon, especially in environments such as intervocically (e.g. Plains Cree, Dobrovolsky 1997) or after a nasal (e.g. Zoque, Wonderly 1951). However, relatively little is known about the ability of ejectives to voice. This chapter will investigate the synchronic and diachronic cases of ejectives becoming voiced, resulting in either voiced stops, or implosives.

Phonologically, this alternation is of some interest because it raises the possibility of feature changing, from [c.e.] to [voice]. Nonlinear phonological theory has attempted to constrain processes to either the spreading or delinking of association lines, yet there is still a residue of processes which are not amenable to either analysis. We will see whether the alternations between ejective and voiced stop require an appeal to feature changing. Based on the data presented here, I argue that all such alternations may be explained by either spreading or delinking, thereby constraining phonological theory.

This chapter will also examine the diachronic changes which involve ejective voicing, which has become a central issue in the diachronic typology of the Glottalic Theory, or specifically, the Ejective Model (EM) of the Glottalic Theory to use Job's (1989, 1995) term. Even supporters of the EM have doubted the model’s accuracy in the trajectory of the sound changes it requires. This chapter will provide empirical support for the change of ejectives to voiced stops, an important precedent for the EM.

The next section will provide background on ejective voicing in diachronic and synchronic phonology. Section 7.2.1 addresses the controversy behind the change of ejective to voiced stop and its importance in the Glottalic Theory. It outlines the importance of diachronic typology, which along with the synchronic typology, is the central issue of this chapter. In §7.2.2 discusses the phonological issues such as the power of direct feature changing and the formal means by which ejectives may become voiced. The synchronic data is covered in §7.3, with illustrative languages including
Salish, Lezgic, and Southern Bantu. Loanword phonology and the diachronic change from ejective to voiced are illustrated in §7.4 with data from the Caucasus, the Americas, and Africa. The synchronic and diachronic changes from ejective to implosive are examined in §7.5. The next section details the phonetics of different types of ejectives and argues that lenis ejectives bear certain affinities with voiced stops, which makes a change from ejective to voiced stop phonetically plausible. Various phonetic trajectories from ejective to voiced stop are examined and evaluated in §7.7, while §7.8 briefly reports on the sociolinguistic variation of ejectives, variation which is often a sign of change in progress. The last section concludes the chapter.

7.2. Ejective Voicing: The Glottalic Theory and Phonological Theory

7.2.1. The Glottalic Theory

As I have noted in the introductory chapter (§1.3.3), proponents of the Glottalic Theory (e.g. Hopper 1973, Gamkrelidze and Ivanov 1972, 1973, 1984, 1995) have relied heavily on typological considerations in their reconstruction of Proto-Indo-European, in which the traditional voiced stops are reinterpreted as ejectives. As Gamkrelidze and Ivanov (1984/1995) assert,

'reconstructions can be considered real if they are consistent with two basic typological criteria: they must agree with synchronic typological universals and they must agree with diachronic typological universals (general schemas for change and transformation of languages).’ (1995:xcv)

Much of the emphasis and argumentation of the Glottalic Theory has revolved around synchronic typological considerations: the phonetic values of each series and whether voiced aspirates can exist without corresponding voiceless aspirates; the bilabial absence or ‘extremely rare occurrence’ in the (traditional) voiced series; the overall rarity of the voiced series, and their rarity in inflectional morphemes; the root structure constraints which prohibit two (traditional) voiced members in a CVC root—all these may be seen as more in accordance with synchronic typology if the voiced series is reconstructed as ejective (see §1.4.3). This chapter is not the place to assess such evidence (see Hayward 1989, Salmons 1993, and Job 1995), but it is hoped that the data provided here will contribute to an assessment of the Ejective Model.
Gamkrelidze and Ivanov also emphasize the importance of diachronic typology:

‘a necessary condition for reality of reconstructions is that they must be consistent with diachronic typological data, with schemas for the change of particular linguistic structures over time, as established by the study of historical facts from individual languages’ (1995:xciv-v).

However, as Garrett (1991) notes, not only should the reconstruction of the proto-language be plausible, but so should the sound changes from the proto-language to its daughters. As Job (1989) points out, in the Ejective Model (EM) of the Glottalic Theory, roughly 75% of the reflexes of the PIE ejectives are voiced stops, so this model predicts that such a shift should be relatively common. Through the use of ‘diachronic typology’, we can evaluate the relative likelihood of such a sound change, just as proponents of the Ejective Model use synchronic typology in their reconstruction of the phonemic system. However, very little work (e.g. Colarusso ([1975] 1988), Job 1984, 1989, and Fallon 1995) has been done on the diachronic (or synchronic) shifts involving ejectives.

Gamkrelidze and Ivanov (1984/1995) present solid evidence from only one language family (Chechen and Ingush’s voicing of ejectives, discussed in §7.4.2.1), and fleeting references to several others, all in only three pages. A central purpose of this chapter is to conduct a fairly large-scale survey of synchronic and diachronic ejective voicing to help determine the relative plausibility of such a change.

Although many scholars find the synchronic reconstruction of PIE in the Glottalic Theory appealing, some, like Job (1995:248), are ‘less [sympathetic], of course, with the EM’s unsupported diachronic hypothesis’. Even one of the theory’s principal founders, Paul Hopper, has acknowledged that ‘the most serious obstacle in the way of ejective interpretation of the Plain Voiced stops is undoubtedly the necessity to posit a widespread change in the Indo-European dialects from ejective to voiced stop’ (1977:68). However, Picard (1995:233) has claimed that ‘there is no a priori motive for excluding the possibility of reconstructing protosegments which have changed across the board if the criterion of naturalness warrants it’. He cites the case of Proto-Algonkian (PA) *i (traditional *θ) which yielded /θ, t/ and /n/ (probably via *l), but whose reflex as the lateral fricative is found only in Ritwan, with which Algonkian comprises the Algic family. Another example of across the board change is in Proto-Muskogean correspondences between /b/ and /k/, for which is reconstructed /k/w/. Note also the widely different reflexes of traditional PIE *gwh, which lost aspiration and/or labialization in all the daughter languages. Thus, widespread change should not be
excluded simply on the basis of 'majority rule' or Occam's Razor. The traditional model
does, however, posit a smaller number of phonetic changes in the daughter languages
than the EM. Yet what of the plausibility of the change from ejective to voiced stop?
How natural is it?

Some scholars who employ the EM such as Baldi and Johnston-Staver
(1989:94), stated that 'there is such an articulatory distance between explosive glottalized
stops and voiced stops that a direct change seems phonologically impossible'. A scholar
relatively sympathetic to the Glottalic Theory, Matasović (1994:145) has claimed that
'this type of phonetic development is extraordinarily rare'. The Glottalic Theory has long
had its detractors who have criticized it on various grounds, including the required shift
from ejective to voiced stop. Most recently, Fox (1995:259), for example, has claimed
that 'the theory requires the voicing of the glottalic sounds in the classical languages, but
there is no phonetic reason why such voicing should take place in these sounds; the
process is an unlikely one, and phonetically implausible.' Picard (1995:233) said of
ejective voicing that 'this seems like a pretty radical change and one that can hardly be
conceived to have occurred in one fell swoop'. This chapter will address some of the
critics' concerns and examine the synchronic and diachronic cases of alternations or
changes between ejectives and voiced stops. Phonetic motivations for such a change will
also be discussed and will be shown to be not as radical and implausible as previously
thought.

7.2.2. Issues in Phonology
In the generative phonology of The sound pattern of English (Chomsky and Halle 1968),
the evaluation metric of phonological rules could not formally distinguish between
common rules of assimilation (1a) and unattested rules of random changes (1b), which
both had the same formalism:

(1) a. [+cons, -son]  →  [+voiced] / [+voiced] 

b. [+cons, -son]  →  [+lateral] / [+low] 

It should be noted, though, that rules of assimilation have featural identity in the
structural change and the determinant (as in (1a) above). Yet as Bach (1968) pointed out
for assimilation rules, there must be not only similar features but similar feature values

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for the rule to be natural; changing the values yields impossible rules which are nevertheless permitted in the formalism of the theory.

In Clements (1985) the formalism of feature geometry organized phonological features into hierarchical class nodes, grouping, for example, laryngeal features under one node, and place features under another, thereby allowing common sound changes to be expressed naturally, while uncommon sound changes were either impossible to express or were more complicated (see McCarthy 1988 and §2.3.2). Thus in feature geometry, assimilation is viewed as the spreading of one feature or node by creating an association line from one segment to another (e.g. Hayes 1986).

Poser (1982) proposes two types of feature changing. One was direct feature changing, which he considered firmly established in order to account for dissimilation. However, given recent analyses of this as delinking plus default (see Chapter Six), there is no clear evidence of direct feature changing. The other account of feature changing was indirect, involving two steps: delinking followed by ‘reassociation’ or, in the current view, default rules. Thus Kiparsky (1993:285) assumes that all structure-changing rules ‘are to be decomposed into deletion (delinking) plus structure-building’. Given the power of direct feature changing, a theory which restricts this device is to be valued over one which permits its unconstrained use.

Clements and Hume (1995:265) claim that feature-changing rules involving such features as [sonorant], [consonantal], and [continuant] ‘are most likely required to express processes of strengthening and weakening’. They also admit that nondefault feature insertion rules ‘are sometimes needed to express the introduction of marked feature values’ (265). Does phonological theory need to admit feature-changing rules for laryngeal features such as [c.e.g.] → [voice], in which case it broadens Clements and Hume’s predictions with respect to fortition and lenition? Or should such a change be handled in two steps: one delinking the feature [c.e.g.], and another inserting a new, marked feature [voice]? I will argue that this change of ejective to voiced is actually realized as either delinking followed by default fill-in of [voice], or spreading of [voice] (with preservation of [c.e.g.] resulting in an implosive, and loss of it resulting in a pulmonic voiced stop). Such an analysis leads to a more constrained theory, and while it does not test Clements and Hume’s claims about the purported feature-changing features, it does not expand their list to include laryngeal features.

Thus far, we have seen and tested a theory of phonology that admits a small number of elementary operations or rule types such as feature or node spreading and
delinking (e.g. McCarthy 1988, Clements and Hume 1995). We have seen the Laryngeal node (and some laryngeal features) spread in assimilation (Chapter Three), and we have seen them delink, resulting in delaryngealization or deglottalization (Chapter Four). We have also examined delinking of various other structures to account for debuccalization (Chapter Five), and have examined dissipulative delinking (Chapter Six), and found that the empirical evidence provided by ejectives largely confirms the predictions of feature geometry and its associated theory of rules.

Moving from theoretical predictions to empirical alternations, we have examined the changes (and formalizations of those changes) which ejectives undergo, using the velars as examples. The change of /pk′/ to /p′k′/ is the assimilative spread of Laryngeal features. The loss of place features usually results simply in a retention of laryngeal constriction: /k′/ → [?]. The alternation between ejective and voiceless unaspirated stop /k′/ → [k] is typically the result of loss of the Laryngeal Node through laryngeal neutralization (Lombardi 1991), where lack of a Laryngeal Node is interpreted as a plain voiceless stop. The alternation between /k′/ → [kʰ], as in Lezgian (§6.3), is seen as (dissimilative) deglottalization, followed by pre-obstruent aspiration of plain voiceless stops, since voiceless unaspirated stops not derived from ejectives are also aspirated in this environment. The change between ejective and voiced stop /k′/ → [g], which we saw in Tillamook (§6.3), will be argued to involve a two-step process of deglottalization followed by voicing of voiceless unaspirated consonants (indirect voicing) or in Columbian Salish, it involves the spread of [voice] with dissociation of [e.g.] (direct voicing). The change from ejective to implosive /k′/ → [g] is viewed as the addition of the feature [voice], often via spreading, without dissociation. The change from ejective to breathy voiced stop /k′/ → [gʰ] is unattested, in part since it would involve the change of two laryngeal features. While such a change could possibly result from spreading of a Laryngeal node specified for those two features, since languages with breathy voiced stops do not typically contain ejectives, this is difficult to verify. Two languages which do, !Xů and Xhosa, do not provide appropriate contact environments to test this claim. In sum, the phonological processes of ejectives we have seen so far and will examine in this chapter pose no challenge to the assumptions that feature changing is a two-part process.
7.3. Synchronic Alternations
7.3.1. Salish: Tillamook and Columbian

This section will examine two Salish languages, Columbian and Tillamook, which provide alternations between ejective and voiced consonants. These languages were briefly outlined in §6.3 since they are motivated by dissimilation, but are also examined here since the outcome is of voicing, one at the phonemic level and the other at the allophonic level.

Tillamook, the Coast Salishan language once spoken along the Oregon coast, was the first Salish language to die. The first thorough, published fieldwork on Tillamook was described in Edel (1939), which she herself admits with refreshing honesty, ‘can pretend neither to completeness, nor to absolute accuracy, particularly with regard to phonology’ (1939:3). Egesdahl and Thompson (to appear) also note that this was one of the earliest Salish grammars, ‘before much was known of their complexities and idiosyncracies’. This work was the main source of Tillamook in Reichard’s (1958-1960) study of Salish, published posthumously and edited by Florence M. Voegelin. Other studies include Swadesh’s (1952) brief phonemicization, and Thompson and Thompson (1966), which is a thorough analysis of the phonology of one of the last semi-fluent speakers. The Thompsons revised their earlier (1966) treatment in Thompson and Thompson (1985) and Egesdahl and Thompson (to appear).

The analyses of the phonemic inventory of Tillamook has varied greatly as the phonemic principle, different trends in phonemicization, and better knowledge of Salish languages were developed. Tillamook, incidentally, is one of the few languages with no bilabials; Proto-Salish *p, p’ > /h/ and *m > /w/. The phonemic inventory given in Egesdahl and Thompson (to appear) is as follows:

---

1 One might question whether, like Athabaskan, the voiced series is phonetically voiceless unaspirated, in which case the voiceless series would need to be specified as [spread glottis] aspirates phonologically. I know of no evidence for this proposition. In addition, Larry Thompson has done a lot of fieldwork in Salish in which some languages such as Thompson River Salish have ‘quite lenis’ stops which were still transcribed as voiceless, not voiced stops. Therefore we may have confidence when the Thompsons use the term ‘voiced’. I believe the burden of proof would be on an alternate analysis to demonstrate that aspiration is phonologically operative in the language.
The uvulars in brackets occur only in reduplicative affixation before their ejective counterparts.

Both the ejectives and the voiceless (aspirates) in reduplicative affixes dissimilate. Thompson and Thompson (1985) observe that ‘glottalized obstruents are deglottalized...[and] deglottalized elements are regularly voiced before vowels.’ They also state in this work that in reduplicative prefixes, 'the aspirated consonants are systematically deaspirated and voiced’ (141). And they refer, in their revisions of Thompson and Thompson (1966), to a distinct aspirated series ‘opposing the voiced stops which occur only before vowels’ (1985:145). Data are presented below which illustrate these processes. Ejective deglottalization and voicing are illustrated in (3), while voiceless (aspirate) (deaspiration and) voicing are shown in (4). The voiced consonants remain (or are redundantly) voiced in reduplications (5). Data are from Thompson and Thompson (1985:141), unless by E&T, which refers to the display numbers in Egesdahl and Thompson (to appear).

(3) Ejectives Voice

<table>
<thead>
<tr>
<th>téni</th>
<th>‘ear’</th>
<th>den-téni</th>
<th>‘ears’</th>
</tr>
</thead>
<tbody>
<tr>
<td>ít’é?en</td>
<td>‘he searched for it’</td>
<td>ít’é?en</td>
<td>‘he searched and searched for it’</td>
</tr>
<tr>
<td>s-q’élél</td>
<td>‘earth-oven’</td>
<td>tš-gq’élél’el’séni</td>
<td>‘I’m baking in the earth-oven’</td>
</tr>
<tr>
<td>(s)sq’-q’w’-awi-n-i</td>
<td>‘I jumped over (it)’</td>
<td>(E&amp;T (55))</td>
<td></td>
</tr>
</tbody>
</table>

(4) Voiceless Aspirates Voice

<table>
<thead>
<tr>
<th>tuq’úsu</th>
<th>‘beaver’</th>
<th>du-tuq’úsu</th>
<th>‘small beaver’</th>
</tr>
</thead>
<tbody>
<tr>
<td>tš-k’énan</td>
<td>‘she takes hold of it’</td>
<td>tš-gq’énan</td>
<td>‘they take hold of it’</td>
</tr>
<tr>
<td>tš-qixftu</td>
<td>‘s.o. chased it away’</td>
<td>tš-gqixftu</td>
<td>‘s.o. kept chasing it away’</td>
</tr>
<tr>
<td>da-tági</td>
<td>‘cedar log’</td>
<td>(E&amp;T (127))</td>
<td></td>
</tr>
</tbody>
</table>
(5) Voiced Consonants Voice

\[\text{g}^\text{*}-\text{g}^\text{*}h\text{-as-w}\text{ôj-ôs}\]

‘if they call me,...’ (E&T (13))

\[\text{g}^\text{*}l\text{-g}^\text{*}l\text{ô}\]

‘EMPH. 2p’ (E&T (25))

\[\text{w}^\text{ô}g^\text{ô}g^\text{ô}l\text{-lal-}\]

‘alive’ (E&T, before (40)) (with infixal redup.)

\[j-s-g^\text{*}l\text{-l-(s)}\text{ôj-wf}\]

‘They want to kill me’ (E&T (87))

(with regular delabialization before [i])

In sum, both the ejectives and the voiceless aspirated consonants lose their distinct laryngeal features and become voiced in the reduplicant.

I analyze this process as loss of the Laryngeal node for the ejectives, since phonologically, the voiceless members are not represented with a Laryngeal node. If it is assumed that the voiceless consonants bear [s.g.], then their Laryngeal nodes would delink as well, though I know of no evidence for this. It could also be that all reduplicated plosives lose their Laryngeal nodes, and thus dissimilation is delaryngealization. In that case, voicing is restored by the voicing rule. However, given Occam’s Razor, the simplest analysis involves simply delinking the Laryngeal node of ejectives, and assuming voiceless plosives have no Laryngeal node. Voicing is the result of regressive assimilation from the following vowel onto preceding stops or affricates. Some evidence for the two-part analysis of deglottalization (or delaryngealization) followed by voicing may be seen in forms like the following:

(6) sûq’i ‘younger sister’

sq-sûq’i ‘younger sisters’

This shows that in non-prevocalic environments, the reduplicated ejective is simply deglottalized. The alveolar lateral affricate ejective /ti’/ deglottalizes but does not voice, as seen in [ûe-û’é?en] ‘he searched and searched for it’ (3). Thompson and Thompson (1966) note that this phone is an exception to the voicing rule.

I analyze the spread of [voice] to create an interpolated Laryngeal node on those segments which do not have one: the deglottalized ejectives, by the ‘Grassmann’s Law’-type dissimilation, and voiceless stops, which do not bear one underlyingly. This rule is formalized as follows:
(7) Voicing Assimilation

\[
\begin{array}{c|c|c}
\text{Redup} & \text{rt} & \text{voice} \\
\text{s} & \text{ont} & \text{+ont} \\
\text{+cons} & \text{-cons} \\
\hline
\text{Lar} & \text{Lar} & \text{voice}
\end{array}
\]

In sum, the change of ejective to voiced in Tillamook is the result of a two-step process: dissimilative delinking in the reduplicant, and regressive spread of [voice] from a following vowel. Thus although the laryngeal feature specification has changed to that of a contrasting laryngeal feature, it is accomplished through indirect means.

In Columbian Salish, 'the first of two glottalized obstruents juxtaposed by C\textsubscript{2}-reduplication may be optionally voiced and deglottalized, and then there is usually an epenthetic \textcircled{o} between the consonants' (Kinkade 1982:66). Columbian has two phonemic series – voiceless (aspirated), and ejective stops and affricates.

(8)a. /k'^up'(ap\'/  
/k'^ip'ap\'/  
/lit'at'/  
/p'ot'at'/  
/lot'at'/  
/k'^st'at'/  
/sp'oq'*'q'u'mix/

There are no cases of deglottalization without concomitant voicing (Kinkade p.c.), and thus although the alternation is optional, both processes apply in tandem. And Kinkade tells me that the sounds in question are indeed voiced, not simply voiceless unaspirated, especially with the svarabhakti vowel. Voiceless stops are heavily aspirated, and do not voice in this environment. Thus only ejectives are targeted for voicing, though with only two contrastive series, we may say that the Laryngeal node of ejectives is delinked and the resulting segment is voiced postvocally (and posttonically), as the form [k'^'adlt\'/] illustrates. Columbian Salish is a case in which direct ejective voicing could be possible if by direct we mean the spreading of [voice] with dissociation of [c.g.]. In sum, Columbian provides strong evidence for a change of ejective to voiced stop, though the
process is postlexical since it creates a new series of voiced stops, which are not underlyingly contrastive. Like Tillamook, it was triggered by dissimilation, but in this case, the change was to a new, allophonic phonetic type, not a distinct phonemic category.

7.3.2. Lezgic: Lezgian and Archi
This section examines two members of the Lezgic (or Lezgian) branch of Daghestanian languages, Lezgian proper and Archi. Lezgian has a non-productive alternation between ejectives and voiced stops in final position. An independent rule of voicing helps confirm the two-part nature of the change as delinking followed by (marked) default. In Archi, ejective affricates undergo voicing, and sometimes deaffrication before tense or voiced-initial consonants.

Lezgian has four series of stops: ejective, voiced, voiceless aspirated, and voiceless unaspirated (Trubetzkoy 1931a, Haspelmath 1993, Fallon 1995). I provide a near-minimal set: /tar/ 'tree' vs. /tʰar/ 'tara (musical instrument)' vs. /tʰab/ 'block (abs. sg.)' vs. /dallaj/ 'quarrel'. All laryngeal features may appear word-finally except voiceless unaspirated ones; this is an interesting exception to Lombardi’s theory of laryngeal neutralization, in which the voiceless unaspirated stops are least marked and are often the default consonant in cases of neutralization. In Lombardi’s framework, Lezgian has a constraint in which final stops must bear a Laryngeal node. In a closed class of lexical items, Lezgian shows alternations between word-final ejectives and voiced stops when there is a preceding ejective. Compare the following forms from Haspelmath (1993:61):

(9)  | Ergative Singular | Absolutive Singular |
---|------------------|-------------------|
q’ep’ini | q’eb | ‘cradle’ |
t’ap’uni | t’ab | ‘block’ |

Another rule of [e.g.] Dissimilation (Haspelmath’s Pre-ejective Ejective Aspiration; see also §6.3) deglottalizes the preceding consonant when there is an intervening high vowel. In these cases, the first root ejective in the singular is deglottalized. After stress is shifted in the plural, a syncope rule deletes the first vowel and the initial stop is subsequently aspirated, before an adjacent consonant. The final consonant, which is an underlying ejective, undergoes voicing in the absolutive singular, as it did in (9) above. The
following are thus additional examples of the same alternations between ejectives and voiced stops:

(7) Underlying PR
    Plural (Plural) Abs. Sg.
    t'up'-ar tʰw'p'-ar t'ub 'finger'
    tj'ip'-er tjʰ'p'-er tj'ib 'span'
    ts'ip'-er tsʰ'p'-er ts'ib 'pot'
    t'ip'-er tʰ'p'-er t'ib 'owl'
    ts'ik'-er tsʰ'k'-er ts'ig 'middle'
    q'yt'-er qʰt'-er q'yd 'winter'
(adapted from Haspelmath 1993:61)

These final stops are voiced, and not simply mistranscribed voiceless unaspirated, since they are also transcribed as such by Mejlanova (1967) and by a linguist of high caliber who did extensive fieldwork in the Caucasus, Trubetzkoy (1931a).

Given such alternations between ejectives and voiced stops, the question is whether one should allow direct feature-changing so that [e.g.] → [voice], or whether there should be a two-step process in which there is delinking, followed by fill-in of a marked feature like [voice]. I believe that this is a two-step process, for reasons given below. I therefore formalize the rule as follows:

(8) Lezgian Deglottalization and Default voicing

Delinking Default

root V root[^ABS.SG.] root V root[^ABS.SG.]
| | | | |
Lar Lar Lar Lar
| | | |
[c.g.] [c.g.] → [c.g.] [voice]

(Morphologically restricted to some nouns in the absolutive singular)

This rule states that in word-final position in the absolutive singular, the second of two ejectives dissimilates to become voiced, first by deglottalization and then by default fill-in of [voice]. As noted above, these alternations are restricted to a closed class of lexical
items. There are many instances of ejectives in word-final position, even in the absolutive singular, e.g. /k'uk'/ 'peak' and /q'yîj'/ 'armpit'. And there are thirteen forms which alternate ejective with aspirates finally, e.g. /met'-er/ 'knees' vs. [metʰ] 'knee (abs. sg.)'.

Next we will examine some other aspects of Lezgian laryngeal phonology to motivate the view that [voice] is the default feature value. Haspelmath notes that there is a ban on word-final unaspirated stops. One rule which is relevant to determining the status of [voice] as a default feature is found in the rule Haspelmath calls Word-final Unaspirated Voicing. There is a regular alternation in all monosyllabic nouns between a root-final voiceless unaspirated stop and the corresponding voiced stop word-finally. The voiced equivalents of / ťs, ĭj, q/ are /z/, ʒ/, respectively, as shown in (9b), since most dialects of Lezgian have lost the historical *dʒ, *dz, *ʒ. Compare the following:

<table>
<thead>
<tr>
<th>(9)</th>
<th>Plural</th>
<th>Abs. sg.</th>
<th>Gloss</th>
</tr>
</thead>
<tbody>
<tr>
<td>a.</td>
<td>jeper</td>
<td>jeb</td>
<td>'string'</td>
</tr>
<tr>
<td></td>
<td>rapar</td>
<td>rab</td>
<td>'needle'</td>
</tr>
<tr>
<td></td>
<td>qatar</td>
<td>qad</td>
<td>'summer'</td>
</tr>
<tr>
<td></td>
<td>jatar</td>
<td>jad</td>
<td>'water'</td>
</tr>
<tr>
<td></td>
<td>mukar</td>
<td>mug</td>
<td>'nest'</td>
</tr>
<tr>
<td></td>
<td>pakʷar</td>
<td>pagʷ</td>
<td>'side, rib'</td>
</tr>
<tr>
<td>b.</td>
<td>warfšar</td>
<td>warz</td>
<td>'moon; month'</td>
</tr>
<tr>
<td></td>
<td>muršar</td>
<td>murz</td>
<td>'edge'</td>
</tr>
<tr>
<td></td>
<td>raʃar</td>
<td>raʒ</td>
<td>'grain'</td>
</tr>
<tr>
<td></td>
<td>maʃwar</td>
<td>maʒw</td>
<td>'astragal'</td>
</tr>
<tr>
<td></td>
<td>raqar</td>
<td>raŋ</td>
<td>'sun'</td>
</tr>
<tr>
<td></td>
<td>qaqar</td>
<td>qaŋ</td>
<td>'sheath' (Haspelmath 1993:53-4)</td>
</tr>
</tbody>
</table>

Because all consonants must have a Laryngeal node word-finally, there appears to be a feature default of [voice], which accounts for the alternation between voiceless unaspirated and voiced in word-final position.

Additional evidence for voice as default is found in certain reduplicated imperatives. In regular reduplicated imperatives, the root consonant is simply reduplicated, as shown in (10a). In stems ending in voiceless unaspirated consonants,
however, the final consonant of the stem is reduplicated as a voiced consonant, as shown in (*10b). (The masdar is a term in Caucasian linguistics for the verbal noun). Data is from Haspelmath (1993:55).

(10)

<table>
<thead>
<tr>
<th>Masdar</th>
<th>Imperative</th>
<th>Gloss</th>
</tr>
</thead>
<tbody>
<tr>
<td>a.</td>
<td>eʃ̣'-i-n</td>
<td>eʃ̣'-i-ʃ̣'</td>
</tr>
<tr>
<td></td>
<td>qʰ-u-n</td>
<td>qʰ-u-qʰ</td>
</tr>
<tr>
<td>b.</td>
<td>k-u-n</td>
<td>k-u-g</td>
</tr>
<tr>
<td></td>
<td>kʰuʃ̣s-u-n</td>
<td>kʰuʃ̣s-u-z</td>
</tr>
<tr>
<td></td>
<td>q-u-n</td>
<td>q-u-ʃ̣</td>
</tr>
</tbody>
</table>

Lombardi (1995:39) claims that languages may have marked default consonants, stating that:

It would be possible to analyze neutralization to voiced (or other laryngeally marked) obstruents in this system, if an authentic case were found. It would require a rule delinking the Laryngeal node, and then a specific rule of fill-in of [voice] (or other feature) on unmarked sounds. This is obviously more complex than linking alone, which explains why it never occurs (or if such a case were found, it would account for its extreme rarity).

I propose that Lezgian is a language in which the marked feature [voice] is such a default. We have thus seen some evidence to suggest that the feature [voice] may be the default consonant in Lezgian. This may be due to the typologically unusual requirement that word-final consonants bear a Laryngeal node (or that there is constraint against no Laryngeal nodes in word-final position). Because [voice] is the default consonant, laryngeal feature changing is not required for the alternation between ejective and voiced stops. Instead, through delinking and default, we may preserve the more highly constrained system which prohibits direct feature changing (at least within laryngeal features). This analysis thus accounts for the alternation between ejective and voiced stop by relying on the fact that [voice] is a default feature and that word-finally, voiceless unaspirated consonants are not permitted. If the voiceless unaspirated stops were

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2 In Fallon (1995:110) I erroneously described this as ‘The final consonant of the stem is reduplicated as a voiceless unaspirated plosive after the morphemic /-u-/’. The text should have read, ‘When the final consonant of the stem is a voiceless unaspirated plosive, the reduplicated consonant is voiced after the morphemic /-u-/.’

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allowed finally, then the analysis predicts that the change of ejective to voiced would not take place.

Archi, a Lezgian language of Daghestan (Kibrik 1994a; see also Kodzasov 1977), was cited by Gamkrelidze and Ivanov (1984/1995) in support of the Glottalic Theory as a language with ‘positional deglottalization of ejectives to voiced obstruents’, but no data were provided, and the reader was referred to Kodzasov (1967). Here I shall illustrate what I believe they meant by ‘positional deglottalization’ to voiced. Archi has three types of obstruents: aspirated, voiced, and ejective, in addition to a tense series. The tense consonants, transcribed with a macron, occur as unaspirated stops (only in medial position, where they are geminate intervocally and simple voiceless unaspirated before another consonant), and elsewhere as geminate ejectives and geminate voiceless fricatives (Trubetzkoy 1931:42-3). Kibrik mentions a process of dissimilation for ‘occlusiveness’ in which ‘an affricate becomes a fricative before a plosive, a strong or ejective affricate becoming voiced’ (see (10a)), and ‘an aspirate becomes a voiceless fricative’ (see (10c)) (1994a:306).

The simple form of ‘house’ can be observed in (10a) below. When the plural suffix is added, the alveolar lateral affricate ejective becomes a voiced lateral fricative, and the initial tense consonant of the suffix undergoes voicing. Before a vowel-initial suffix, the affricate remains unchanged (10b). (The lateral sounds of Archi include the affricates /tI, t'w, t', t'w/ and fricatives /l, l', l', l'/ and the lateral sonorant /l/.) Example (10c) shows loss of occlusion when the affricate occurs before the tense consonant, which subsequently voices. Tense-initial suffixes are shown in other environments in (10d).

(10)  

(a)  

<table>
<thead>
<tr>
<th>Archi Form</th>
<th>English Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>noti'</td>
<td>'house' (301)</td>
</tr>
<tr>
<td>noti'-tor</td>
<td>[noljdör] 'house (nom. pl.)' (306)</td>
</tr>
<tr>
<td>noti'-tor-tjaj-n</td>
<td>[noljdortjen] 'house (gen. pl.)' (307)</td>
</tr>
<tr>
<td>(b)</td>
<td></td>
</tr>
<tr>
<td>oti'; oti-ór</td>
<td>'sheep (sg.; pl.)' (310)</td>
</tr>
<tr>
<td>(c)</td>
<td></td>
</tr>
<tr>
<td>bèts - ìu</td>
<td>[bèsdu] 'blind (adj.)' (306)</td>
</tr>
<tr>
<td>(d)</td>
<td></td>
</tr>
<tr>
<td>abadlaw-ìu-t</td>
<td>'eternal' (318)</td>
</tr>
<tr>
<td>dibir-ìu</td>
<td>'mullah (nom.)' (310)</td>
</tr>
</tbody>
</table>

The loss of ejection and occlusion in (10a) is not due to a more general constraint against ejectives in preconsonantal position, since there are words such as /et’mus/ ‘to tie
There exist other cases in Archi of ejective affricates becoming voiced fricatives. The examples below show alternations of the following types: /t'/ ~ /s/, /t's/ ~ /s/, as well as /tʃ/ ~ /ʃ/ and /tʃ, (tʃtʃ)/ ~ /ʃ/. They may well involve the same plural suffix as discussed above in (10), but I follow Xajdakov's transcription of the initial consonant of the suffixes below:

(11) Singular    Plural
moʧ'-or    meʤ-den 'beard'
χafts'-i    χaʃ-du 'tongs'
gwafts'-i    gwaʃ-du 'dog'
gwafts-i    gwas-du 'mare' (Xajdakov 1967:610)

I do not have sufficient access to more detailed sketches of Archi to determine whether the two processes of ejective voicing are similar. Nevertheless, in leniting, the ejective affricates deglottalize, deaffricate, and voice.

7.3.3. Southern (Zone S) Bantu
Doke (1967:41) describes the 'somewhat irregular' process of 'vocalization' in Venda, a Southeastern Bantu language. In the regular formation of class 5 nouns, the prefix /li-/ is added, typically with monosyllabic stems; the plurals are formed by adding the class 6 prefix /ma-/ as in (12a). Some nouns, however, have a zero realization of the class 5 prefix (12b).

(12) Singular    Plural    Gloss
a.  li-ŋo     ma-ŋo     'tooth'
    li-ga     ma-ga     'step'
b.  ḩuβa     ma- ḩuβa 'day, sun'
    φungo     ma-φungo 'sentence' (Poulos 1990:24-5)

In the formation of nouns of class 5, the ejectives change regularly such that /p' t' t' k'/
There are no words with initial voiceless aspirated stops in this class. (The situation with the other consonants is more complicated, involving the change to a fricative or affricate, and need not concern us here; Doke (1967:159) terms the other changes 'spasmodic irregularities'). Examples are given below, in which there is alternation between the initial voiced consonants in the singular and their cognate ejectives in the plural (with class 6 prefix /ma-/):

(13)

<table>
<thead>
<tr>
<th>Sg.</th>
<th>Pl.</th>
<th>gloss</th>
</tr>
</thead>
<tbody>
<tr>
<td>a.</td>
<td>bako</td>
<td>ma-p'ako</td>
</tr>
<tr>
<td></td>
<td>daka</td>
<td>ma-t'aka</td>
</tr>
<tr>
<td></td>
<td>dope</td>
<td>ma-t'ope</td>
</tr>
<tr>
<td></td>
<td>gumbu</td>
<td>ma-k'umbu</td>
</tr>
<tr>
<td>b.</td>
<td>bango</td>
<td>ma-p'ango</td>
</tr>
<tr>
<td></td>
<td>demba</td>
<td>ma-t'emba</td>
</tr>
<tr>
<td></td>
<td>gole</td>
<td>ma-k'ole</td>
</tr>
</tbody>
</table>

As Doke (1967:157) noted, 'In each case the unaffected stem consonant is shown in the plural, the voiced consonant of the singular indicating the action of the suppressed prefix Ji-. That is, the noun class 5 prefix disappears and there is concomitant mutation ('vocalization') of the initial root stop consonant. In Poulos' analysis, he claims that 'it is in fact the vowel i of Ji- that actually exerts this so-called influence on the following consonant' (1990:26) and uses the morphophonemic symbol I- to indicate the changes induced for class 5.

The alternation between the ejective-initial stem and the voiced variant could be handled in a number of different ways, depending largely on one's view of morphology as item and arrangement or item and process (e.g. Hockett 1954 and many works too numerous to cite). One could view the change, following Poulos, as spreading of [voice] from the vowel of the prefix /Ji-/, which is subsequently suppressed morphologically.

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3 David Odden (p.c.) has suggested that in Venda, as in Nguni, Sotho, Tsonga, and others, the phonological opposition is /p b t d k g/, and that in certain contexts the voiceless stops voice, while in others, the voiceless consonants are realized as ejectives.

4 However, no evidence to support this view is provided in Poulos' chapter 10 as he had promised (1990:26).
One could propose that certain class 5 morphemes are required to take a prefix which is a floating [voice] feature, which spreads to a consonant-initial ejective and delinks the previous laryngeal specification (cf. Leiber’s 1982 analysis of consonant gradation in Fula). Whatever the formalism, there is an alternation between ejectives and voiced stops in Venda, though it is not a regular phonological process.

Donnelly (1992, 1995, p.c.) reports that in Xhosa, a Nguni (Southern Bantu) language which has full aspirated, ejective, and breathy-voiced series (indicated by a subscript umlaut), in addition to a bilabial implosive and its many clicks, ‘/k/’ is the only voiceless ejective which tends to be unejected and frequently voiced’ (1992:2). In the first syllable of any root, ejection is maintained, e.g. [-k’]ek’a ‘turn around’. However, in non-initial position, the velar ejective (which is only clearly ejective under emphasis) is never fully ejected and can always be voiced (see also Lanham 1960):

(14)  /-pʰek’-a/ [-pʰega] ‘cook’
/-sek’-a/ [-sɛga] ‘put’
/-sɛleka’/ [-sɛleɡa] ‘carry on the back’
/-tʰak’atʰ-a/ [-tʰaɡaɡʰa] ‘bewitch’
/da-k’ad-a/ [-daɡaɡa] ‘tear to pieces, mangle’
/-kʰok’-a/ [-kʰogga] ‘draw out’

The plain voiced consonants are distinct from the underlying breathy voiced consonants, which exhibit a wide variety of depressor effects. (See Traill, Khumalo and Fridjhon 1987 for a phonetic study of this phenomenon in Zulu).

The exact status of voicing in Xhosa is subject to interpretation, but in Donnelly’s and in other analyses, [depressor] is used to describe the breathy voiced consonants and [voice] itself does not play a role. Thus in Xhosa, there is apparently a postlexical rule of intervocalic ejective voicing, whose output yields a phonation type distinct from the underlying breathy voiced series. The unusual feature of the Xhosa rule is that it targets velars, the most robust of ejectives, while the ‘weaker’ ejectives at the labial and dental places of articulation maintain their ejection. The rule is difficult to express, but might most easily be explained by the rightward spread of [voice] from a preceding vowel onto a non-initial velar ejective, akin to the process in Columbian.

There are quite similar findings in Zulu, which, like Xhosa is a Nguni language. Zulu has distinct ejection, e.g. /t’uɓa/ ‘soften’ vs. /tʰuɓa/ ‘become darkened’, though
often ejectives occur after homorganic nasals, e.g. [nant'ì] ‘here it is’ (Doke and Vilakazi 1964:775). Doke and Vilakazi notes that the ‘radical’ (voiced) form of k in Zulu ‘is devoid of aspiration but with slight voicing (with some speakers appearing to the European ear almost as g). This is “soft-k”, and occurs in the infin. prefix uku-, the adverbiaformatives ku- and ka-, the feminine suffix -kazi, the intr. and neut. v. suffixes -ka, -eka, -akkala, and sundry individual words, e.g. i(li)hlakani, inkuku, hleka, buka, etc.’ The ‘sharp-k’ is ‘always found in the nasal compound nk, e.g. nanku, inkabi and further occurs in a limited number of words apart from n, e.g. kaka (k’á:k’a), i(li)kati (ilik’ázi’ì).

Giannini, Pettorino and Toscano (1988) conducted a phonetic study of two speakers of Zulu, and analyzed the velar ejective /k'/, which is ejective in root initial position. Non-initially, however, spectrograms of /k'/: ‘show glottal vibrations during the steady state and a weak burst of noise immediately followed by the vowel (VOT = 0)’ (1988:104). Giannini et al. note that the ejective ‘has all the acoustic characteristics of a velar voiced’ stop, and thus use the IPA symbol [g] to describe the intervocalic velar ejective. It thus appears to be another case of intervocalic ejective voicing. Rycroft (1981:B4), cited in Giannini el al. (1988:100), also noted that the voiced [g] form of /k'/ ‘is never found root-initially or after a nasal’, though he noted that elsewhere it varies freely with ejective [k'].’ (See also Doke 1967:92). Thus Zulu also shows evidence of a rule voicing intervocalic velar ejectives, in a way similar to Xhosa ejective voicing.

Ziervogel (1952:3) offers two other potential cases of ejective voicing. In Swati (Swazi), another Nguni language, the velar ejective in non-root-initial position ‘has no aspiration and can easily be mistaken for g’ and could be regarded as semi-voiced, as shown in the following examples:

(15) k'ubu[g]a ‘to look’ k'anga[g]i ‘how often?’

It is unclear what evidence there is that this sound is underlyingly an ejective.

In addition, the sequence /nt'/ tends to be deglottalized to /nt/ ‘which is often heard as nd’ (Ziervogel 1948, 1952). Thus the word for ‘water’ is variously given as /emant'ḭ - emantí - emandi/. It thus appears that these sounds are in free variation. The ejective voicing in this environment appears to take place in two steps. David Odden (p.c.) informs me that after nasals, both ejectives and aspirates become phonetically voiced, based on his waveform analysis of one speaker. Thus it seems that postnasal
ejectives deglottalize, and this rule of deglottalization feeds a rule of postnasal voicing. This voicing, however, lacks the tonal depressor effect of underlying voiced consonants.

In sum, we have seen a variety of Southern Bantu languages which have alternations or free variants between ejectives and voiced stops. Some were morphologically irregular, while some seemed to be a fact of phonetic implementation. Ejective voicing could be explained in these cases as the spread of voice from a preceding vowel or morpheme; there was no evidence for direct feature-changing.

7.3.4. Free Variation
There are several cases of synchronic free variation which do not appear to be rule-governed alternations. In this section we will examine data from Georgian, Coast Tsimshian, Slave, and minor cases in South Semitic.

Vogt (1958:28) notes that there are many pairs in Georgian involving variation between ejective-sonorant-ejective clusters, where the ejectives are identical, and voiced-sonorant-ejective clusters. Such variation is never contrastive (though of course ejectives and voiced stops are contrastive in other positions, e.g. /k'an/ vs. /gan/ – the names of the respective letters, or /k'lasi/ ‘class’ vs. /gleξi/ ‘peasant’). For example:

\[
\begin{align*}
\text{(16)} & \quad \text{p'rp'eni} \sim \text{brp'eni} \quad \text{brp'eni} \quad \text{brp'eni} \quad \text{brp'eni} \\
& \quad \text{ts'rts'na} \sim \text{ts'rts'ola} \sim \text{dzrts'ola} \\
& \quad \text{k'rk'ali} \sim \text{grk'ali} \\
& \quad \text{k'rk'inva} \sim \text{grk'inva}
\end{align*}
\]

The case is thus one of phonemes in free variation. It is difficult to tell which form is basic, and thus whether there is dissimilative voicing, or whether there is laryngeal assimilation. Vogt says that in many cases only the ‘redoubled’ (identical consonant) forms exist, especially in verbs of an expressive character (1958:29).

Coast Tsimshian (Dunn 1979), a Penutian language, has voiced, voiceless, and ejective plosives, as well as glottalized sonorants. Regarding the ejective series, Dunn notes that ‘glottalized segments often simplify by losing the glottalization and then becoming voiced’ (1979:12). Dunn does not, however, provide evidence that this process is accomplished in two steps, though I assume this is correct. He gives the following examples of free variation, which I have modified slightly to conform to the IPA:

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Dunn also notes that the ejective uvular may become a voiced uvular or sometimes velar stop, in reduplications:

(18)  
| q'ojlq     | galgoliq | 'dull' |
| q'os       | gasgos   | 'jump' |
| q'oomtk    | gaxgoomtk | 'hope' |
| q'wąs     | qwisgwas | 'break' |

He also gives /q'odź/ 'slice' and the reduplicated form /q'odźq'odź/ 'butcher (iterative)', again suggesting that the process is not obligatory, but is in free variation.

Rice (1989) reports that Slave (Athabaskan) ejectives are usually strongly glottalized but 'they are often voiced intervocally', e.g. /kots'é/ 'to there' varies between [kots'é] and [kodzé], /ʔetlu/ is optionally realized as [ʔetlu] 's/he knows', and /tʰu k'ê/ can be pronounced [tʰu ge] 'on the water' (Rice 1989). Rice (p.c.) points out that in Slave, voiceless unaspirated stops are voiced intervocally, and that ejectives have 'a tendency to merge with the voiceless unaspirated ones, so [they] could be voiced intervocally.' Apparently in Slave, voicing is accomplished in two steps: one for deglottalization, and then another step of voicing of voiceless unaspirated consonants—those segments with no Laryngeal node.

Johnstone (1970:296) notes that the Modern South Arabian (MSA) language Sheri has an interdental ejective fricative [Ø'] which is in free variation with a sound symbolized by <đ>, which is 'a not wholly voiced dental fricative...enunciated with the blade of the tongue on the upper teeth'. For example, the word for 'on' is either [đir] or [Ø'ir] (Johnstone 1975:156). This is apparently a relatively unusual case of (partial) voicing of ejective fricatives. Johnstone (1975:6) also claims that the post-glottalized
(ejective) consonants of MSA have ‘partially voiced and more wholly voiced variants’. He also notes that:

‘native speakers seem to have difficulty on occasions in distinguishing between certain of these voiced variants of glottalized consonants and their non-glottalized (voiced) correlates. This is particularly so in regard to the “contrasting” pair s/z, though to my ear there is considerably more tenseness involved in the articulation of s’” (1975:6).

Clearly, this impressionistic data calls for more formal instrumental analysis and systematic investigation (see also §7.6.3). But it is one more clue to the variation between ejectives and voiced consonants.

Finally, Palmer (1965:6) reports in Tigre of ‘alternation in terms of voice and ejection with respect to two successive consonants in the same word’ in the following two examples: /fatok’ - fodag/ ‘creek’ and /maftak’ - mafdag/ ‘check’. These alternations, however, are not systematic and seem to be restricted to the words listed above.

7.3.5. Summary

In sum, synchronically, we have seen some evidence for the voicing of ejectives. The two Salish languages offered interesting comparisons in that in Tillamook, the ejective changed features to another underlying feature: [voice]. This process was clearly deglottalization followed by voicing, a rule needed independently. In Columbian, ejectives voiced, but purely allophonically, and so this was analyzed as the spread of [voice] and dissociation of [c.g.]. In both cases the change was conditioned by a following vowel. Lezgian offered interesting, though morphologically conditioned, alternations. It also provided strong evidence that [voice] may act as a default consonant, adding credibility to the two-part analysis.

In the Nguni languages, the velar ejectives appear to change regularly, but these are not the place of articulation we would expect to undergo voicing. Remaining cases of voicing involve special morphological restrictions, random variation, and idiosyncratic properties of certain lexical items. However, in no case was a direct feature change of the type [c.g.] → [voice] required. Assimilative spread with dissociation, or delinking followed by default or spread were sufficient to account for these changes.
7.4. Historical Alternations

7.4.1. Loanwords

Schmidt (1991) discusses the process of ejective dissimilation in Svan, a Kartvelian language (discussed also in §6.4.1). In all the Kartvelian languages, there is only a three-way stop system of voiceless (aspirated), voiced, and ejective stops. The voicing is prompted by a dissimilation as far back as Proto-Kartvelian in which co-occurrence of two ejectives is avoided (Schmidt 1991:480). In Svan, too ‘there is a strong tendency to dissimilating voicing of one of two ejectives’:

<table>
<thead>
<tr>
<th>Georgian</th>
<th>Svan</th>
<th>Gloss</th>
</tr>
</thead>
<tbody>
<tr>
<td>k'ak'-ali</td>
<td>gak'</td>
<td>‘walnut’</td>
</tr>
<tr>
<td>p'ap'a (Mingrelian)</td>
<td>bap'</td>
<td>‘priest’</td>
</tr>
<tr>
<td>p'et're</td>
<td>bet're</td>
<td>‘Peter’ (Rogava 1982)</td>
</tr>
<tr>
<td>k'ots'aχur-i</td>
<td>gots'χir</td>
<td>‘barberry’ (Topuria 1967:79)</td>
</tr>
</tbody>
</table>

In Svan there seems to have been a rule or constraint that prohibited two ejectives within a root.

There is another example of a different sort of change, perhaps from an earlier period of loans:

(20) Georgian /tʃ'ak'i/ → Svan /tʃ'äg/ ‘mare’ (Schmidt)

This example does not dissimilate the first consonant, as the others did, but rather it is the second ejective which becomes voiced. The Svan phonemic inventory does have a voiced palato-alveolar affricate, so the problem does not involve the creation of ill-formed representations.

The Svan examples are interesting since the dissimilation went to another marked class, voiced stops, instead of to the usually unmarked voiceless stops. A similar phenomenon occurs in Georgian loanwords in Ossetian.

Rogava (1982), using data from the work of Akhvlediani, noted that of two ejectives or aspirates borrowed into Ossetian from Georgian, one became voiced in the second period of loans.
(21) **Georgian**  
Georgian Ossetian Gloss
---
p'it'na bit'ana ‘mint’
t'ik'i dik'i/ditj'i ‘wineskin’
p'ark'i bark'i/bartj'i ‘small bag, little sack’
k'ot'oji got'osi ‘banočka (for bloodletting)’
p'et're bet're ‘Peter’
p'at'ara liaxvi bat'ara liaxvi ‘Malaja Liaxvi (river)’

In Ossetian, there were a few words with two voiceless (aspirates) in Georgian in which the first became voiced as well: Georgian /kotjora/ became Ossetian /gošora/ ‘crested’. Rogava did not give examples of loans from the second period with voiceless consonants that were not followed by another voiceless consonant to show that this change was in fact dissimilative, and not simply the indiscriminate voicing of the initial consonant of all loans.

It should be emphasized that these processes apply only to loanwords. Rogava (1982) notes that such dissimilation is characteristic of Kartvelian languages in Georgian loanwords of Svan, in loanwords of Georgian dialects, and in words borrowed into Old Georgian from other languages (e.g. Greek παράκλησις, which normally would have yielded /p'arak'lis/, became in Old Georgian /barak'lis/).

In loanwords there is another similar process of dissimilation of what in Rogava’s analysis are two ‘voiceless’ consonants in a cluster (ejectives and voiceless aspirates), the second of which voices:

(22) Georgian Svan Gloss
---
laf'k'ari lafgår ‘army’
skeli sgeli ‘thick’
ʃkeri ʃger ‘Black Sea rhododendron’ (Rogava 1982)

Here we have both voiceless stops and an ejective becoming voiced after strident fricatives. If we must think of /s/ and /k/ as voiceless, it would be difficult for the privative theory to handle these cases, since both consonants would lack Laryngeal nodes. Furthermore, there would be a difficulty in unifying both ejectives (with a Laryngeal node specified for [c.g.]) and voiceless stops undergoing the same change to voiced. David Odden (p.c.) suggests that this could also be analyzed as simply a case of
neutralization in which neither aspirated nor glottalized consonants could occur after sibilants (or perhaps [+spread] fricatives). It would be typologically unusual for the neutralization to favor [voice] (see Lombardi 1991), but the other account is also unusual. Unfortunately I could not find additional data to provide more specific data to test.

There are also a few instances of dissimilation in Amharic documented by Leslau (1995:26-7; see also 1997b:415-16). For example, what he calls contiguous dissimilation can be found in the variation between /ak’t’a t’ja’ a/ ~ /agt’a t’ja’ a/ ‘direction toward something’. Such dissimilations can also involve voicing the dissimilating consonant, often in loanwords, as in /k’ant’ar ~ gant’ar/ ‘quintal’, /k’unt’at’o ~ k’undød’o/ ‘top of a tree or head’, /t’ărăp’p’eza ~ t’ărăbbeza/ ‘table’ (Gk. /trapeza/), /as’ā p’at’os ~ as’ābat’os/ ‘raspberry bush’, and /wăk’k’ät’ā ~ wāgğät’ā/ ‘pound’.

7.4.2. Elective Changes to Voiced Obstruent

In an attempt at constraining sound changes to conform with ideas of naturalness, Picard (1994, 1995) has formed a principal of minimality which states that a consonant sound change can never involve more than one of its major phonetic properties of voicing, place, and manner of articulation. He claimed that the shift of *T’ to D ‘is in clear violation of this constraint’ (233). However, if we view this from a phonological point of view, all that is changing are the laryngeal features, the features which correspond to only one of the ‘major phonetic properties’ of a sound. So Picard’s criticism is invalid; for further criticism of Picard’s claims, see Joseph and Wallace (1993). I have argued in §7.3 that phonologically, the change from ejective to voiced should be expressed either in two parts: delinking and feature insertion, or spreading and dissociation, so that the power of feature changing may be minimized. But the change itself involves only a change in laryngeal state. Phonetically of course, there are differences involved in not only vocal fold vibration, but amount of constriction, tension of the vocal folds, movement of the larynx, and so on. But the question remains whether ejectives may become voiced.

Since sound change and phonological rules permit the creation of new segments, such as the palatalization of velars in Old English, e.g. ceosan; phonemic split, such as the Old English voiced allophones of fricatives becoming phonemic; the merger of categories, e.g. loss of umlaut in OE /y:/ > /u/; and chain shifts in both vowels (the Great
Vowel Shift) and consonants (Grimm’s Law), then it should not be difficult to accept the possibility of the change of ejective to voiced, especially when place of articulation, continuance, sonorancy and more, are all preserved. Deglottalization as we saw is the loss of a laryngeal feature, [e.g.]. Voicing of ejectives is simply the substitution of one feature [voice] for another, [e.g.], perhaps by way of feature loss followed by spread of [voice] from an adjacent vowel in a structure-filling way.

While critics have questioned the possibility of ejective voicing, Job (1995) points out that the commonness of the change from ejective to voiced has been overstated by the Glottalicists. Gamkrelidze and Ivanov (1972), cited in Job (1995), simply allude to the ‘sonorization of the glottalized [stops] in a number of North Caucasian languages’. Gamkrelidze and Ivanov (1973:154) refer to the change in ‘several’ (einigen) Caucasian languages. Hopper (1977) cites Gamkrelidze and Ivanov (1973) and their ‘discovery of such a change in certain Caucasian languages’. In the next sentence, this becomes ‘the interesting possibility that the change is characteristic of the Caucasian area’ (emphasis added).

In support of the change from ejective to voiced required by the Glottalic Theory, Gamkrelidze and Ivanov (1995) present fairly complete data from Nakh, but only sporadic examples from Northeast Caucasian, a passing reference to Northwest Caucasian, a few examples of dissimilative voicing in loanwords from Svan and Ossetic (discussed in §7.4.1), an allusion to Archi (§7.3.2), and reference to Arabic *q > g. We will begin by examining the Nakh data, which is some of the strongest and best documented evidence for the voicing of ejectives. Then we will evaluate the other cases cited by Gamkrelidze and Ivanov in §7.4.2 on the Caucasus. Then we will review other putative cases of diachronic ejective voicing in languages of the Americas (§7.4.2.2), and Africa (§7.4.2.3). We will conclude, with Job (1989:129), that there is no indisputable instance of unconditional change of the type *t' > d. However, Salmons (1993:53) surely overstates the case that ‘reconstructing ejectives leaves us with a natural gap without [attested] sound changes’. There are some strong examples of conditioned change, and examples of deglottalization followed by voicing.

7.4.2.1 The Caucasus
Chechen, Ingush, and Bats (or Batsbi or Tsova Tush) are the three Nakh Caucasian languages. Chechen and Ingush are more closely related to each other than either one is to Bats. Gamkrelidze and Ivanov posit that Chechen and Ingush non-initial ejectives

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changed to voiced stops, while Bats maintains the Proto-Nakh ejectives in this position. They cite this as one of the more convincing examples of the precedent for the sound change ejective to voiced, which is required by the Glottalic Theory. Although the position that ejectives voiced is somewhat controversial (cf. Dešeriev 1963, Imnajšvili 1977, Job 1989, and Matasović 1994), scholars such as Sommerfelt (1938), Črelašvili (1975a,b), Nichols (1993, 1995), and Fallon (1993) argue that the direction of change must have been from proto ejective to voiced stop.

In initial position, all three stop series (ejective, aspirated, and voiced) correspond. For example, I illustrate this with the coronal stops, with data from Sommerfelt (1938) unless otherwise indicated:

<table>
<thead>
<tr>
<th>(23)</th>
<th>Bats</th>
<th>Chechen</th>
<th>Ingush</th>
<th>Gloss</th>
</tr>
</thead>
<tbody>
<tr>
<td>date</td>
<td>dät:i</td>
<td>dät:a</td>
<td>'butter'</td>
<td></td>
</tr>
<tr>
<td>t'um</td>
<td>t'um</td>
<td>t'um</td>
<td>'marrow'</td>
<td></td>
</tr>
</tbody>
</table>

In non-initial position, the Nakh voiceless stops all correspond; a few examples are shown in (24a). The voiced stops in Bats correspond to zero or a glide in Chechen-Ingush (24b).

<table>
<thead>
<tr>
<th>(24)</th>
<th>a.</th>
<th>Bats</th>
<th>Chechen</th>
<th>Ingush</th>
<th>Gloss</th>
</tr>
</thead>
<tbody>
<tr>
<td>k'nat</td>
<td>k'ant</td>
<td>k'ant</td>
<td>'boy, young man'</td>
<td></td>
<td></td>
</tr>
<tr>
<td>latsar</td>
<td>latsar</td>
<td>latsar</td>
<td>'to have'</td>
<td></td>
<td></td>
</tr>
<tr>
<td>zok</td>
<td>zək</td>
<td>zək</td>
<td>'beak'</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>b.</th>
<th>Çabik'</th>
<th>Çajg</th>
<th>Çaig</th>
<th>'spoon'</th>
</tr>
</thead>
<tbody>
<tr>
<td>qadal</td>
<td>qela</td>
<td>qal</td>
<td>'mare'</td>
<td></td>
</tr>
<tr>
<td>saq</td>
<td>saj</td>
<td>saj</td>
<td>'deer'</td>
<td></td>
</tr>
</tbody>
</table>

The non-uvular ejectives in Bats correspond to voiced stops in Chechen and Ingush. The data below is taken from Sommerfelt, except where an asterisk indicates data corrected by Nichols in Gamkrelidze and Ivanov (1995:45-6). Nichols (1994a) states

5 Nichols' translator's note in Gamkrelidze and Ivanov (1995:45 fn 61) observes that this is a loan from Ossetic /sag/.
that in final position, a voiced manner of articulation reflects the Proto-Nakh and Proto-
Nakh-Daghestanian glottalized series. Where possible, I have tried to find what I feel is a
likely cognate from the Daghestanian data in Bokarev (1981), or Kibrik and Kodzasov
(1990), for which I have used the following abbreviations: CA = Chadakolob Avar and

(25) Nakh Ejectives in Non-initial Position

<table>
<thead>
<tr>
<th>Bats</th>
<th>Chechen</th>
<th>Ingush</th>
<th>Gloss</th>
<th>Daghestanian</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) nʕap’</td>
<td>naːb</td>
<td>naːb</td>
<td>‘sleep’*</td>
<td></td>
</tr>
<tr>
<td>qap’u, qaup’</td>
<td>qōbu</td>
<td>larva</td>
<td>‘worm’</td>
<td></td>
</tr>
<tr>
<td>(b) fat’</td>
<td>jad</td>
<td>jod</td>
<td>‘knot’</td>
<td></td>
</tr>
<tr>
<td>fat’</td>
<td>jada</td>
<td>joda</td>
<td>‘pitchfork’</td>
<td></td>
</tr>
<tr>
<td>jwet’</td>
<td>jad</td>
<td>jod</td>
<td>‘whip’</td>
<td>GC ţsat’án</td>
</tr>
<tr>
<td>let’ar</td>
<td>liedar</td>
<td>liedar</td>
<td>‘flow’* (cont’d)</td>
<td></td>
</tr>
<tr>
<td>sart’ar</td>
<td>sardam</td>
<td>sardar</td>
<td>‘a curse; to curse’</td>
<td></td>
</tr>
<tr>
<td>bat’er</td>
<td>bald</td>
<td>bord (&lt;<em>bader)‘lip’</em></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(c) ḫ’anik’</td>
<td>ḫ’enig</td>
<td>ḫ’eng</td>
<td>‘chin’*</td>
<td>Andi ḫ’ank’ala</td>
</tr>
<tr>
<td>phak’al</td>
<td>phagal</td>
<td>phagal</td>
<td>‘hare’</td>
<td></td>
</tr>
<tr>
<td>dak’ardar</td>
<td>dagar-d-ar</td>
<td>dagar dar</td>
<td>‘to count’</td>
<td></td>
</tr>
<tr>
<td>dak’ dar</td>
<td>dagar</td>
<td>d-agar</td>
<td>‘to burn’</td>
<td></td>
</tr>
<tr>
<td>mak’ar</td>
<td>magar</td>
<td>magar</td>
<td>‘to be able’</td>
<td></td>
</tr>
<tr>
<td>țsark’</td>
<td>țserg</td>
<td>țserg</td>
<td>‘tooth’</td>
<td></td>
</tr>
<tr>
<td>dok’</td>
<td>dwog</td>
<td>dwog</td>
<td>‘heart’</td>
<td>Andi rok”’o (N93)</td>
</tr>
<tr>
<td>dik’</td>
<td>dig</td>
<td>dig</td>
<td>‘axe’</td>
<td>Lak rik”’ (N93)</td>
</tr>
<tr>
<td>(d) k’atš’</td>
<td>k’ezi</td>
<td>k’aza</td>
<td>‘puppy’*</td>
<td>GC k’unț’á</td>
</tr>
<tr>
<td>daš’i</td>
<td>d-ezi-</td>
<td>deza</td>
<td>‘dear, difficult’</td>
<td></td>
</tr>
<tr>
<td>maš’</td>
<td>mezi</td>
<td>maza</td>
<td>‘louse’</td>
<td>CA nats’</td>
</tr>
<tr>
<td>laš’ar</td>
<td>lazar</td>
<td>lazar</td>
<td>‘to be sick’</td>
<td>Archi aš’is’a (B81)</td>
</tr>
<tr>
<td>haš’uk’</td>
<td>hozu</td>
<td>hazilg</td>
<td>‘sparrow’</td>
<td></td>
</tr>
<tr>
<td>maš’ri</td>
<td>marza-</td>
<td>merza</td>
<td>‘sweet, sugared’</td>
<td></td>
</tr>
<tr>
<td>d-utš’</td>
<td>d-uz</td>
<td>d-yz</td>
<td>‘fill’</td>
<td>Lak utš’ (N93)</td>
</tr>
</tbody>
</table>
Job 1981 concluded that the change ‘ejectives to voiced stops in Nakh had to be abandoned’. However, implicit in this view is a change from voiced stop to ejective, criticized by Fallon (1993) as phonetically implausible, though perhaps not impossible. This view also has no principled explanation for the Morpheme Structure Condition in Chechen and Ingush in which ejectives generally do not occur finally or medially. If we accept that non-initial ejectives became voiced, then we have a principled explanation for the distribution of ejectives. Finally, Job’s view defies Occam’s Razor in that Bats would preserve alleged Nakh-Daghestanian voiced plosives, while most other languages ejectivized them. It is clearly preferable to presume the voicing change for Chechen-Ingush.

It is highly likely that the intervocalic deletion of the voiced stops and the voicing of ejectives could be conceived of as part of the same lenition process. It is possible, as Odden (p.c.) has suggested, that the ejectives were deglottalized and that the resulting voiceless unaspirated stops were reinterpreted as voiced stops. Perhaps this is a more common phonetic path. But it is also possible to view the voicing as derivative from the adjacent vowels, and thus as the spread of [voice]. What is important for the Glottalic Theory is to establish that the changed from ejective to voiced is both possible and plausible. The Nakh data, however, simply show a conditioned sound change for non-uvular ejectives; they do not show the unconditioned loss of ejection required by the Glottalic Theory.

Gamkrelidze and Ivanov note that ‘similar correspondences’ (between ejectives and voiced obstruents) are found in Northeast Caucasian, citing the following data:
(26) a. Avar /tsts'ar/ ‘name’
    Rutul /dur/
    Caxur /do/

b. Archi /moJot/ ‘beard’
    Rutulian /miJoti/
    Lak /Otiri/
    Tabassaran /midzit/
    Agul /mudzur/

See also Nichols (1993) and Kibrik and Kodzasov (1990:212). Bokarev (1981:108) lists several correspondences between Tabassaran (Tab.) voiced affricates and other Daghestanian cognates with ejectives, e.g. Avar /mots/ vs. Tab. /vaz/ ‘moon’.

Gamkrelidze and Ivanov also note, citing Giginejšvili (1973, 1977:106), that the Proto-Daghestanian fortis ejective affricates yield (some) voiced stops pretonically, and voiceless stops posttonically, though no language is mentioned:

(27) *tstst’, *tjtj’, *q’q’, *ttd’ →
    d, ?, q’, g  Pretonically
    t, tj, q, k  Posttonically

No specific examples are even provided. Some examples, however, were included above in (25), while others are from Nichols (1993):

(28) *tst’s’ → d  *tsts’ Vr ‘name’ > Rutul /dur/, Caxur /do/>
    3 *aR[tj]’i ‘right (adj.)’ > Burkixan Agul /hardzal/
    g *ttlt ’in-i ‘winter’ > Chirag Dargi /ga/ (cf. Lak /k’w’i/)
    *(CV)=(lV)tltl’  ‘meat’ > Chirag Dargi /dik/ (cf. Lak /dik’/)

See also Bokarev (1981), and Kibriv and Kodzasov (1990), which was the source for much of Nichols’ reconstructions.

Gamkrelidze and Ivanov quote Colarusso (1975:82), who notes that in East Circassian, when an unaspirated series is lost, voicing or aspiration in the non-glottalic series may be a sufficient cue to distinguish that series from the ejectives, which may in turn be realized as ‘laryngealized or unaspirated’. Colarusso’s footnote to this statement
notes that 'this is only a possibility'. He states that in Armenian, some dialects have 'strongly ejective glottalic, laryngealized glottalic, and unaspirated realizations of the unaspirated, unvoiced series' (114). He goes on to observe that Ubykh and Georgian 'have taken advantage of such a shift in the glottalic series'. No actual data or references are given, and the referent to 'such a shift' is ambiguous between laryngealized and unaspirated. Therefore this evidence based on this citation is highly tentative.

The other evidence (discounting Indo-European since its cases assume an ejective reconstruction which is still being evaluated) includes voicing in loanwords from Svan and Ossetic (§7.4.1), and Archi (§7.3.2). Their final claim regarding Proto-Semitic will be examined in §7.4.2.3.

Colarusso (1981) comments on the shift of *t’ to /d/ posited for the Glottalic Theory:

' [The Glottalic Theory] does have a precedent in NWC [North West Caucasian] (cf Colarusso [1988] 1975:82-3). In Kabardian, /p’, t’,.../ have "Knarrstimme" or creaky voicing (cf Kuipers 1960:19-20)6. In some Abaza dialects, this has given rise to voiced segments in certain positions. Contrast the standard Abaza forms in [29] (Sedjuechenko 1956:633) with the Anatolian dialect forms in [29] (Allen 1956 and 1965h). In [Anatolian], the standard stative present /-p’/ and the active present /-j-t’/ are shifted to /-h/ and /-j-d/ respectively.'

Lomtatidze and Klychev (1989:110) also briefly mention this correspondence, though they call /-p’/ the present finite stative ending and /-(j)t’/ the dynamic verb finite ending. Colarusso (1981) gives the following examples:

(29) Standard Abaza Anatolian Abaza

a. /s-tj’j’w-a-p’/ /s-tj’j’w-a-b/ 'I sit, I am sitting'

b. /s-t’-j-t’/ /s-t’-j-d/ 'I write, I am writing'

Compare the closely related language Abkhaz, which, like Standard Abaza, has ejectives for its finite suffixes:

6 The Committee of American Anthropological Association (1916:15) described glottal trill as 'a vowel broken up by a rapidly succeeding series of glottal closures (German Knarrstimme)' and 'may be indicated by putting the apostrophe over the vowel.' This sounds like a laryngealized vowel. Apparently, the term Knarrstimme has been extended to include consonants as well. Kuipers (1960:19) defined it simply as 'a kind of glottal trill'.
(30) ba(rà) bə-pcədžə-w+p’ ‘you.Fem you.Fem-beautiful-STAT.Pres’
də-q’a-a-z+ə-wa-jt’ ‘(s)he will be’ (Hewitt 1989b:52)

The more distantly related Ubykh (Charachidze 1989) also has the suffix /-jt’/. The fact that Ubykh, Abkhaz, and Standard Abaza all share the ejective suffix(es) point to an innovation in Anatolian Abaza, and thus are another instance of the voicing of ejectives. The change apparently occurred only in these two morphemes, however.

Finally, Georgian has sporadic voicing of ejectives, some as the apparent result of a change from Old Georgian to Modern Georgian, and others as dialectal variants. A few of the examples which Neisser (1953:7-8) provides are given below:

(31) k’at’uni > Psavian dialect uaduni ‘wildcat’
t’unt’ruk’i > dundruξa ‘fat, full’
īs’up’ak’i > ǳubaξi ‘coarse’
p’elentś’uk’a > beledžuxa ‘ugly, dirty’

However, this apparently dissimilative voicing was not regular or rule-governed.

7.4.2.2. The Americas
The language Jicaque (Toi) figures in several proposals published in the literature for correspondences between ejectives and voiced stops. First, the reconstruction of Proto-Jicaque suggests a process of ejective voicing in the Western Jicaque dialect. Second, there is a correspondence between Jicaque ejectives and Tequistlatecan voiced stops. Finally, there is a controversial correspondence between Jicaque ejectives and Subtiaba voiced stops.

Proto-Jicaque was reconstructed by Campbell and Oltrogge (1980), based on two languages: Western Jicaque (WJ) of El Palmar (now extinct), and Eastern Jicaque (EJ) or Tol, spoken by 300 persons in Montaña de la Flor, Honduras. The reconstructed proto-phonemes are as follows:
The EJ ejectives correspond to WJ voiced stops in certain positions, as illustrated below, with the Proto-Jicaque (PJ) form provided where reconstructed. The data in (33) illustrate the bilabial (33a), the alveolar affricate (33b), and the velar ejective (33c).

(33)  

<table>
<thead>
<tr>
<th>PI</th>
<th>EJ</th>
<th>WJ</th>
</tr>
</thead>
<tbody>
<tr>
<td>a.</td>
<td>*p'i(j)</td>
<td>p'ij</td>
</tr>
<tr>
<td></td>
<td>-</td>
<td>p'uts(=); t'up'juts'i</td>
</tr>
<tr>
<td>b.</td>
<td>*p'aiś'</td>
<td>m-p'aiś'</td>
</tr>
<tr>
<td>c.</td>
<td>-</td>
<td>nits', ne?e</td>
</tr>
<tr>
<td></td>
<td>*pik'a(he)</td>
<td>pi?a-he</td>
</tr>
<tr>
<td></td>
<td>*-t'ek'a (?)</td>
<td>?ja, ?eja, ?oja</td>
</tr>
<tr>
<td></td>
<td>?</td>
<td>?inan</td>
</tr>
<tr>
<td></td>
<td>*k'os (?)</td>
<td>?os ('I sit, I am')</td>
</tr>
</tbody>
</table>

The alveolar ejective *t' does not have voiced reflexes, e.g. EJ /t'i/ 'to cut' vs. WJ /uté/. The environment for ejective voicing is unclear, especially with relatively few examples provided. It appears that ejective voicing took place postvocically. One exception is the first form in (33a) *p'i(j) 'body', which, as Campbell and Oltrogge note, may have had a nasal prefix before it. Another exception is *k'os 'to be', which may not be a cognate.

---

⁷ Campbell and Oltrogge (1980:209) speculate that if this is a true cognate, perhaps the voicing is due to the 'inalienable possession of body parts—in this case perhaps it had n-my.'

⁸ This data is listed under reflexes of *ts' in part because of dialectal forms within Tol. However, given the reflexes between EJ /ts/ and the voiced velar in WJ, it can also illustrate ejective voicing from *k'.
Campbell and Oltrogge (1980:209) state that the conditioning environment of the velar ejective in WJ (33c) is that it voices after a voiced consonant with an optional intervening vowel (presumably to account for /tenegé/ 'to sing', and it voices intervocally, as in /pugahe/ 'cougar'. One form which undermines this is the putative cognate 'to be', which shows voicing in initial position (with the same glottal stop reflex in EJ). Usually in initial position, there is deglottalization of velars in WJ, while finally, there is deletion:

(34)    PI    EL    WI
    *k'as       ?as       kat       'blood'
    *k'awa       ?awa       kouf, ko       'fire'
    -       ?ono, ?ona       koné       'sour'
    -       ?an       kan       'zapote'
    *sok'       sok'       ti'oo       'tail'

Likewise, the usual reflexes of the non-velar ejectives show deglottalization:

(35)    PI    EL    WI
    *p'is       p'is       puet       'deer'
    *p'isa(h)       p'isá       podtjá       'macaw'
    -       t'i       ute       'to cut'
    *tit'       tit'       tet       'louse'
    *tš'il       tš'il       tš' in       'hair'
    *tš'ul       tš'ul       oʃ'oun       'intestines'

Note, however, that the form for 'louse' *tit' does not show the expected voicing reflex in WJ. Therefore the conditioning environment of all ejectives is not simply after a voiced consonant or intervocally; (33) shows voicing in initial and final position as well and therefore appears relatively unpredictable, though it is often intervocalic.

Of some relevance to the voicing of the ejectives is the behavior of the voiceless pulmonic stops, which are voiced after a voiced consonant, with an optional intervening vowel. The data in (36) show the plain voiceless stops in (36a)-(36c), while the aspirated bilabials are shown in (36d), and the velar, in (36e). There are only a few examples of *tʰ, which generally shows deaspiration, e.g. EJ /petʰel/ vs. WJ /peten/ 'wasp', even where we might expect voicing.
The Jicaque data support a two-part analysis of ejective voicing. First, Western Jicaque completely lost [constricted glottis] as a distinctive feature. Second, in certain voiced environments such as after a voiced consonant or a vowel, there is voicing of both the deglottalized ejectives and the voiceless consonants—temporarily merged, since phonologically speaking, neither has a Laryngeal node. There is some minor variation by place of articulation, and in certain environments, the aspirates also voiced. But WJ is a language which holds an important precedent: complete loss of glottality, though with (conditioned) voicing of the (former) ejectives.

The second set of correspondences which show ejective voicing occurs in Oltrogge’s (1977) reconstruction of Jicaque-Tequistlateco. Campbell and Oltrogge (1980) believe that this relationship ‘will hold up’ and ‘is certainly worth much additional investigation’ (223). Campbell (1997:325) assigned a +65% probability of a relation between the two languages, with a confidence level of 50%.

The obstruents of Tequistlateco (Chontal of Oaxaca) are as follows:

<table>
<thead>
<tr>
<th>(37)</th>
<th>p</th>
<th>t</th>
<th>s</th>
<th>ʃ</th>
<th>k</th>
<th>?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>s’</td>
<td>ʃ’</td>
<td>k’</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b</td>
<td>d</td>
<td>g</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>f</td>
<td>s</td>
<td>i</td>
<td>j</td>
<td>h</td>
<td></td>
<td></td>
</tr>
<tr>
<td>f’</td>
<td></td>
<td>i’</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

In a binary comparison between Jicaque and Tequistlateco, Oltrogge reconstructs the Proto-Jicaque-Tequistlateco (PJT) consonants as follows:
Oltrogge posits a PJT *t' from a single Jicaque/Tequistlateco correspondence t'/d:

(38) p t t's k ?
   pʰ t'sʰ kʰ
   pʰ t t's k'

Jicaque
   Tequistlateco

Oltrogge implies a sound change from ejective to voiced in Tequistlateco, which lacks an alveolar ejective, but which has an otherwise robust glottalic series: /tʰ t's tʃ k' tʃl/, in addition to a voiced and a voiceless series.

Oltrogge admits that evidence for PJT *t' ‘is admittedly weak’ but believes it can be defended, since the rest of the reconstruction for ‘to cut’ *t'eh contains more regular correspondences, and since the phoneme *t's changed to t's/ initially in disyllabic stems in Tequistlateco. However, this defense rests in part on the ‘indeterminate nature of the voiced vs. voiceless contrast in Tequistlateco’ (1977:30). Citing Turner and Turner (1971:xiii), Oltrogge (1977:28) notes that the ‘Chontals vary the pronunciation of some words, varying from … voicing of the stop to voiceless and vice versa’. Voiced and voiceless stops apparently only contrast in very few places. Perhaps there is truly free variation, or perhaps there is a contrast but the voiced stops are phonetically voiceless unaspirated and variation is a product of the fieldworker. At any rate, the evidence for ejective voicing in Tequistlateco is weak, resting only on a single correspondence of dubious phonetic interpretation, which could in fact simply be deglottalization.

The final case of purported ejective voicing is controversial. It involves a binary comparison between Jicaque and Suhtiaa (Oltrogge 1977). Campbell (1979: 965; 1997:325) found Oltrogge’s evidence weak, and, in his estimate, the two languages have a 60% chance of being unrelated, a figure in which Campbell estimates his own 80%
confidence. He thus recommends that this proposal ‘be abandoned’. There is also a genetic dilemma, because if Tequislateco is Hokan, and Jicaque and Subtiaba are related, then Jicaque and Subtiaba, an Otomanguean language, must not be related. However, Oltrogge, following Rensch, assigns Jicaque, Subtiaba, and Tequislateco to the Otomanguean branch. Unlike Campbell, Oltrogge believes that Jicaque and Subtiaba share more similarities than Jicaque and Tequislateco. The evidence of ejective voicing is based on conditioned variation in only a single example.

In Jicaque-Subtiaba, Jicaque is conservative, preserving the voiceless unaspirated, the voiceless aspirated, and the ejective stops and affricates. Subtiaba has generally preserved the voiceless unaspirated stops, though they are voiced after nasals, but has introduced a new voiced series. The Subtiaba voiced stops arise from a variety of sources, including voicing of the bilabial aspirate, voicing of plain voiceless stops in intervocalic position, and voicing of the alveolar ejective. New voiceless obstruents come from deglottalized ejectives. Pulmonic and ejective affricates are deaffricated (and deglottalized), with palatalization before /u/.

Oltrogge gives the Jicaque: Subtiaba correspondence sets t’/t and t’/d. Recall that initially, Subtiaba voices the alveolar ejective, while elsewhere it deglottalizes it, as it does for the other ejectives.

(40) PJS Jicaque Subtiaba

* t’ > t’ : > d / initially
> t / elsewhere

In (41a) below, we can see initial voicing of the alveolar ejective – the only ejective to undergo such voicing. In intervocalic position, Subtiaba apparently deglottalizes the alveolar ejective.

(41a, b.)

\[
\begin{align*}
\text{Jicaque:} & & \text{Subtiaba:} \\
* t’ o?o[n] & \rightarrow & t’ o?o[n] & \rightarrow & t’ i \\
\text{t’o?o [‘to shut’]} & \rightarrow & \text{do:ko [‘to close’]} & \rightarrow & \text{t’i [(-spat):tu [‘to chop’]} \\
& \text{Jicaque} & \text{Subtiaba} & \text{Jicaque} & \text{Subtiaba}
\end{align*}
\]
In the first example, ‘to shut’, Oltrogge illustrates a Jicaque initial ejective which corresponds to an initial voiced stop in Subtiaba. In the second example, ‘to chop’, the Jicaque ejective corresponds to a voiceless stop, since in Subtiaba a prefix has been added and the ejective is no longer in initial position. Unfortunately, these are the only data for these correspondences.

In the Mayan languages, final ejectives in Cakchiquel appear to have undergone voicing in Yucatec:

(42)  

<table>
<thead>
<tr>
<th>Cakchiquel</th>
<th>Yucatec</th>
<th>Pocoman</th>
</tr>
</thead>
<tbody>
<tr>
<td>‘honey, bee’</td>
<td>kap’</td>
<td>kab</td>
</tr>
<tr>
<td>‘sandle’</td>
<td>saxap’</td>
<td>sanab</td>
</tr>
</tbody>
</table>

Thompson and Thompson (1985) compare Tillamook voicing with data from related Salishan languages. Recall from Chapter Six and §7.3.1. above that in Tillamook reduplications, ejectives in the base were voiced in the reduplicant. Apparently in some roots, too, there was also dissimilative voicing, compared to the roots in other Salishan languages.

(43)  

<table>
<thead>
<tr>
<th>Tillamook</th>
<th>Other Salish</th>
<th>Source</th>
<th>Gloss</th>
</tr>
</thead>
<tbody>
<tr>
<td>√dak’*’</td>
<td>√t’ak’*’</td>
<td>(Okanagan)</td>
<td>‘lie (down)’</td>
</tr>
<tr>
<td>√g’ats’</td>
<td>√t’sáq’*’</td>
<td>(Thompson – with metathesis)</td>
<td>‘wet’</td>
</tr>
<tr>
<td>wegéq’</td>
<td>wéq’eq’</td>
<td>(Klallam)</td>
<td>‘frog’</td>
</tr>
</tbody>
</table>

9 In the correspondence set Jicaque [?] to Subtiaba [k], it would make more sense, given what we have seen in Chapter 5 on Debuccalization, that Jicaque debuccalize a velar ejective or voiceless stop, than it would for Subtiaba to turn a glottal stop into a velar. Oltrogge reconstructs glottal stop in PJS on the basis of this one correspondence set ? : k. Other relevant sets and their reconstructions are as follows:

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>*k</td>
<td>k</td>
<td>g</td>
<td>in initial polysyllabic words and prefixes, after nasal;</td>
</tr>
<tr>
<td>*k’</td>
<td>k</td>
<td>k</td>
<td>elsewhere</td>
</tr>
</tbody>
</table>

Given the limited data one can only guess at a conditioning environment for such a debuccalization rule, though intervocalic position is a favorable one for debuccalization. The same would go for the correspondence set h : g, which Oltrogge reconstructs as *h.
McLendon (1964) discusses several correspondences between Eastern Pomo and Yana. There are two shifts of interest here. McLendon found four cases of bilabial ejectives corresponding to the voiced counterpart. For example, the Central Yana and Yahi bilabial ejectives correspond to the Eastern Pomo ejective:

(44) \begin{align*}
\text{Yana} & \quad \text{E. Pomo} \\
\text{p'uugi} & \quad \text{bu:kú} & \text{‘tule/pack basket’} \\
\text{p'asi} & \quad \text{ba:já} & \text{‘buckeye’} \\
\text{hap'alaa-} & \quad \text{bór} & \text{‘mud’} \\
\text{p'ulsu} & \quad \text{ji:biː} & \text{‘tail’}
\end{align*}

There were also three cases of the alveolar affricate ejective /ts'/ corresponding to a voiced affricate /dz/, although this time in Yana (E Pomo ‘bird’ /fi:s’iːjá/ vs. Yana /dzud?awi/; see also the sets ‘owl’ and ‘poke’). Although some affricates remained stable (alveolar, velar), and some shifted their place of articulation but maintained ejection (correspondences like q':k’ E Pomo q’o?:6: ‘doctor’ and Yana /k’uuwi/ ‘shaman, doctor’), it is interesting to note that there are correspondences (and presumably historical sound shifts) in Yana from ejective to voiced stop, though the direction of change remains uncertain and contradictory.

7.4.2.3. Africa

In this section, we begin by surveying some correspondences in Afro-Asiatic and other languages of Africa. We start with the Cushitic language Oromo, in which bilabial ejectives voice, and then move to Omotic, which has evidence of velar ejective voicing.

Stroomer (1987:13-14) reports the following correspondences between /b/ and /p'/ in his study of Southern Oromo dialects. Compare, for example, /rop'ii/ ‘hippo’ in Boraana dialect of Marsabit, Kenya and /robi/ in the Waata dialect of Malinda, Kenya. Compare also Boraana /kobee/ ‘shoes’ with Orma /kop’aani/ and Waata /kobaani/. BI = Isilio Boraana. Here follows a list:
Boranana        Gloss         Orma            Waata
\( \text{i} \text{tj} \text{a} \text{ba} \)  'to break s.t.'  \( \text{i} \text{tj} \text{a} \text{p} \text{a} \)          
\( \text{ko} \text{bee} \)  'sandals, shoes'  \( \text{korp} \text{aani} \)  kobaani 
\( \text{ko} \text{rbees} \a \)  'he-goat'  \( \text{korp} \text{eesa} \)  korp'eesa 
\( \text{tj} \text{o} \text{tj} \text{oba} \)  'to drop down'  \( \text{tj} \text{o} \text{tj} \text{op} \text{a} \)  'id.; to rain' 
\( \text{simp} \text{irree} \)  'bird'  \( \text{jimbirree} \)  jimbirree 
\( \text{dip} \text{uu} \) (BI)  'narrowness; trouble; need'  \( \text{dip} \text{oo} \) (mf)  'narrow' 
\( \text{seep} \text{ani} \)  'leather straps of a milk container'  \( \text{feep} \text{ani} \)  'storage rack for milk containers' 
\( \text{bees} \text{ee} \)  'money'  (Sw. pesa)  \( \text{p} \text{eesaa} \)  beesee (1987:19-20) 

Some correspondences between velar ejectives and voiced velar stops may be found in the Lowland East Cushitic languages, but sufficient data is lacking. For more, see Hayward (1984) and Heine (1978).

Bender (1987, 1988) notes that the reflexes of Proto-Omotic *k' in Janjero include deglottalization in initial position (see Chapter Four), and medial or final debuccalization or voicing. In other series, the bilabial ejective debuccalized, and the coronal ejective and ejective africate deglottalized. Thus Janjero has no glottalics (Bender 1988: 124). Here is an example of ejective voicing: Proto-Omotic *gonk' 'skin' is [g0qk'] in Mao, [goo(\text{n})k'] in Keléid but/googo/ in Janjero, /goga/ in Dizoid, and /go(i\text{n})ga/ in North Omotic (Bender 1988).

Fleming's (1988) study of Southern Omotic consonants yields a possible example of ejective voicing after a nasal:

(46)  Karo bank'i  Dime biŋ, biŋ-u, Hamar bannk  'spear'  (166)

Johnstone (1975) discusses Modern Southern Arabian (MSA) dialects, which displays a few apparently sporadic instances of ejective voicing. The sibilant ejective fricative seems to have voiced in Sheri in the following word:

(47)  Harsüsi  Mehri  Šeri  
\( \text{j} \text{os} \text{aws} \)  \( \text{d-j} \text{os} \text{aws} \)  es\'\text{od}  'he fears: the fish'
In another case, Sheri’s interdental ejective fricative corresponds to voiced stops in the other Modern South Arabian languages:

(48) Sheri  Ḥarsūsi  Mehri  
    ek’aθ’ar  k’āдуur  k’āдуur  ‘he was able: the leopard’

Finally, there are a few cases of the ejective /t'/ alternating with /d/:

(49) Ḥarsūsi  Mehri  Sheri  
    t’aad  t’aat’  t’ad  ‘one’ (Johnstone)

Leslau (1938) also noted some of this type of variation, some of it apparently in free variation in Soqot’ri:

(50) Soqot’ri /nidob/, /nidom/ ‘to fall’, vs. Mehri /nat’ab/  
    Soqot’ri /rk’d/ ‘to take’, dat. /rak’at’a/ ‘collect’ for /lak’at’a/;  
    Soqot’ri /jehŭk’ed/, /jehŭk’et’/ ‘he is impotent’, vs. Arabic /saqi’t/’

In Amharic, Cohen (1970:32) remarks that /p'/ is used only by cultivated speakers, while most speakers replace it with /b/: /t’arap’eza, t’arab’eza/ ‘table’ (or in one case, with /k'/).

The final piece of evidence which Gamkrelidze and Ivanov present as support for ejective voicing is of Proto-Semitic *q, which they interpret, following Cantineau (1952) and Martinet (1953) as *k’. They cite this distinction as responsible for Arabic qāl and gāl dialects (recall McCarthy’s analysis of this in §5.3.2.2) with respect to the representation of uvulars. Although a majority of scholars believe that Proto-Semitic had ejectives (Alan Kaye, p.c.), I am unaware of any scholar who believes that ejectives survived into Arabic, and that this alternation represents ejective voicing. Therefore this example should be discounted as evidence.

The last set of African data comes from Nilotic languages. Fleming (1983) is a preliminary work regarding relations of Kuliak to other Nilotic languages. However, there are a few correspondences of interest here. Note that there are other types of correspondences besides those listed here.
Several of these changes imply a shift from ejective to voiced plosive.

Berta (Bender 1989) has ejective, voiced, and prenasalized voiced stops, and an alveolar implosive, along with voiced and voiceless fricatives and an ejective fricative. Bender describes three main dialects in which there is a ‘frequent dialect correspondence’ between bilabial ejectives in Undu (U), which is less Arabized, and in Fandasi (F), and voiced bilabial stop in Mayu (M), which is more Arabized. He provides the following two examples:

(52)  

<table>
<thead>
<tr>
<th>U</th>
<th>F</th>
<th>M</th>
</tr>
</thead>
<tbody>
<tr>
<td>p'fida</td>
<td>bfidaa</td>
<td>‘bite (vb)’</td>
</tr>
<tr>
<td>gos'op'o</td>
<td>gos'obo</td>
<td>‘storm’</td>
</tr>
</tbody>
</table>

However, I have found in Bender’s data that the Mayu dialect does have /p'/ which corresponds to /p/ in the other dialects, as in the following forms in all three dialects: /p'eqp'él/ ‘bread’, /fyp'ul/ ‘bush (wilderness)’ /p'ip'isi/ ‘narrow’, and /p'ála/ ‘plow’. These examples indicate that Mayu voicing of /p'/ was sporadic, and suggest that perhaps there has been subsequent dialect borrowing, or that there was a case of lexical diffusion which did not spread far throughout the lexicon.

Lastly, Ehret 1983 discusses Eastern Sudanic correspondences and simply alludes to an occasional voiced reflex of *t' and *p' in unspecified languages.

7.4.3. Summary

The strongest evidence for the voicing of ejectives has come from a handful of languages: Nakh non-initial ejectives, dissimilative voicing of loanwords in Svan and Ossetian, and dissimilative voicing of roots in Tillamook. The process of deglottalization followed by voicing appears well attested for Western Jicaque. Other examples appear to be sporadic, as the Abaza verbal suffixes, particular words in Modern South Arabian, or certain places of articulation, as in the bilabial ejectives of Boraana Oromo and Mayu Berta, or the velar ejective of Janjero. Other data is suggestive, but reconstructive studies of Nakh-Daghestanian, Jicaque-Tequislateco or Jicaque-Subtiaba, Cushitic, Omotic, and Nilo-
Saharan are still in their infancy and generally lack well-worked-out sound changes. These languages remain rich areas of exploration for precedents of ejective voicing. However, although here I have expanded the examples proposed in the literature for the change of ejective to voiced, and have included many new ones, there is no language in which ejectives unconditionally, and across the board, all turned to voiced stops, unlike deglottalization, for which we saw a few precedents in Chapter Four.

Of course, if the Ejective Model is correct, then many branches of Indo-European would also show voicing. Armenian would be one language in which the Western Armenian dialects shifted from ejectives to (voiced?) lenes (Kortlandt 1978), while Eastern Armenian preserved ejectives. Such a change would also have occurred in Italic (Baldi and Johnston-Staver 1989), and other branches. But as Job (1989) cautions, this is simply based on reconstruction, rather than well documented evidence. And if we are testing the plausibility of the Glottalic Theory, it would be circular reasoning to include the Indo-European languages. Nevertheless, we have seen numerous cases of diachronic ejective voicing, though not of the exact type required by the Glottalic Theory.

7.5. Ejective and Implosive Alternation

Bomhard (1984:138) cites Martinet (1970:113, §4.28), who claimed that ejectives can develop into implosives through a progressive anticipation of the voice of the following vowel. (See also Rasmussen [1989:168, cited in Awedyk 1993:262 fn 12], who believes such a change of ejectives into voiced implosives is typologically natural). In contrast, Tosco (1988) has claimed that one cannot derive implosives from a voicing process in intervocalic position, though it is unclear if he was referring simply to Eastern Cushitic. Tosco further denied that ejectives could voice just as voiceless stops can voice, since this implies 'for glottalized segments the same kind of relation as between voiceless and voiced plains' and since this change 'is phonetically and phonologically unpluralue [sic]' (314). He concedes that 'an implosive is indeed the phonologically voiced counterpart of an ejective', but emphasizes that 'phonetically the two series (implosives and ejectives) have quite different qualities'. Tosco attempts to apply Foley's (1970:90) strength hierarchy, assigning ejectives the highest strength. (Incidentally, this is the only work in which I have seen ejectives placed relative to other stops in a sonority or strength hierarchy). Implosives, as 'the maximum voiced stop' are assigned to the bottom of the strength hierarchy: t' > t > d > d. Thus Tosco's ranking is a lot like Ladefoged's (1973) scale of 'Glottalicness' (§2.2.2), though it differentiates voiceless
from voiced stops as in the traditional sonority hierarchy. Tosco concludes that 'it is therefore more probable that an ejective undergoing a process of weakening will go down the scale, eventually losing its glottalic feature; and indeed cases of t’ ~ d alternations are very rare.'

Recall, however, from §2.1.4.2 and §3.1.2 that there is evidence which characterizes implosives as both [c.g.] and [voice]. For example, implosives often devoice syllable-finally, yielding either voiceless implosives and/or ejectives, e.g. S'aamakko and Mayan Chontal. So far in this chapter, we have been considering changes of laryngeal features in which the feature [constricted glottis] is changed to [voice], usually by means of delinking and then some type of addition of [voice] (via spreading or default). In the cases of ejective implosivization we discuss, the feature [voice] is not substituted for, but added to the specification of the Laryngeal node, so that spreading but not dissociation takes place.

7.5.1. Synchronic Ejective Implosivization

Synchronically, I have found only one case of morphophonemic ejective implosivization, and one allophonic case, in stark contrast with the many diachronic cases. Gragg (1976) and Lloret (1992) give evidence of the implosivization of ejectives in Wellegga Oromo. When a voiced or voiceless stop comes in contact with a following nasal, they undergo complete assimilation with the following nasal:

(53) bit-na binna ‘we buy’
did-na dinna ‘we refuse’
ḍ3ad3-na ḍ3aŋna ‘we boast’

The coronal ejective in the same environment undergoes metathesis and implosivization:

(54) fit’-na fǐnd’a ‘we finish’ (cf. /fiit’/ ‘finish’ (Owens 1987))
lit’-na lǐnd’a ‘we enter’

In Wellegga, the combination /p’-n/ does not occur, but /k’-n/ is attested, e.g. /dak’na/ ‘we go to’. Underlying implosives before the nasal are deleted, with compensatory lengthening, e.g. /fed-na/ → [feena] ‘we want’.
Lloret (1988:65-68, cited in Lloret 1995) explained these alternations by appealing to external ordering. In that analysis, the coronal ejective metathesized with an adjacent coronal nasal, then underwent implosivization, presumably through the spread of [voice] from the nasal, which at this point in the derivation, must be specified. This is the analysis that I accept and propose here. However, Lloret (1995) changed her analysis by (1) attempting to unite various assimilatory phenomena across several Oromo dialects, and (2) assuming, influenced by McCarthy (1989), a complex representation of ejective as having a branching Place specification with Coronal and Pharyngeal and [+glottal] dependent from Pharyngeal, as shown below:

(55) Lloret’s Representation of Ejectives

```
Place
   Coronal       Pharyngeal
          [+glottal]
```

This representation prevents true homorganicity (following Hayes’ Linking Condition) with the following plain Coronal nasal and thus complete nasal assimilation does not apply, as it would for (54). However, in her view, implosives are represented with the laryngeal feature [e.g.] (but not [voice]), and with simple Coronal place (without a Pharyngeal place). In Lloret’s representation, then, implosives are homorganic with nasals and thus should undergo complete assimilation, but they do not. Instead, as we saw, the implosive deletes and the preceding vowel is lengthened. Since the ejective and the implosive must be distinguished both from each other and from the non-glottalic phonemes, I see no reason this cannot be done through extrinsic rule ordering in which both Compensatory Lengthening and Ejective Metathesis precede a rule of total nasal assimilation.

Heine (1981) reports that Waata Oromo /k'/ ‘tends to be replaced by a voiced velar imposive’ [g] in fluent speech. Presumably the following words are illustrative; I have supplied the phonetic representation (PR) to Heine’s forms, based on his voicing rule:

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Waata has no underlying velar implosive, thus this is a classic postlexical rule. It also contradicts Tosco’s claim that ejectives will not undergo implosivization. Heine also reports Waata has implosivized the bilabial ejective.

Other alternations between ejective and implosive seem to be in free variation. Heine (1975:32) observes that ‘the phonology of Ik shows a remarkable variation…’. One example of this variation is the fact that one speaker pronounced /k’/ as a [f]—that is, a voiced palatal implosive (1975:33). In Kefa (Omotic) languages there is apparent free variation between ejectives and implosives. For example, the word for ‘bright, shiny’ in Dime alternates between /bɛłxɔn/ and /p’ɛłxɔn/ and in words like ‘know’ /dɛs ~ t’es/. There is apparent free variation between ejective and implosive in the Chara and Kefa word for ‘darkness’ or ‘evening’ /dum ~ t’um/ (Fleming 1976:317). Fleming also mentions cases like the variation in Ubamer ‘heart’ /lip’a ~ liɓa/.

Heine (1982) examines various dialects of the Cushitic language Boni (Aweer). In Kilii, the palatal ejective /c'/ ‘tends to be replaced by an implosive palatal stop /f/.’ For example, /hac’is-/ or /hafis-/ ‘sneeze’. /k’/ is optionally replaced by the implosive /ɡ/: e.g. /k’oorij-/ or /ɡoorij-/ ‘cut trees’. Also, Heine reports that preceding high back vowels, /k’/ tends to be replaced by an implosive uvular stop (which would be [ɡ] but which he symbolizes with [q’]). For example, ‘flow’ is /k’uk’ul-/ or [ɡʊdul-] (1982:45).
Other relations between ejectives and implosive appear to be allophonic, and sometimes vary by place of articulation. Dayley (1985) describes Tzutujil, a Greater Quichean Mayan language. There is a glottalized series in which the anterior (bilabial and alveolar) consonants are implosive (also, optionally, the uvular glottalized consonant), while the alveolar and palatoalveolar affricates and the velar stop are ejective. Thus the glottalic system is /ɓ, ɗ, ʃ, ʝ, k', q'(ɔ)/. In positions other than prevocalic (e.g. word-finally and pre-consonantally), the implosives are realized as voiceless ejectives.

Here are some examples:

(58) | UR    | PR      | Gloss     |
-----|--------|----------|-----------|
/ɓaaq/ | [ɓaaqʰ] | 'bone'    |
/ʃiːj/  | [ʃiːj'] | 'smoke'   |
/ɗooɗ/  | [ɗooɗ'] | 'snail'   |
/ʃiːʈ/  | [ʃiːʈ'] | 'dog'     |
/meeʃs'/ | [meeʃs'] | 'eyebrow' |
/ʃiʃtʃ']/ | [ʃiʃtʃ'] | 'metal, car' |
/k'ooli/ | [k'ooli] | 'there is' |
/siik'/ | [siik']  | 'tobacco' |
/q'aaq'/ | [q'aaq'] | 'fire'    |

Thus Tzutujil displays implosive devoicing to yield ejectives for /ɓ, ɗ/, while the uvular ejective is apparently optionally imploded prevocalically. I know of no morphophonemic alternations between these sounds. England (1983) makes a similar proposal for Mam in which the alveolar ejective is purportedly optionally voiced everywhere but final position: /t'ut'an/ → [ɗɔdɔŋ] → t'ut'ɔŋ] 'watery'.

Finally, there is a putative case of ejective implosivization which has been instrumentally disproven. Hoard (1978) claimed that in the Tsimshianic language Gitksan noncontinuants became voiced before sonorants, e.g. /tuus/ → [duus] 'cat'. He also claimed that ejectives became implosives, e.g.

(59) | UR    | PR     | Gloss     |
-----|--------|---------|-----------|
/t'aa/  | [ɗaa]  | 'to sit' |
/t'k'a/  | [t'ga'] | 'skin'   |
/q'ilt/  | [ɡeilt] | 'top (of hill)' |
Although this has been reported as a case of ejectives becoming implosive, just as the voiceless stops became voiced, acoustic studies have rejected this claim. Ingram and Rigsby (1987) disprove Hoard’s claims with instrumental studies, using waveform analysis, including data from the same informant as Hoard’s. Rigsby and Ingram (1990) agree that Gitksan has a rule of voicing but that it applies only to the plain stops and affricates, not the ejectives. Their studies showed that speakers of Gitksan used a weak, lenis ejective; there was no evidence of an implosive realization. The phonetic qualities of lax ejectives are discussed in §7.6.

7.5.2. Diachronic Ejectives Implosivization

There are many diachronic cases of ejectives becoming implosives. Unfortunately, many of the reconstructions are not as firmly established as one would hope, and thus the sound changes illustrated here could be subject to modification. Nevertheless, I hope to give a sample here for what has been proposed in the literature. The bulk of the data is from African languages, especially in Afro-Asiatic. We will examine data from Proto-Afro-Asiatic and see ejective implosivization in Proto-Chadic and Proto-Eastern Cushitic. We will then look at Omotic and Cushitic examples, and finally, simply allude to examples in Nilo-Saharan and Mayan for which data is lacking.


(60) PAA
*tap’- ‘mud’
*sap’-/sap’- ‘to suck, drink’
*t’oj/t’aj ‘to fly; bird’
*k’aʃ- ‘bone’

PC
*taɓ ‘mud’ (143)
*səɓ ‘to suck’ (143)
*dəj- ‘bird’ (146)
*fəʃu ‘bone’ (163)

He also considers that Proto-Eastern-Cushitic *d derives from PAA *t’, *ts’, and ʕ’.  

(61) PAA
*t’ab-/t’ab- ‘to cover’
*səɬ-/səɬ- ‘to burn’
*ʕəw-/ʕəw- ‘to harm, injure’

PEC
*dib- ‘to cover, bury’ (146)
*dəɬh-/*dəɬh- ‘charcoal’ (150)
*dəɬ ‘to hit, strike’ (158)
Various individual branches within Afro-Asiatic also show ejective implosivization. Bender (1987) has undertaken a study of Omotic languages in an attempt to reconstruct Proto-Omotic. Of particular interest for the voicing of ejectives is the fact that North Ometo, South Ameto, Chara, and Aroid seem to have voiced implosives which correspond to Gimira, Gonga, Dizoid, and Mao ejectives, and Janjero voiceless stops. Bender has reconstructed (correctly, in my opinion), an ejective, which shows voiced reflexes in the above-listed languages. Other ejectives have relatively consistent reflexes, except that *k' often has medial /g/ correspondences in Janjero, suggesting a rule of intervocalic voicing of ejectives. Bender (1988:124) observes of Proto-Omotic that 'there seems to be no *d, and modern d is often the reflex of *t' (Chara-Ometo and Aroid).

Compare, for example, the following, where the capital letters stand for vowels in alternation: A = /a - e/; E /i - a/:

(62)

<table>
<thead>
<tr>
<th></th>
<th>Ometo 1-3</th>
<th>Kefoid</th>
<th>Dizoid</th>
<th>Mao</th>
</tr>
</thead>
<tbody>
<tr>
<td>*ts'ap' 'root'</td>
<td>ts'Aɓ</td>
<td>ts'ap'o</td>
<td>–</td>
<td>t(s)ap'i</td>
</tr>
<tr>
<td>*t'am 'breast'</td>
<td>d'anis, dam</td>
<td>t'aa(n)ts-</td>
<td>t'iam (ammi)</td>
<td></td>
</tr>
<tr>
<td>*hEt'iJ 'sneeze'</td>
<td>hAdEj</td>
<td>hAtt'is-</td>
<td>–</td>
<td>(didiJ)</td>
</tr>
<tr>
<td>'kill'</td>
<td>woɗ</td>
<td>(w)ut'</td>
<td>wuj (?)</td>
<td></td>
</tr>
<tr>
<td>'night, cloud, dark'</td>
<td>d'um, tuuna</td>
<td>t'um-/t'uw-</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

In Mocha the word for 'lighten, flash' is /p'arik'/ while the cognate word for 'bright, shiny' in Dime alternates between /Belxan/ and /p'elxon/. Though Fleming (1976) simply notes the correspondence, given that Bender has already proposed reconstructions with implosivization of ejectives, I believe these should be additional examples.

Another example may be inferred from Fleming (1976:361), who notes that 'It is clear that Manjo of the Gojeb is simply Kefa, albeit with implosives /ɓ d ɗ/ in place of /p' t' k'/'. He gives as an example the correspondence between Kefa /da:k'ø/ and Manjo /daɗɡø/. He notes that 'in some Kefa dialects [d] occurs, while in my data it varies with [t'] between dialects. In Manjo of the Gojeb /ɓ/, /d/, and /ɗ/ occur as phonemes, replacing their egressive counterparts' (1976:367).
Heine (1982) reconstructs Proto-Boni (Sam, Lowland East Cushitic) with ejectives, but the Jara dialect has no ejectives. These appear to have become implosives, as the following examples illustrate:

(63)  

<table>
<thead>
<tr>
<th>Proto-Boni</th>
<th>Boni</th>
<th>Kili</th>
<th>Jara</th>
<th>Gloss</th>
</tr>
</thead>
<tbody>
<tr>
<td>*c'eb-iij</td>
<td>e'iij-</td>
<td>-</td>
<td>fbiij</td>
<td>'to break'</td>
</tr>
<tr>
<td>*k'âàlén</td>
<td>-</td>
<td>k'aalén</td>
<td>çaallén</td>
<td>'cow which has not yet given birth'</td>
</tr>
</tbody>
</table>

Sasse (1979) writes of cases in Cushitic in which a voiced implosive corresponds to a velar ejective, e.g. Dasenech and Elmolo [gʃ] correspond to *k'. See also Dolgopolsky (1977:7) and Heine (1973).

Wedekind (1979:148-9) observes some implosivization in Highland East Cushitic. In word-initial position, Sidamo /t'/ corresponds to Gedeo implosive /dʃ/ as in /t'iiibi/ vs. Gedeo /diiibi/ 'push! sg.', and in Northern Sidamo /t'aæge/ vs. Southern Sidamo /d'æggii/ 'news'.

According to Dolgopolsky (1977), Proto-Cushitic *t' became implosive /dʃ/ in Galla, and implosive retroflex /dʃ/ in Somali. This is confirmed in work by Arvanites (1991), who has proposed a reconstruction of Proto East Cushitic (PEC) consonants.

According to Dolgopolsky (1977:8), Proto-Chadic *k' became implosive /gʃ/ in Tera, and before *i in Margi became the glottalized palatal implosive <dy>. And the counterpart of Semitic and Cushitic *t' 'seems to have changed into Proto-Chadic injective *dʃ (d is found in Hausa, Bolewa, Angas, Margi, etc. as the etymological counterpart of Semitic and Cushitic *t', while ejective t' is unknown in Chadic.' (1977:8).

Ehret (1994) has reconstructed Nilo-Saharan and posits a series with ejectives (along with plain voiceless, voiceless aspirated, voiced, and implosive stops). According to his reconstructions, there are several correspondences of ejective to voiced (perhaps by way of deglottalization). Taking the dental ejective, he posits some (conditioned?) variation in Kanuri, but voicing in Maba. For the alveolar series, voicing occurs in Maba and Songay, while in the labial series, it occurs in Kanuri, Songay, Dongolawi, Gaam, among others. There is little ejective voicing posited for the velar series (only partially in Kunama), in keeping, perhaps, with the phonetic robustness of back ejectives. Bender
(1997) provides a brief overview of Nilo-Saharan historical phonology, and one may see various instances of ejective voicing according to his reconstructions.

Finally, we turn from Africa to Central America. Campbell (1973:45-6) notes that

'in Mayan languages it is clear that many of the injectives have come from original ejective (glottalized) consonants. For example, the /?q/ mentioned above seems to have come from *q' (ejective). Tzutujil and Mam have further changed *t' (ejective) to ?d in recent times. We might speculate that these changed in accordance with response to [sic] Greenberg's generalization about implosives favoring the front; the inbalance [sic] of a system with /b/ and /?q/ may have exerted pressure, creating more front injectives.'

Thus in Campbell’s view, ejectives have become implosives, which would normally indicate ejective voicing. More recent studies, however, have distinguished voiceless from voiced implosives. And so it is possible that these were an intermediate stage between ejective and implosive.

7.5.3. Summary
In §7.5 we have seen ejectives become implosives from a couple of angles. Synchronically, there were not many solid examples, except for Wellegga Oromo /t'/, which alternates with the phonemic /d/ after nasals. In fast speech in Waata Oromo, the velar ejective is reported to become implosive. We observed some free variation in Ik, Omotic, and Cushitic, and also observed that ejectives and implosives may be allophonic variants of one another according to place of articulation. Diachronically, Afro-Asiatic languages have a plethora of ejective implosivization, in Omotic, and especially in the various Cushitic languages. It has also been reported for Nilo-Saharan and Mayan. The consequences of ejectives becoming implosives for the Glottalic Theory will be addressed in §7.7.

7.6. Phonetic Explanation
As mentioned in the introduction, scholars such as Baldi and Johnston-Staver (1989:94) believe that 'there is such an articulatory distance between explosive glottalized stops and voiced stops that a direct change seems phonologically impossible'. Consequently they posited an intermediate implosive stage for Italic. In an attempt at explaining why ejectives rarely undergo change, Dolgopolosky (1977:5) claimed that 'glottalized stops
practically never undergo lenition, which can be explained by the way they are formed’. He claims that if the stop has been spirantized, the cavity is no longer closed and raising air pressure in the cavity requires more muscular effort than in non-fricative ejectives. ‘Therefore relaxation of muscular effort, which causes lenition of voiced and/or voiceless non-glottalized consonants (as in Spanish, Celtic languages, Modern Greek, Berber dialects, Proto-Germanic, Danish, Amharic, in Hebrew and Aramaic..., etc.), does not produced lenition of glottalized stops.’ Dolgopolsky admits in a footnote that there are some exceptions (such as debuccalization, and frication of velars in some languages). But he, too, seems to think that ejectives do not lenite to say, voiced stops. Is there really ‘such an articulatory distance’ between ejectives and voiced stops?

We have already seen that such a change is possible (though admittedly relatively rare) phonologically. Furthermore, I have documented in this chapter several cases of such a change synchronically and diachronically. In this section we will examine some of the details of the phonetic production of ejectives in order to ground such changes in a phonetic basis. I argue below that there are two different types of ejectives, supporting a long-recognized phonetic typology suggested at least since 1916. I then examine a more explicit typology proposed in Kingston (1985). I discuss in some detail the phonetic correlates of the typology as supported through instrumental investigation. The phonetic differences between these ejective types provide important clues and a probable pathway for the change from ejective to voiced. Perceptual correlates of ejectives will also be examined. Then we turn to examine two cases of quasi-voiced ejectives, a type of intermediate glottalized consonant which straddles the border between ejectives and voiced consonants and which may provide further insights into the relation between pulmonic and glottalic sounds.

7.6.1. Different Types of Ejectives

All ejectives share basic phonetic similarities of production, namely the closure of the glottis and closure at some place of articulation in the oral cavity, raising of the larynx to compress the air trapped between the oral closure and the glottis, and a release of the glottal closure after that of the oral stop to create an abrupt release (Doke 1923, 1926; Catford 1939/1973). However, it has long been recognized that there are two general types of ejectives. Swanton (1911:210) made what is perhaps the earliest distinction between these two types of ejectives in Haida in observing that ‘some speakers bring these out very forcibly, while others pass over them with considerable smoothness’. The
Committee of American Anthropological Association (1916:14), whose members were Franz Boas (chair), P.E. Goddard, A.L. Kroeber, and Edward Sapir, and whose assignment was to make recommendations on the phonetic transcription of Indian languages, wrote:

A common type of glottalized consonant in American languages is the so-called "fortis". These consonants are generally pronounced with simultaneous glottal closure and with glottal release subsequent to that of the oral release. We may distinguish here between the simple glottalized stop and the true fortis produced with very high pressure and accompanying increased muscular tension of the articulating organs, which gives to the sound its abrupt exploded character. It is recommended that the orthography already in use (namely, \( p! \), and correspondingly for other consonants, be retained for the true fortis; \( \dot{p} \) (and correspondingly for other consonants) should be used to indicate the more weakly articulated glottalized consonant of this type.

This difference in ejective type is often noted in phonetic descriptions of ejectives. In fact, the phonetic difference led Frachtenberg (1922) to posit for Siouan a ‘double series of glottalized explosives differing in the quality and amount of stress employed in their production’ (444)—the ‘real explosives’, symbolized as [t!], vs. ‘the glottalized stops of ordinary strength’, symbolized as [t']. As Hymes (1966) showed, the two types of ejectives were not contrastive and were due in part to a lack of understanding of the phonemic principle. Others have noticed different realizations of the ejective according to position in the word. For example, in Kiowa Apache, [t'] and [k'] ‘are actualized with fortis glottalization in word initial position, but not in word medial position’ (Bittle 1963:78).

More often, however, the difference between the two ejective types is made in comparisons between languages which the linguist has worked with. Sapir (1938: 248) noted that ‘in the overwhelming majority of cases the glottalized consonants are fortis, as in Chinookan and Athapaskan; in others, as in Chitimacha and Taos (Tanoan), they are lenes’\(^{10}\). Stanley Newman comments that in Yawelmani ‘in acoustic effect these consonants are markedly different from the violently glottalized consonants which occur in the languages of the Northwest Coast, such as Nootka or Bella Coola.’ (1946: 224).

In addition to field linguists, skilled lab and field phonetician Peter Ladefoged (1973:78) hinted at some of the differences in the phonetic realization of ejectives, noting

\(^{10}\) Bright (1990:24) notes that ‘Sapir’s list of languages which contain such sounds [ejectives] mistakenly includes Karok’.
that the terms ejective and implosive should not be interpreted as discrete phenomena. He states that we need terms like ‘weakly implosive’ and ‘weakly ejective’, the latter to describe English glottalized stops. Furthermore, such a difference, he argues, should be characterized in phonological theory:

The inadequacy of current phonological theories becomes more apparent when we consider sounds like the velar ejectives in Hausa and Navajo. These consonants may be given the same label and written with the same symbol [k’] in a phonetic transcription. But they do not sound the same. If a Navajo speaker used a Hausa velar ejective while speaking Navajo, it would sound as if he had a foreign accent. It is very difficult to describe differences of this kind in terms of phonological features, but if there is a noticeable difference between two sounds in different languages, such that either of them would sound foreign if it were used in the other language, then this difference is part of the linguistic facts of each language’ (1980:498-9).

Ladefoged makes an interesting point about the phonetic differences: they are part of the linguistic facts of each language. But to suggest that this reflects on the inadequacy of phonological theory is to blur the distinction between phonetics and phonology. It has long been shown (Sapir 1933/1972:28) that for many Native American languages, for example, ejectives and laryngealized sonorants pattern together as glottalized consonants. They thus share a phonological feature of [c.g.], despite the different ways they are produced physically. Likewise, the role of [voice] in relation to Voice Onset Time is not one-to-one in all languages. It is a well-known fact of English that initial stops which are phonologically voiced often have no prevoicing, and even a VOT lag of 11-27 ms, depending on place of articulation (Edwards 1992, citing Klatt 1975). Likewise, no language distinguishes implosives from laryngealized stops (Ladefoged 1971:27), but these are noticeable differences in the allophonic realizations of phonemic categories. So despite the phonetic differences of the types of ejectives, phonological theory is not particularly threatened, as long as it makes provision for the phonetic implementation of tense or lax ejectives, just as it allows for differences in VOT (e.g. Keating 1984).

If we need to differentiate phonetic transcription to distinguish fortis from lenis ejectives, then I suggest reviving the distinction made by the Committe of American Anthropological Association (1916) mentioned above. We could transcribe the Navajo ejectives as [k!] and the Hausa ejectives as [k’]. Alternatively, because the phonetic symbol [!] is officially sanctioned as a (post)alveolar click (IPA 1989a, 1989b, 1993), and often used in superscript form for downstep, we could use a double apostrophe [k’’]
or double closed quote [k"] for fortis ejectives, and a single apostrophe [k’] for lenis ejectives when such a distinction needs to be made in narrow or comparative transcriptions. The double apostrophe, to my knowledge, has never been proposed for use as a phonetic symbol (e.g. it is not in Pullum and Ladusaw 1986), yet it is easily available on virtually every keyboard and in every font. Another alternative would be to adopt Pike’s (1947:6) diacritic for fortis, a double quote below the symbol (here using double syllabic marks due to typographic limitations), e.g. [k’].

Appendix A ‘Impressionistic Phonetic Descriptions of Ejectives’ contains impressionistic descriptions of ejectives from forty-five different languages from seventeen typologically diverse language families. More precise phonetic correlates of fortis and lenis ejectives will be discussed below. However, next I will summarize the main impressionistic findings.

There seem to be different phonetic and stylistic environments that characterize fortis and lenis ejectives. Although some languages may have exclusively one or the other, based on the descriptions I have gathered in the Appendix, I summarize the typical distribution of ejective types below, with sample languages to illustrate the point:

(64) Characteristics of Fortis and Lenis Ejectives

<table>
<thead>
<tr>
<th>Fortis</th>
<th>Lenis</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Style</strong></td>
<td><strong>Position</strong></td>
</tr>
<tr>
<td>higher register (Hausa)</td>
<td>word-initial (Kiowa Apache, Armenian, Georgian, Maidu)</td>
</tr>
<tr>
<td>emphatic or careful speech (Armenian, Georgian, Maidu, Tswana, Wintu, Yurok)</td>
<td>beginning of stressed syllable (Armenian, Wintu)</td>
</tr>
<tr>
<td>foreigner talk (Georgian)</td>
<td>final position (Armenian, Hupa)</td>
</tr>
<tr>
<td>citation (Eastern Pomo, Yurok)</td>
<td>idiolectal (Maidu, Southeastern Pomo, Wintu)</td>
</tr>
</tbody>
</table>

(continued)
From this data, I propose the following phonetic tendency to describe the change in ejective type from fortis to lenis:

(65) Ejective Lenition

Ejectives tend to lenite from fortis to lenis, or from lenis to more lenis, in fast speech and in weaker phonetic environments. Strong conditioning environments are typically word-initial and/or at the beginning of a stressed syllable. Weak conditioning environments are typically elsewhere, e.g. in unstressed syllables, word-medially, in clusters, etc.

Ejection Lenition seems to be roughly equivalent to what Kaisse calls a ‘fast speech rule’, which she describes as a ‘purely phonological rule dependent only on speech rate, syllabification, and the features of the focus and determinant’ (1985:1). Ejective Lenition is in accord with the tendency for stronger segments to be found in strong syllable positions such as the onset, and weaker segments to be associated with weak syllable positions such as the coda (see, for example, Burquest and Payne (1993:117-18)).

7.6.2. A Phonetic Typology of Ejectives

There is a growing phonetic and phonological literature on the patterning of ejectives within a phonological system and the frequency of ejective by place of articulation. For example, Jakobson (1969), Greenberg (1970), Campbell (1973), Javkin (1977), Gamkrelidze (1978), Fordyce (1980), Maddieson (1984), and Henton, Ladefoged, and Maddieson (1992).
Although much work has been done on the production of voiced and voiceless stops, comparatively little has been done on the production of ejectives, especially considering the fact that they are the fourth most common type of stop (Henton, Ladefoged, and Maddieson 1992). There is an abundance of impressionistic descriptions, cited above and in the Appendix. Yet Ladefoged (1971:2) has warned us that 'as most practicing phoneticians would agree from experience, published phonetic descriptions are almost impossible to interpret accurately.' There is, however, a growing and sophisticated literature. There is some brief analysis of ejectives in Jakobson, Fant, and Halle (1952). One of the earliest full-scale instrumental phonetic studies is Sumner (1957), which is, however, very dated and not of great use. Other studies include Aoki (1970b), Hogan (1976), and Dent (1981). More detailed and comparative investigations may be found only beginning in the mid-1980s, with Lindau (1984), Kingston (1985a, 1985b), Fre Woldu (1979, 1985, 1986, 1988), Pinkerton (1986), Ingram and Rigsby (1987), Rigsby and Ingram (1990), Giannini, Pettorino, and Toscano (1988), Lindsey, Hayward, and Haruna (1992), Sands, Maddieson, and Ladefoged (1993), McDonough and Ladefoged (1993), and other papers in recent issues of *UCLA Working Papers in Phonetics*. Published spectrograms of ejectives are also given in Ladefoged and Maddieson (1996:37). The most detailed studies are the dissertations by Kingston and Fre Woldu. I will summarize the most important findings, as they relate to ejective voicing, in the next section.

Kingston (1985b) investigated the ejectives of Tigrinya, a Semitic language of Ethiopia, and Quiché, a Mayan language spoken in Guatemala. He found several important differences between the two languages, and used these differences to propose a phonetic typology of tense and lax ejectives. Their characteristics are shown in (66):
(66) Kingston's Tense/Lax Ejective Typology

<table>
<thead>
<tr>
<th>Feature</th>
<th>Tense (Fortis)</th>
<th>Lax (Lenis)</th>
</tr>
</thead>
<tbody>
<tr>
<td>F0 of following vowel:</td>
<td>elevated</td>
<td>depressed</td>
</tr>
<tr>
<td>Voice onset time (VOT)</td>
<td>long</td>
<td>short</td>
</tr>
<tr>
<td>Type of burst and effect</td>
<td>intense; silence</td>
<td>weak; low intensity noise</td>
</tr>
<tr>
<td>Transition to max. amp.</td>
<td>abrupt; rapid rise</td>
<td>gradual; slow rise</td>
</tr>
<tr>
<td>Voice at voice onset</td>
<td>modal</td>
<td>creaky</td>
</tr>
<tr>
<td>Vocal Folds</td>
<td>stiff</td>
<td>slack</td>
</tr>
</tbody>
</table>

(adapted from Kingston 1985a:166; 1985b:30)

Some examples of tense and lax ejectives are as follows:

(67) Tense/Fortis          Lax/Lenis
    Tigrinya (Fre Woldu, Kingston)  Quiché (Kingston)
    Chipewyan (Hogan)               Gitksan (Ingram & Rigsby)
    Navajo (McDonough & Ladefoged)  Hausa (Lindau; Lindsey et al.)

Of course the phonetic realization of ejectives is a gradient phenomenon, and so the classification into two categories represents more prototypical clusters of properties. Other divisions may be possible such as Dolgopolsky’s (1977:4-5) three-way typology of strong, medium and weak-force glottalization, exemplified by Circassian, Georgian, and Amharic, respectively. But here I will focus on Kingston's binary classification because it is the most detailed and it is in accord with the traditional distinction of fortis and lenis ejectives.

The primary purpose of examining some of these phonetic traits is to show that there are several phonetic similarities between lenis ejective and voiced stops which permit the change from ejective to voiced stop to be considered a natural and plausible phonetic change, especially since these phonetic characteristics are present in synchronic variation, from which a phonological rule and a sound change might arise (Ohala 1988). The points that I will highlight include Voice Onset Time, the state of the vocal folds, the state of the larynx and oral pressure, and perceptual cues.
7.6.3. The Phonetics of Tense and Lax Ejectives

7.6.3.1. Voice Onset Time

As Hogan (1976) has pointed out, there are several different measurements which can be made during the production of an ejective. The first is the pre-release silence (for stops), during which there is both oral and glottal closure. Next is the oral stop burst, which results from release of the oral articulators. Then comes another silent period between the burst and the vowel onset. Catford (1983:345) defines ejective VOT as the time-lag between the oral release and the onset of glottal vibrations. The ejective components are schematized below in Figure 7.1 in a waveform from a token of Zerq’ Chechen /k’æ/ ‘wheat’ which I have collected (Fallon 1991):

<table>
<thead>
<tr>
<th>Stop duration</th>
<th>Vowel</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>b</td>
</tr>
</tbody>
</table>

Chechen [k’æ] ‘wheat’

Figure 7.1: Waveform illustrating ejective VOT for Chechen [k’æ] ‘wheat’.

Kingston (1985a:16-7) noted that

‘the most frequently encountered variation [among ejectives] is in the relative timing of the glottal and oral release: the glottal closure may be released together with or soon after the oral one or it may be significantly delayed (Kingston 1982). Corresponding to this difference in the timing of the glottal release relative to the oral one is an impression that ejectives with simultaneous release of glottal and oral closures are less forceful than those where the glottal release is delayed.’
There is a great deal of variation among ejectives in terms of VOT. Kingston proposes that fortis ejectives have longer VOT, while lenis ones have shorter VOT. The shortest reported VOT of any ejective is 10 ms in Abkhaz (Catford 1983), with an average of 12 ms (Catford 1992:197). Other languages with short VOTs include Dargi dialects (16-60 ms; Gaprindašvili 1966), Hunzib (22 ms avg.; Catford 1992:197), Ingush (26 ms avg.; Warner 1996); and Pocomchi /p'/ (30 ms; Pinkerton 1986:135). Some languages with medium-length VOTs include Abaza (51 ms avg.; Catford 1992:197) and Gitksan 89.2 ms; Ingram & Rigsby 1987). Those with long VOTs include languages such as the Navajo coronals (108 ms; McDonough and Ladefoged 1993) and Bzhedug (114 ms; Catford 1992:194-5).

Lindau found that in intervocalic ejectives in Hausa, four of her twelve speakers had such short-lag or even zero VOT that they realized the ejective as unaspirated [k] or even voiced [g]. (Lindsey, Hayward, and Haruna (1992) also found that some speakers realize the velar ejective as voiceless unaspirated). Lindau (1984) found that Navajo ejectives had a total duration twice that of the Hausa ejectives (roughly 200 ms to 100 ms, respectively). Lindau also examined the ratio of closure duration to VOT. ‘The closure duration in Hausa is about twice that of the VOT part, while the closure duration in Navaho is only 1.5 times as long as the VOT.’ (1984: 154). Likewise, recall Giannini, Pettorino and Toscano’s (1988) study of Zulu (cited in §7.3.3), which found noninitial /k'/ ‘has all the acoustic characteristics of a velar voiced’ stop, including 0 ms VOT. Such short VOT in some languages mentioned above indicates such weak ejection that merger with the voiced stops becomes a distinct phonetic possibility.

In sum, VOT in ejectives varies considerably. Some ejectives which were quite robust, with VOTs of over 100 ms, but the VOT for other ejectives matches that of a voiced stop. Thus in some languages, VOT is so minimal that on the basis of this parameter alone, some lenis ejectives share this similarity with voiced stops.

7.6.3.2. State of the Vocal Folds
In Kingston’s phonetic typology of ejectives, fortis ejectives are said to have stiff vocal folds, while lenis ones are lax. In Tigrinya, an Ethiopian Semitic language with fortis ejectives, Kingston inferred that there was a quick transition ‘from the tightly adducted state of the vocal folds to the moderately stretched state characteristic of modal voice. The elevation of F0 indicated the vocal folds only lose their stiffness gradually’ (166). He surmises that the vocal folds in the Mayan language Quiché, by contrast, ‘must not be
terribly stiff to create the irregular, weak, low frequency creaky voice observed after ejectives.’ Kingston notes that one problem with assuming the vocal folds are stiff during closure of the ejective and then gradually relax is that for speakers like T1, his first Tigrinya informant, (or the Quiché speaker examined in Kingston 1982), ‘the vowel after an ejective begins with extremely low frequency, creaky phonation. As the voice quality becomes modal, F0 slowly rises, which suggests that the tension applied to the folds is gradually increasing rather than decreasing’ (1985a: 242-3).

Fre Woldu 1985 contains a wealth of data on the production of ejectives. A native speaker of Tigrinya, he describes some of the muscle activity actually involved in his production of ejectives:

‘There is a direct innervation to the vocalis muscle before the closure onset. This innervation is responsible for the narrowing of the glottis and for keeping the vocal folds tightly closed. This transglottal mechanical pressure continues even when the innervation that caused it has ceased....When the mechanically induced transglottal pressure (closure) has progressed far enough the vocal folds’ vibration starts. The onset of these vibrations has a characteristically hard and creaky voice quality.’ (1985:153).

Note that Fre Woldu claims that there was creaky voice quality even in what Kingston considers fortis ejectives. Fre Woldu notes two distinct differences in muscle activity. The first part, or pre-release phase, is caused by active innervation. The second part, or the glottalization following the release, is due to purely mechanical factors caused by tissue tensions.

Lindsey, Hayward, and Haruna (1992) investigated glottalic consonants in Hausa using electrolaryngographic data. Among the glottalic consonants investigated were two ejectives /k'/ and /ts'/. At the onset of the consonant, ejectives appear (with respect to low open quotient) more like the glottalic /b, d/ for some subjects but more like /b, d/ for others (while others are still difficult to classify) (522).

Robins and Waterson (1952:65-6) studied kymographs of Georgian ejectives and found that they were voiced: ‘Single intervocalic glottalized consonants are frequently articulated with some voice, in which case the glottalization is more easily heard in the vowel than the consonant itself.’ Similarly, Wickstrom (1974), cited in Rigsby and Ingram (1990), reported a ‘light voicing bar’ in Gitksan that was ‘probably due to some vibration of the vocal cords during the glottal release’ (1974:63).

Related to the state of the vocal folds during production of the ejective is the transition to modal voicing in the vowel. Kingston has stated that fortis ejectives will
have modal voice, while lenis ejectives will have creaky voice. Lindau (1984:154) noted that ‘in Navaho, the glottal release coincides with the vowel onset, so the vowel starts with a sharp, large amplitude. In Hausa, the glottal release occurs together with the oral release, and the vowel begins gradually, with aperiodic vibrations’.

Ingram and Rigsby (1987) found that voice onset in Gitksan is not abrupt, but gradual, with several laryngealized cycles before periodic voicing begins. Rigsby and Ingram (1990:260) call the Gitksan ejectives preglottalized, and note that the glottal gesture precedes the oral, and that there is no ejection per se. There is a creaky quality to the following vowel. The period of the glottal cycle changes as the last glottal pulse prior to oral closure is approached, and there is a sharp fall in pitch over the last five or so cycles as compared to the negligible fall for final plain obstruents. No observable differences in the closure period or oral release gesture between the final glottalized and plain obstruent were found.

Simeone-Senelle (1991) reports that in general, the Modern South Arabian languages always have glottalization but with a variable degree of laryngeal constriction. Lonnet and Simeone-Senelle (1997:341) observe that MSA ejectives may be glottalized or laryngealized, while in the Soqotri dialect, the emphatics (ejectives) are voiced or weakened. In the Mehri dialect of Qishn, the laryngeal occlusion is relaxed, provoking a laryngealization or ‘creaky voice’ that is difficult for linguists to distinguish from ordinary voicing. These authors observe that many dialects have a weak ejective articulation for the stops /t’ k’/, and are quasi-voiced for fricatives /ʃ s’ j’/ (1997:367). The last example of voicing is when /k’/ palatalizes, the quasi-voiced affrication converges with /g/, and it sometimes converges with [ʒ].

Warner (1996) found for Ingush that the voice quality after an ejective can be aperiodic, creaky, or normal.

In sum, we have looked at different aspects of laryngeal muscle activity. As Fre Woldu has noted, the relative timing of gestures is important in maintaining certain aerodynamic and acoustic features associated with ejectives. The musculature of the larynx, including the vocalis, the lateral cricoarytenoid, and the cricothyroid seem to play a crucial role in producing the glottal closure necessary for an ejective. And in the case of Hausa, there are physiological similarities between the glottal periods of both ejectives and voiced stops, lending plausibility that such a change is phonetically possible. Further similarities to voiced consonants comes from the voice quality of lenis and some fortis ejectives at voice onset. Such ejectives show creaky and/or laryngealized vowel quality
which is closer in quality to modal voice than the tight vocal adduction commonly associated with ejectives. In the next section we will look at the role laryngeal raising and oral pressure play in ejective production.

7.6.3.3. State of the Larynx and Oral Pressure
Although it is not one of Kingston’s criterial features of the ejective typology, laryngeal raising plays a major role in influencing changes in oral pressure (Po) and therefore, the intensity of the release burst which creates the distinct popping characteristic of ejectives. Ladefoged (1982:120; 1993:130) says that in his observations of Hausa ejectives, the larynx is pulled upward ‘about one cm’. Kingston 1985a found that three Tigrinya speakers (T1-T3) raised their larynx during production of ejectives from 4 - 6 mm. There was greater range of movement in the more careful style of one speaker. Kingston found lower pressure increase (of 5 cm H$_2$O) in one speaker, compared to increases of 10 - 13 cm H$_2$O in other speakers. Kingston (1985a) continues that ‘if the larynx moves relatively little in more casual styles, then Po will not be elevated as much and the ejectives in particular will have weaker bursts’ (52-3). This ‘explains the impression of weak articulation of ejectives one gets listening to T2 or for that matter Tigrinya’s holding a rapid conversation with one another’ (53).

Fre Woldu (1985: 115; 1988:712) provides tracings from a frontal cineradiographic examination of the larynx during the author’s production of Tigrinya ejectives. He found that during the early period of occlusion, the glottis was tightly closed and the whole larynx raised. This gesture reached its maximal height slightly before or at the moment of release. The degree of vertical laryngeal movement varies with the place of articulation and the following vowel. Labial ejectives have longer movements than the dentals and velars.

As for peak intraoral pressure, Fre Woldu (1985: 132; 1988:711) reports values (and standard deviations) for four speakers. The bilabial ejectives had peak pressure of 167.5 mm of water, (sd = 17.5), the dental had 221.6 (21.1), and the velar had 215 mm of water (5.97). The pooled averages of pressure show that ejectives had roughly twice that of voiceless aspirated stops, and 3-4 times that of voiced stops. Thus in a fortis ejective language like Tigrinya, oral pressure is much greater than that for voiced stops.

Pinkerton obtained air pressure recordings of glottalized stops, including ejectives, from a number of speakers of Quichean languages. She found an average difference of 5 cm of water between the air pressure of [k’] and the surrounding
nonglottalized obstruents (1986: 130). For the uvulars, as we might expect from the small size of the supraglottal cavity, there was 'an initially high positive pressure impulse—averaging about 9 cm of water—followed immediately by a negative impulse averaging about -6 cm of water' (135).

Ingram and Rigsby infer that Gitksan lenis ejectives have less laryngeal movement, since 'reduced upward movement of the larynx would produce a weaker and shorter compression phase. This is consistent with the lower observed amplitude release burst and shorter VOT's of Gitksan glottalized stops' (1987:137). That is, they interpret the fact that the amplitude relative to peak amplitude of the following vowel is low, indicating low intraoral air pressure prior to release and comparatively weak compression gesture.

Ingush ejectives 'sound as if they have very weak bursts' (Warner 1996). Their average peak burst power was not significantly different from that of voiceless stops.

Khachatrian (1996:51) reports that in Armenian ejectives, upward movement of the larynx 'is almost always present in isolated articulation of the stops and affricates, but in speech is often absent or cannot be followed'.

In sum, we have seen that the amount of larynx movement plays a large role in the amount of oral pressure increase; in general, the greater the upward thrust, the greater the amount of compression and hence oral pressure increase. Of course, the larynx probably also coordinates with the muscles in the vocal tract walls to help increase pressure. We have also seen, even among speakers of fortis ejectives, that there is less laryngeal raising in conversational speech and so the pressure increase and hence the robustness of the ejectives is not as great as in more careful speech. This is one of the phonetic reasons behind the rule of Ejective Lenition proposed above in (66). Some of the most salient acoustic characteristics of ejectives are due to the increase of oral pressure, which largely derives from the raising of the larynx. When the compression is less, the burst is less intense, and the VOT is generally shorter. So this is another aspect of the way ejectives can become more voiced-like. Next we turn to perceptual factors which may influence the interpretation of ejectives as voiced consonants.

7.6.3.4. Perception
In large measure because of their often short VOT, ejectives, especially lenis ones, have often been mistaken by fieldworkers for voiced stops. Swanton (1911a: 210) noted in
the case of those Haida speakers who ‘pass over’ ejectives ‘with considerable
smoothness’, that ‘it is very easy to mistake them for corresponding sonants’.

Sometimes these misperceptions find their way into dictionaries, as Doke reports:

‘It is noticeable that when emphasis is required the ejection becomes very
pronounced. In ordinary speech, however, to the untrained ear the ejection of the
explosives is scarcely perceptible. As with the unvoiced explosive, so with the
ejective explosives, confusion has often been made with the corresponding voiced
form. For instance we find entered in Bryant’s Zulu-English Dictionary *gela* (cut
down) instead of *k?7^e:laA*.’ Doke (1926:47)

More recently, Ingram and Rigsby (1987) report that for non-native listeners,
‘Gitksan glottalized stops may, in certain instances, be perceptually confused with plain
voiced stops, with which they are actually in phonemic contrast’ (134). Such confusions
were not only made by missionaries such as Price, but also by trained linguists such as
Hoard (1978:115) and Rigsby (Rigsby and Ingram 1990:259).

Johnstone (1975) noted that the ‘voiced allophone of /s/’ in Modern South
Arabian was sometimes confused with /z/ by native speakers. Caflisch (1990: 20) points
out the Georgian ejectives sound voiced to ‘many speakers of languages other than
Georgian’. Aronson (1989:16), too, says that ‘the acoustic impression one often gets
from these [glottalized] stops is that of a voiced stop’.

Although the evidence is sketchy, and misperceptions by non-native speakers do
not constitute an empirical basis for sound change, the acoustic similarity between
ejectives and voiced stops suggests a perceptual basis for the change of ejective to voiced,
in addition to the physiological bases explored in detail above. In the following section,
we will examine two languages which, for lack of a better term, I have dubbed ‘quasi-
voiced’ ejectives.

7.6.3.5. Quasi-voiced Ejectives
In this section, I will discuss reported cases of ejectives (or ejective-like sounds) which
appear to have a phonetic realization that is quite similar to voiced (especially
laryngealized) sounds. Of course truly voiced ejectives have long been recognized as a
phonetic impossibility (Catford 1939, Ladefoged and Maddieson 1996:79-80). The first
case is Kabardian, a Caucasian language (Kuipers 1960), which Colarusso (1981) has
discussed in relation to the Glottalic Theory. The second language is Gorum, a Munda
language described by Zide (1978). I should point out that neither language has, to my
knowledge, been subjected to rigorous instrumental investigation, and we would do well to bear in mind Ladefoged’s caveat about impressionistic phonetic descriptions. Nevertheless, because the Kabardian case has entered the literature on the Glottalic Theory, it is worth describing. And the Gorum data is worth examining because it is similar to Kabardian, yet different in important ways with respect to ejection and (creaky) voicing.

Phonetically, Kuipers describes the change from ejective to voiced via creaky voicing in Kabardian as follows:

‘Complete closure [of the glottis] varies with a kind of glottal trill (“Knarrstimme”). In the plosives and fricatives the larynx moves downward during the implosion and adds to the compression of the air by an upward movement during closure or constriction. The oral and glottal closures are released simultaneously. The consonants ts’, k’ and c’ often have an element of voicing, especially in the middle of a word.’ (1960:19)

Kuipers speculates that this may be because during the downward movement of the larynx, the airstream causes the vocal folds to vibrate. ‘Furthermore, the glottal trill which can replace the complete glottal closure can be voiced. The impression of voicedness in these consonants is strengthened by the fact that they are expiratory lenes’ (1960:19-20).

Colarusso agrees that most Kabardian ejectives are lenis and made with creaky voice (1989:267, 1992:10-12). (There are two exceptions, /l’/ and /r’/, which ‘are made with extreme supra-glottal articulatory tension’ (1989:267)). Colarusso ([1975] 1988) discusses the glottalized sounds in some detail. He interprets Kuipers’ description of larynx lowering as ‘a brief interval of glottal voicing, viz., they are slightly imploded’ (1988:81). Colarusso claims that this is a natural part of the gesture for a glottalic consonant since ‘the larynx must be slightly lowered in order to be raised in creating the piston-like action associated with ejectives, often even when the vocal cords are not held tightly shut’ (82). Fre Woldu (1985) does not describe such lowering in Tigrinya ejectives, so I cannot agree with Colarusso that lowering is a natural or even necessary part of the production of an ejective.

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11 ‘This distinguishes glottalic consonants from groups with ?, in the latter case the glottal release comes later than that of the preceding consonant, cf. jap’aq ‘he educated him’ versus jap’aq ‘you (s.) dyed it’. Groups of voiceless p followed by ? are distinct from both p’ and p’? by the expiratory fortis-character and the facultative aspiration of p. “Weak” voiceless stops are not found before ?.’ Kuipers (1960:19, fn 2). 394
Perhaps because Kabardian may have a slight laryngeal lowering before the larynx raising, the compression of supraglottal air is not as great as it could be. In addition, because the vocal folds do not form a tight glottal seal, they are able to create the 'glottal trill'—i.e. a laryngealized voice quality, which has periodic glottal cycles, though there is adduction of most of the vocal folds. This laryngeal quality creates an effect quite similar to voiced stops. Thus Kabardian could be an example of ejective voicing via laryngealization. However, careful phonetic study is certainly needed before accepting this scenario.

Arlene Zide (1978) describes glottalic consonants in Gorum, a Munda language, which bear a certain similarity to ejectives, though they are not produced in the same way. It is a laryngeal segment 'but which in fact, phonetically would have to be considered creaky voice' (70). Zide notes that 'the stops called glottalized or pre-glottalized in the Munda languages are neither ejective nor implosive in nature. Rather, they lie somewhere between the two'. Zide then describes the production of these sounds as the following sequence of events:

1. glottal stop
2. oral closure (minus a pressure buildup)
3. glottal release and optionally
4. nasal release plus velic release of the slight pressure (of pulmonic air)
5. voicing

Zide treats these stops in terms of Ladefoged's (1973) notation that they are pulmonic, unaspirated and perhaps partially voiced, with glottal stricture closed. Zide cites Catford (1968) in his description of glottalic egressive stops (ejectives), and she says this 'fit[s] the Munda glottalized consonants quite well'. However, she contradicts herself when she notes that the Munda sounds are not ejective. 'The potential outward flow of air which Catford refers to seems to be an essential element of the Munda pre-glottalized consonants' and is 'directly relevant to phonological rules which deal with the release of such consonants.' (72) These rules deal with nasal excrescence in morpheme-final position and bear no relevance on the production of the glottalized sounds themselves.

It seems to me that these sounds could be described as glottalized but without any laryngeal compression. Their exact status will remain speculative until instrumental work
is undertaken. However, they remain an intriguing 'missing link' between ejectives and voiced consonants.

Norman Zide (1969:414) noted that in Munda, there is no voice contrast in morpheme-final stops. ‘Nowadays’, he writes, the glottalized stops ‘are phonetically unreleased and glottalized – weakly voiced or unvoiced – but phonologically they are best treated as voiced in all the [Munda] languages’.

Regarding the orthography, N. Zide (1969:426) observes that ‘final checked b d j g, the sounds usually transcribed following Bodding as p’ t’ c’ k’, are written in Ol Cemet’ [script] as simple voiced stops (which morphophonemically they are) unmarked for checkedness, and voiceless stops in final position (almost all in loanwords) are written with the simple stop character and a “dechecking” diacritic’.

Perhaps this study, or the transcription, led to the impression that ejectives voice. Awedyk (1993:263 fn 13), citing a personal communication from Werner Winter, notes that in Santali (Munda) the dental ejective /t'/ alternates with plain voiced /d/. However, this is totally false. Patricia Donegan (p.c.) confirms that Munda has no ejectives. And recall Zide (1978), who says the glottalized consonants are neither implosive nor ejective but somewhere in between. This class of sounds deserves more careful phonetic study since they may serve as a possible ‘way station’ in the transition between ejectives and voiced stops.

7.6.4. Summary

In this section we have examined some details of the phonetics of ejectives which share certain affinities with voiced sounds and therefore make the change from ejective to voiced stop less of a phonetic or phonological impossibility. There are two general types of ejectives, fortis and lenis, and the lenis ejectives share certain qualities with voiced stops – moreso at least than the prototypical ejective. These include VOT, where we saw that some languages have very short lag VOT, and some Hausa and Zulu speakers realize the velar ejective as voiceless unaspirated or even voiced. Ejectives with stiff vocal folds are said to have longer VOTs since it takes longer to achieve modal voice. The vocal folds in lenis ejectives are said to be less stiff, and often are accompanied by creaky voice or laryngealization. The amount the larynx raises may vary by speaker and speech tempo, but less raising of the larynx generally reduces the high oral pressure characteristic of the ejective release burst; this reduction makes the production of ejectives more similar to voiced stops. Perceptually, lenis ejectives are often mistaken for
voiceless unaspirated or voiced consonants; fortis ejectives are certainly quite distinct from voiced stops. Finally, mention was made of two languages, Kabardian and Gorum, which bear certain similarities to both ejectives and voiced stops but are 'neither fish nor fowl'. The constellation of these similarities should make it easier to understand phonetically why some ejectives may indeed become voiced stops.

7.7. Phonetic Pathways and Phonological Developments

In this section, now that we have covered some of the phonetic explanations, I will examine and evaluate the plausibility of various paths for ejective voicing. After a general discussion, I will move on to direct voicing, indirect voicing, laryngealization, and finally, implosivization.

Critics of the Glottalic Theory sometimes object that ejective series are typically robust and do not undergo change. Haider (1985:7) notes that ‘ejective glottalic series are stable, compared to other marked series as e.g. labialization, retroflexion, aspiration’12. He also cites Hagège and Haudricourt (1978), who state that ejectives are stable in language contact (though note our discussion of the dissimilative voicing in Svan and Ossetic loans). But this is not to say that ejectives cannot change. Compare the stability of the initial voiceless stops in Indo-European. Among the dental/alveolar series, for example, only in Germanic do we find spirantization, and we find aspiration in Armenian. All other Indo-European languages have maintained their inherited series. Yet just because a series is typically stable does not mean that it cannot change. Old Irish has lost its voiceless labial. Only among the PIE voiceless palatal series do we begin to see more variation in reflexes. Even ejectives, as we have seen in other chapters, can

12 Haider claims that glottalic affricates are ‘quite stable and frequent’ (1985: 8) and cites Greenberg (1970:130) in claiming that in some languages, the only glottalic consonants are ejective affricates. The languages in question are (Hokan) Chontal (Waterhouse and Morrison 1950) and Korana Hottentot (Beach 1938). He questions why there are no affricate ejectives in the EM of PIE, but this confounds the implication. Simply because, as Maddieson (1984: 109) showed, ‘ejective affricates occur only in those systems containing glottalic stops (almost exclusively ejectives)’ does not mean that every system with ejectives must have affricates. Berta, Koma, and Soqotri (Maddieson 1984) are but three examples. Therefore this part of Haider’s objection is completely invalid. In addition, we have seen several examples from the Caucasus which demonstrate the ability of ejective affricates to undergo change.

The exception in Iraqw, which is a language that contains implosives. In UPSID 1992, the same is generally true, though some languages contain only ejective fricatives. I do not feel that this in itself constitutes a good argument against the Glottalic Theory for failing to reconstruct PIE ejective affricates.
lose a series due to deglottalization (e.g., unconditionally in Udi, in the Usuch-Tschaj variation of the Dokuzpara dialect of Lezgian and in the Kkujada variety of the South Avarian Andalal dialect (Job 1984)—see the chapter on Deglottalization. And ejectives may undergo debuccalization, and as we have seen in this chapter, voicing, so I would hardly call them stable.

Although ejectives might be resistant to change cross-linguistically, we can only use this to argue for the relative likelihood of such a change. We cannot rule out as implausible any changes in ejective series which involve spreading or delinking to feature geometric structure, as I hope to have shown in this thesis. Let us turn now and look at the simplest path of change, what I will refer to as ‘direct voicing’.

### 7.7.1. Direct Voicing

One of the great contradictions of sound change is that it often appears phonetically gradient, as shown by Labov’s work (e.g. 1994), yet phonologically it is quantal, involving shifts in distinctive features or phonemic categories. As Lass (1997:221) points out, a permissible step in sound change depends on a theory of primitives. The primitives in the phonological theory assumed here are distinctive features and phonological structure such as the class nodes of feature geometry, so phonologically, no change can be smaller than these. Yet as I have suggested in §7.6, the phonetic realization of ejectives is quite variable and cannot be accounted for in any detail with the presence or absence of two privative laryngeal features, [constricted glottis] and [voice]. I believe that there can be a gradient phonetic change between ejectives and voiced stops involving some or all of changes such as a decrease in VOT, the loss of distinctive oral pressure, relaxation of vocal fold tension to permit voicing, and so on. Yet phonologically, these changes may at some point be reinterpreted, restructured into new segments. The contradiction is the natural result of the tension between phonetics and phonology, the gradient vs. the categorical.

The devices of phonological theory are not inadequate in attempting to reflect a speaker’s knowledge of sound categories. Thus we can express direct ejective voicing as the spread of [voice] from a vowel, a rather direct change which telescopes what historically may have been a series of minute changes. The results will often be a changed to pulmonic voiced consonant with loss of glottal constriction, but it can also be to an implosive, where [c.g.] and [voice] coexist. Or we can express this as indirect voicing in two parts, as the delinking of the laryngeal feature [c.g.], followed by default
fill-in (or spreading). We have seen some evidence for all of these changes. In order to express minute details of sound production, however, we need a theory of phonetics such as Keating (1984) which can be integrated into the phonological component.

In diachronic cases like Chechen-Ingush, it seems that we could posit a direct change (from spreading [voice] from a vowel), though perhaps historically this was achieved incrementally. Based on the phonetic evidence I have provided, I do not believe that such a change is impossible. Compare for example, the Hausa data in which there was zero VOT for some speakers, or the evidence that Georgian ejectives are made with voiced realizations. If we allow ejective voicing synchronically, as I suggested for Columbian and Xhosa, there is no reason to disallow such a change diachronically.

Hayward (1989:47) mentions the significance of Ingram and Rigsby (1987) and Lindau (1984) for the Ejective Model, as did Fallon 1992 independently. Hayward (1989:47) notes that if PIE ejectives were lax, 'it is unclear why they did not merge with the unaspirated allophones of either the voiced aspirated (ii) or voiceless aspirated (iii) series.' As we have seen from the phonetic discussion, there is sufficient distinction between lax ejectives and voiceless or voiced unaspirated series so that no merger need be required until the sounds were restructured.

Direct voicing, then, seems to me to be a distinct possibility, though not especially common, as the Glottalic Theory implies. Upon closer examination, even the proponents of the Glottalic Theory seem to prefer intermediate steps as we shall see in the next section on laryngealization.

### 7.7.2. Indirect Voicing

Indirect voicing is another possibility. The indirect voicing of ejectives involves their loss of distinct glottalization and the subsequent voicing of the voiceless unaspirated series. This is easiest to detect if other series, typically another voiceless one, undergo voicing as well. For example, indirect voicing seems to take place in Slave and Tillamook, and has occurred in Western Jicaque, for example. Another type of indirect voicing, delinking followed by [voice] as a default, was proposed for Lezgian.

Indirect voicing may have more appeal to historical linguists uneasy with the idea of ejectives becoming voiced. But as Hayward pointed out, it may cause trouble if unaspirated allophones do not also voice. In addition, if another series does not undergo voicing, then the indirect approach may not be motivated. It may be simpler simply to posit spread of [voice] from an adjacent vowel. There do not seem to be any cases of a
shift from ejective to voiced in languages with contrastive voiceless unaspirated and voiceless aspirated series in which the unaspirated was not also affected.

7.7.3. Laryngealization

Another commonly posited path of development from ejective to voiced is via laryngealization. Gamkrelidze and Ivanov (1984:49-52) suggest that the development of glottalized (ejective) stops was to voiced pre-glottalized stops (or stops with laryngealized voicing) to plain voiced. They also note that glottalized consonants are closer to voiced on Ladefoged’s scale of laryngeal/glottal features since ejectives have a closed glottis and voiced sounds have a partially closed, vibrating glottis (see the literature review in Chapter 2). To compare, Ladefoged’s (1973) scale classifies ejective and voiced stops as follows:

(69) p’ b

<table>
<thead>
<tr>
<th>Feature</th>
<th>p’</th>
<th>b</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glottalicness</td>
<td>+1</td>
<td>0</td>
</tr>
<tr>
<td>Glottal stricture</td>
<td>8</td>
<td>5</td>
</tr>
<tr>
<td>Voice onset</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

When described featurally, there are differences in all three of Ladefoged’s categories. However, in two of the features, the difference is only by a factor of one. As far as glottalicness is concerned, we have seen that in Tigrinya conversation, ejectives have much less compression than in isolation because the larynx is not raised as high. The less the larynx rises, the more voice-like it becomes. In terms of Voice Onset Time, we have seen great variability for ejectives, but some have such low VOT as to be virtually voiced, as in Hausa or Abkhaz. Finally, in terms of glottal stricture, although we have no physiological data on lenis ejectives, it seems likely from the many phonetic descriptions of Abaza, perhaps Kabardian, and Hausa, that ejectives can become laryngealized. It is certainly conceivable that glottal stricture due to medial compression of the vocal folds not be as tight. This could be another factor in the weakness of conversational ejectives, since if the glottis is not tightly closed, there will not be as great a change in oral pressure.

Colarusso 1988 notes that the Ejective Model change from ejective to voiced (via laryngealization) is plausible since ‘laryngealized stops give a very good approximation
of normal voiced stops.' Colarusso speculates what systemic changes may lead to laryngealization and ultimately voicing:

'This weakening of the ejective source configuration may be related to the loss of the unaspirated series. The presence of an unaspirated series may motivate a language to realize its glottal series as true ejectives so that they are phonetically more distinct from the unaspirated series. In this regard Bzheduakh appears to be extreme, having made its glottalic series so strongly ejective as to have obliterated an earlier distinction between ejective consonant and ejective consonant plus glottal stop. Once an unaspirated series is lost, the presence of voicing or aspiration in the other non-glottalic series may be a sufficient cue to distinguish them from the glottalic one. The ejective series may then be realized as a laryngealized or unaspirated one.' (Colarusso [1975]1988:81-2)

Colarusso leaves open the possibility that the way to voicing is via simple unaspirated voiceless stops, which, according to Lombardi (1991), are what results from laryngeal neutralization. I believe this is a quite plausible path of sound change.

Ladefoged and Maddieson (1996:55) observe that in some languages, laryngeal constriction occurs closer to the release of the consonant and that voicing is 'irregular or absent during the closure'. This ties in with the fact that ejectives, with glottal constriction, also lack voice during closure. Laryngealized segments also vary in their timing from a single segment [d] to a sequence of [d?] or [?d]. The sequence with the glottal stop first corresponds most closely to the change that I envision, since ejectives contain glottal-stop like constriction. The voiced stop component corresponds to the voicing component as a transition to the vowel. Eventually, the glottal component is lost.

7.7.4. Implosivization

Many linguists now believe that PIE ejectives became implosive. The earliest discussion of such a change which I have found is a hypothetical path in Martinet (1955 [1964]: 114). Martinet said (my translation below):

'We can, moreover, imagine a passage of /t/ to /d/ by progressive anticipation of the voice of the following vowel, and likewise, in the end of the account, a result /d/ if the sonority /voicing extends finally to the whole phoneme. This would permit us to envisage the passage of a correlation like

\[
\begin{align*}
\text{p} & \rightarrow \text{t} & \rightarrow \text{k} \\
\text{p?} & \rightarrow \text{t?} & \rightarrow \text{?k?} & \rightarrow \text{?b} & \rightarrow \text{?d} & \rightarrow \text{?g} & \rightarrow \text{b} & \rightarrow \text{d} & \rightarrow \text{g} \\
\end{align*}
\]
Martinet is vague, perhaps purposefully so, about whether the preglottalized sounds are to be interpreted as truly preglottalized, laryngealized, or perhaps implosive. He may be hinting at the latter, since he says that post-glottalization and preglottalization are one and the same series. This type of ‘complementary distribution’ across source features (with respect to place of articulation) is relatively common among glottalized consonants.

Several languages which have both ejectives and implosives seem to have them in complementary distribution by place of articulation. In Maddieson (1984), for example, the languages Ik, Berta, and Hausa do not contrast glottalicness within a place of articulation. It is worth investigating what spectral characteristics ejectives and implosives may share, since physiologically, ejectives and implosives involve movement of the larynx in opposite directions. Mary Beckman (p.c.) has suggested that this common acoustic factor may be pressed voice, but a more thorough examination of the acoustics of glottalic sounds than is possible here may shed light on this phenomena.

Pinkerton (1986) has examined several Quichean languages and found through a careful study of acoustic and aerodynamic data that phonetically, some of the sounds which were thought to be (voiced) implosives are actually voiceless implosives. Pinkerton used a pressure transducer (and a nasal catheter) to obtain air pressure measurements of ejectives. She found, as Campbell (1973) mentioned, that several of the languages actually contained voiceless implosives at bilabial, alveolar, and even uvular places of articulation. The data from several of the Quichean languages, which have only implosive uvulars, go against Greenberg’s (1970) predictions that languages will have implosives at more anterior regions if they have more posterior implosives. The uvular implosive is, however, voiceless. At the alveolar place of articulation, there were three variants of the glottalized alveolar: (1) an ejective; (2) a voiceless implosive with voicing lag in Tactic Pocomchi; and (3) an implosive with voicing lead in Tzutujil. This suggests, at least within the Quichean languages, a possible development of:

(70) voiceless ejective > voiceless implosive > voiced implosive

Lindau (1984) found that ‘five out of the fourteen Hausa speakers produced implosives with (nearly) voiceless closures’ (149). Lindau later specifies that the voicelessness occurred at the beginning of the closure, ‘presumably from a glottal closure as the larynx descends’ (151). She speculates that the voiceless aperiodicity may serve to distinguish the implosives from the periodic voicing of the plain voiced stops. This may
well be a link between ejectives and implosives. Note, however, that Pinkerton proposes the change from voiceless implosive to voiced implosive, while Lindau implies that there is a change in the opposite direction, from voiced to voiceless implosive.

Ladefoged and Maddieson (1996:82) observe that the laryngeal setting of implosives may vary and that they can be produced with modal voice. The change from implosive to voiced stop is most easily explained with this type of implosive.

Haider (1985) is an interesting variant of the Glottalic Theory which posits implosives for the traditional voiced series (hence Job's (1989) apt term the Ejective Model, since it is no longer synonymous with the Glottalic Theory (Hypothesis). Haider proposes a simple deglottalization rule in the daughter languages; as Salmons (1993:42) notes, 'the change is simply a loss of glottalic character, an extremely straightforward process'. Haudricourt (1950, 1975), Greenberg (1970), Blust (1980) and Solnit (1992) have noted the diachronic development of voiced implosive to voiced stop. For example, Greenberg (1970:131 reports that in certain positions, the bilabial implosives in the Mayan languages Mayan and Tsotsil are realized allophonically as voiced stops. Diachronically, he reports a merger of /d/ and /d/ in Alur, the change in Cham from *ʔb > b, and others. The development of implosives from voiced stops seems to me more common than the reverse, though Ladefoged and Maddieson (1996) have said that 'there is a gradient between one form of voiced plosive and what be be called a true implosive, rather than two clearly defined classes' (82). In additional support for his thesis, Haider claims that the PIE *b gap thus results from *ɓ > *m, a sound change attested in Tong (Hagège and Haudricourt 1978:100); Vietnamese, where 'salt' /muoi/ corresponds to Muong /ʔbo:i/ (154). Greenberg (1970:137) also states that this occurs in Po-ai Thai, some Burmese Shan dialects, and Jarai, where implosives have changed to glottalized nasals.

Salmons, in discussing Haider (1985), notes the apparent contradiction in positing an implosive versus an ejective glottalic series. 'Reconstructing implosives requires positing a change, albeit an attested one, while reconstructing ejectives leaves us with a natural gap without sound changes.' (53). I hope I have shown in this chapter that there certainly are attested sound changes involving ejective voicing and that the contradiction is spurious. Nevertheless, Salmons' solution is to note that a sharp distinction between ejectives and implosives is not always made in a given phonological system. And we have seen this in our discussions of languages from Maddieson (1984) and such languages as Mam and Tzutujil. Salmons (1993) proposes 'positing a variable
glottalic set, consisting of implosives and/or ejectives' (24). As for the change from glottalic to voiced, Salmons (1993:42) states that 'in my own view, a direct change from glottalic to plain voiced is quite simple because...ejective and implosives often coexist within a system or in closely related dialects.'

With regard to the Indo-European daughter languages, Salmons proposes that Germanic and Armenian had (or evolved) ejectives, while most other Indo-European dialects had (or evolved) implosives. (Baldi and Johnston-Staver (1989) argue that PIE ejectives became implosives and then voiced stops in Italic). Salmons argues that 'in fact, some later developments are easily motivated by assuming a dialectal split between implosives and ejectives'. In this way Salmons claims to overcome Garrett's (1991) objection to the Glottalic Theory that so many of the Indo-European daughter languages show voiced reflexes of the supposed ejective series, since they are reinterpreted as implosive by Salmons.

Salmons unfortunately does not indicate why some dialects evolved ejectives and others implosives, nor does he formalize his proposal. The evidence he cites merely argues that in some languages, the glottalics are in alternation within a series as in Hausa /b d k' k'i k''/. Perhaps saying that ejectives and implosives are in complementary distribution with respect to place of articulation would be more precise than 'alternation', which implies morphophonemic alternation. If he assumes such a mixed glottalic series, then in saying that there was a dialectal split or splits, then in Germanic and Armenian, the anterior implosives would have yielded ejectives in order to feed deglottalization of the revised Grimm's Law: *b *d > p' t', then *p' t' k' > PGmc *p t k. Such a change may be typically word-finally, but it does not seem likely in initial position, though this merits further study. If the anterior implosives had not devoiced, but simply deglottalized in Grimm's Law, then *b d k' > b d k, which is incorrect. In most other PIE languages, the presumed velar ejectives would have voiced: PIE *k' > g, and then all glottalics would undergo devoicing *b d g > b d g. Otherwise, simple devoicing would have yielded the incorrect *b d k' > b d k'.

If this is not what Salmons intended, then the other possible interpretation does injustice to the facts. Salmons could also be seen to propose reconstructing a 'glottalic' series (whose value in the parent language is undetermined) but which had variable reflexes in the daughter languages: ejectives in Germanic and Armenian, and implosives in most others. However, as Gamkrelidze (1990) points out, the markedness relations for implosives tend to favor, not disfavor the labial place of articulation (see also
Greenberg 1970, Maddieson 1984). If there were a true dialectal split, then the series which evolved voiced implosives would be counter to typological expectations, based on the commonness of labial implosives and their paucity in the velar series. And the converse is true for the velar ejectives turned implosive. These voiced velar implosives are extremely rare in phonological inventories. Additional objections are raised by Job (1989:130), who commented on the shift of ejective > implosive > plain voiced. ‘Such a drastic change in the ejective model would raise a number of questions and objections directed against the very core of the model.’ Here I must agree with Job. Although I have documented cases of the change, the synchronic typological considerations run against this view. Indeed, such a proposal undoes the original justification of the Ejective Model.

7.7.5. Summary
Let me give a schematic overview of some of the phonetic paths from ejective to voiced sound:

Figure 7.2. Phonetic paths of ejective voicing.

Figure 7.2 illustrates the part of a lenition hierarchy relevant to ejective voicing; the other common change, debuccalization, is not shown. Reading from left to right, a fortis ejective may become more lenis. An ejective may then deglottalize, and eventually undergo voicing (indirect voicing), or it may undergo direct voicing, as from assimilation to an adjacent vowel. An ejective may also become implosive, perhaps via a stage of voiceless implosion. Or an ejective may undergo laryngealization in which the glottalic component bleeds into creaky voice so that eventually the whole segment becomes voiced and laryngealized, and eventually simply voiced.
In sum, we have seen that there is a tremendous amount of variation in the production of ejectives, both cross-linguistically and individually. I have discussed four possible directions of change from ejective to voiced: direct and indirect voicing, laryngealization, and implosivization. Baldi and Johnston-Staver (1989:94) note that 'breathy voice, creaky voice, and implosion have all been mentioned as reasonable intermediate stages, though there is no direct evidence to suggest which, if any, stage the sounds passed through'. I have found no documentation for ejectives changing to breathy voiced, and so I do not believe this is a plausible intermediate stage. Creaky or laryngealized voicing seems to be fairly common, as we have seen in Kabardian, for example. And implosivization has occurred independently in a number of African and Central American languages. I feel that these changes are valid possibilities, and that given dialectal variation, they both could be paths of ejective development. And I hope I have shown that we should not, as Baldi and Johnston-Staver do, automatically rule out the possibility of direct phonetic or phonological change.

7.8. Social Variation
In this review of the phonetics of ejectives, we have seen that the production of ejectives is gradient. As noted in §7.6, the strength of an ejective is dependent on its phonological position and on the fast-speech rules of a language. In addition, though, we have seen ejectives vary according to register (Hausa, Greenberg 1941; Georgian, Kingston 1985). We have also seen reports of idiosyncratic variation: Maidu (Shipley 1964), Southeastern Pomo (Moshinsky 1974), and Wintu (Pitkin 1984). Because sound change is often drawn from a pool of synchronic variation (Ohala 1988), we would expect to see this variation attain the status of a sociolinguistic marker. And, indeed, there are several cases which suggest that this has happened, though there are, to my knowledge, no quantitative Labovian analyses of such sociolinguistic variation.

Pinkerton (1986), in an important phonetic study of seven Quichean languages spoken in Guatemala, noted that there was 'considerable regional (and possibly individual) dialect variation' (135), some of it also varying by age of the speaker. Ingram and Rigsby have shown that the ejectives of a female speaker of Gitksan were more fortis than those of her son, who, although bilingual, 'clearly favored English in his everyday speech'. Compare also the following remarks by Andrade (1933) regarding Quileute speakers:
'The harsh, cracking sounds of q' and t̪ are much softer among the young folk, who because of their fluent command of English are in more intimate contact with the white people. These sounds frequently provoke ridicule from some of the Whites upon hearing them for the first time, and even those to whom these sounds are more or less familiar frequently mimic them in a grotesque manner when jesting with the Indians. This may exert a restraining influence upon the younger Quileute who as a rule seem to be very sensitive to ridicule and aspire to social equality with the Whites.' (Andrade 1933: 154).

In addition, Andrade mentions that 'the articulation of the whole glottalized series is much more energetic among the old generation' (1933:156). The above quotes clearly illustrates the social pressures that can affect the production of ejectives, though in this case the pressure came from the dominant group which spoke a different language13. Interestingly, in the Wintu case cited above (Pitzking 1984), the younger speakers made more fortis ejectives.

Herbert (1985) notes that Southern Bantu ejectives are much weaker than in Caucasian languages. He also notes that in some languages, ejectives are a mark of formal style, as in Zulu, or they have social marking, as in Southern Bantu, where females have stronger ejection than males. Like Herbert's observations regarding Southern Bantu, (and intragenerational data in Ingram and Rigsby 1987), Pinkerton's data indicate that there is sociolinguistic marking attached to ejectives.

Khachatrian (1996) reports that glottalization in Armenian 'may have also social stratification, since the speech of less educated people bears traces of dialect articulation and is more vigorous' (1996:52).

The social variants are reported in different languages to vary along all the traditional sociolinguistic parameters: age, gender, region, and style; only social class lacks, but if less education correlates with lower social class in Armenian society, then it can vary along this parameter as well. The many different ways of producing ejectives can result in attaching sociolinguistic value to a variant, which in turn can help propel sound change, such as from ejective, to eventual (merger with) voiced sounds.

As William Labov (1994:17-8) has noted

'studies of linguistic change in progress, which complement the strengths and weaknesses of traditional diachronic data, should illuminate features of the past

13 Michael Silverstein reported to me at BLS-21 that he had faced a little ridicule even from fellow linguists for the production of his lenis ejectives at a meeting of Athapaskanists, who produced more fortis ejectives.
that were hidden from view, and so contribute toward the resolution of long-standing questions of historical linguistics.’

In this section I have shown that there are signs that production of ejectives can correlate with sociolinguistic variables. In §7.6 I showed that ejectives may undergo a type of lenition in which they lose some of the most salient properties of ejectives and therefore become more like voiced sounds. I would therefore not be at all surprised if, given enough quantitative sociolinguistic studies, we could find a change in progress from ejective to voiced stop.

7.9. Conclusion

In this chapter I have examined the change of ejective to voiced from several angles, emphasizing the importance of this data for both phonological theory and for historical linguistics. The change from ejective to voiced is accounted for in two ways: as direct voicing via spread of an adjacent vowel, as in Columbian Salish (§7.3.1) and Xhosa (§7.3.3.), or indirect voicing via delinking of the Laryngeal node or the feature [e.g.], then applying [voice] as a default (Lezgian) or spreading [voice] in a feature-filling way (Tillamook in §7.3.1, optionally in Slave in §7.3.4). The spread of [voice] may be concomitant with dissociation of [e.g.], in which case a voiced pulmonic stop results, or there may be no dissociation, in which case an implosive results. In no case were powerful rewrite rules of the type [e.g.] → [voice] required, and thus phonological theory does not need to revise its assumptions of rule types involving spreading and delinking of association lines.

Although the voicing of ejectives is not as widespread as the changes required by the Ejective Model, we have seen voicing and implosivization both synchronically and diachronically in a number of different languages and language families. One of the best documented examples is in Chechen-Ingush (§7.4.2.1), where non-initial ejectives became voiced. There was no evidence for a change of the type required by the EM: loss of glottalization across the board in an unconditioned fashion.

I have also examined in some detail both the anecdotal and instrumental data to show that there is strong reason to support a phonetic typology of tense and lax ejectives. I have supported Kingston’s typology from various phonetic studies, including many which Kingston did not examine, in addition to documenting the origins of such a typology. I have proposed a tendency of Ejective Lenition, which states that under certain prosodic and phonotactic conditions, tense ejectives lenite to lax ejectives.
Finally, I have outlined various possible phonetic pathways from ejective to voiced, including implosivization and laryngealization, and have found evidence that the realization of ejectives can lead it to become a sociolinguistic marker.

I have increased the empirical database of sound alternation and sound change involving ejectives, thereby contributing to synchronic and diachronic typology. I also hope to have dispelled the myth of implausibility of ejective voicing. The data gathered here do not by any means validate the Ejective Model—such validation will require careful study and reassessment of almost 200 years of assumptions (e.g. the papers in Vennemann 1989). However, they do help rebut some of the Glottalic Theory’s sharpest criticisms and should breathe new life into the debate. Garrett (1991:803) said the Glottalic Theory ‘was an exciting proposal but perhaps...one whose time has come and gone’. But like Mark Twain (and more recently, Bob Hope), I think rumors of its death are greatly exaggerated.
8.1. Introduction
In phonology, fusion, Herbert (1977:144) noted, 'has long been recognized within the
domain of suprasegmental phonology'. And fusion and fission are processes long
known in historical linguistics. Jakobson (1931[1990]), for example, defined fission
periphrastically as 'a phoneme splits into a group of phonemes' and fusion was described
as 'a group of phonemes is transformed into a phoneme'. Other terms for fusion, some
only for these processes in vowels, include: coalescence, coalescent assimilation,
contraction, merger, monophthongization, and unification. Terms for fission include:
breaking, diphthongization, fracture, linearization, split, segmentalization, and
unpacking.

Herbert (1977:145) pointed out that consonantal fusion 'occurs much more rarely
than either vocalic or suprasegmental fusion and has played a much lesser role within the
theory.' While fusion is still among the less well understood phenomena, it has played
an increasingly important role in contemporary theory.

Fusion has been proposed by Avery and Rice (1989) and Clements and Hume
1995:265) as one of the elementary rule types found in autosegmental phonology, along
with linking and delinking of association lines, and default feature insertion. The creation
of ejectives through fusion with glottal stop certainly provides an abundance of examples
of such a process. Clements and Hume also note that fission, designed to account for
diphthongization and other types of 'breaking' phenomena, may be another elementary
rule type, one which has been used by Clements 1989c, for example. Ejective fission is
the separation of the glottal from the supralaryngeal elements so the result is a sequence
of glottal stop followed by a pulmonic stop.

Section 8.2 provides the theoretical background to account for these processes,
starting with basic analytical questions such as whether a given string of phones, say
[kʔ], is a phonological unit or a cluster. This is important since if an underlying cluster
becomes a unit [k’], then we may say fusion has taken place, while those that remain a
cluster have not undergone fusion. Thus §8.2.1.1 reviews some of the generally accepted phonological criteria for units vs. clusters. Arguments relating to ejectives as units are given in §8.2.1.2, while evidence for their derived, biconsonantal status is shown in §8.2.1.3. A brief review of various generative formalisms of fusion is provided in §8.2.2, and fission, in §8.2.3. The few examples of synchronic and diachronic ejective fission are analyzed in §8.3, while the next section contains reference to a wealth of fusion processes which create ejectives. The last section concludes that both fission and fusion should be admitted as basic (but relatively rare) nonlinear operations on representations.

8.2. Theoretical Background

8.2.1. On the Status of Clusters with Glottal Stop vs. Ejectives

8.2.1.1. General Considerations

Before proceeding, it will be helpful to review the arguments for fusion in relation to one of the classic questions in phonology: How to decide if something is one unit or two? This question is important because some purported cases of ejective fusion are simply the result of a theoretical decision to treat ejectives as clusters, which then undergo phonetic fusion, rather than recognizing them as underlying units. The answer to whether ejectives are one unit and hence do not undergo fusion, or whether they originate from two units and hence do undergo fusion may be found in the familiar arguments on treating certain sequences (especially affricates) as a unit or as a cluster (e.g. Chao 1934, Pike 1947, Zellig Harris 1951, Hockett 1955, Hyman 1975, Lass 1984, Burquest and Payne 1993, and Steriade 1994). Burquest and Payne (1993:115-6) offer the following suggestions, with my comments in parentheses:

(1) a. ‘Are the potentially ambiguous consonants the only attested clusters? If so, then perhaps they are single units. For example, Cashinahua /ts. ñ/ if interpreted as clusters, would be the only such clusters in the language. Postulated segments should conform to a language’s phonotactics.’ (If a language’s only clusters involve voiceless stop plus glottal stop, it is probably best to analyze them as unit ejectives).

b. ‘If both members of an ambiguous sequence are not attested outside the sequence, this is usually evidence for a single segment. For example, Spanish /tʃ/ is a unit, because /ʃ/ does not occur elsewhere.’ (An analysis which postulated ejectives as
sequences of stop plus glottal stop, but which did not otherwise have an independent glottal stop lacks credibility.)

c. ‘If a sequence has wide occurrence, it is typically a unit.’ (One problem is that because ejectives are typically marked, their frequency, even if they are analyzed as units, will generally not approach that of voiceless stops (e.g. Trubetzkoy (1939/1969:264; cf. Hayward 1989, Wedekind 1990a)).

d. ‘Typically, clusters will not have severely limited distribution for both members of the cluster.’ (Do glottal stops, for example, occur only in clusters after voiceless stops?)

e. ‘Examine allophonic or morphophonemic alternations.’ (Many such examples will be provided below).

f. Examine external evidence like language games, slow syllabification, slips of the tongue, etc. (The only such documented evidence that I am aware of involves syllabification).

Hyman (1975:133) reviews older generative claims regarding economy of feature counting as one criterion. For example, Harms (1966) argued that in some languages, it could be more economical to establish clusters of consonant plus /h/, while in other cases, it could be more economical to establish aspirated consonants: /Ch/ vs. /Ch/. Harms takes this argument to an extreme, claiming that speakers take into account the proportion of lexical items in determining their phonological representations in order to create the most economical representations.

Many such analyses will always involve the problem of indeterminacy, or non-uniqueness (Chao 1934). Ohman et al. (1976:155), for example, discuss Welamo, a North Omotic language, and claim that ‘it is not clear whether all combinations involving glottal stops are to be treated as clusters or as glottalized consonants.’ Liccardi and Grimes (1968) are also ambivalent in their analysis of the phonemes of Itonama. In evaluating the following claims presented below, it would be wise to keep in mind Hockett’s (1955:162) maxim that, ‘in a way, what counts is not so much the interpretation which one accepts as the evidence on which that interpretation is based.’

Phonetically speaking, it should not in principle be difficult to determine whether one is dealing with a glottalic egressive ejective or with a sequence of pulmonic egressive obstruent followed by glottal stop. Ladefoged and Zeitoun (1993:13), for example, suggest the simultaneous recording of oral and subglottal pressure to distinguish between
[f ] and [f?] (though such measurements may present practical difficulties). However, Ladefoged and Maddieson (1996:369) observe that 'there is no sharp division between ejectives and plosives accompanied by a glottal stop.' But even where languages have phonetic ejectives, this begs the questions of how they behave phonologically.

I should point out that sometimes analyses are hard to pin down because different linguists will analyze the same language differently, and sometimes change their mind. Aoki (1970:66) notes that 'frequently, older grammars lack the glottalized series'. For example, Tonkawa was analyzed by Hoijer (1933-8) as having glottalized stops and sonorants, but in Hoijer (1946) these are analyzed as clusters. Likewise, the aspirates and ejectives of Takelma (Sapir 1922) were reanalyzed by Swadesh as clusters, with no explanation except apparently to reduce the phonemic inventory (Sapir and Swadesh 1953). A flavor of some of these controversies, including more recent treatments of Tonkawa, is presented below.

8.2.1.2. Ejectives as Units
One of the most clear-cut arguments that ejectives are single phonemes (and therefore no fusion process can be posited) comes from languages like Kwakiutl (Boas 1947), a language in which there are no initial clusters, and glottalized stops or laryngealized nasals and liquids do not appear in a cluster. It is therefore inconsistent with pattern congruity to posit ejectives as the only consonant clusters (reasons (1a) and (1d) above).

Abkhaz (Hewitt 1989b) has a series of ejectives but no independent glottal stop, so the ejectives are considered units, by (1b) above. Languages with ejectives and glottal stop outnumber those with ejectives but no glottal stop by roughly three to one. Maddieson (1984) lists many languages with ejectives but no glottal stop, including: Amharic, Eastern Armenian, Dakota, Dizi, Georgian, Hamer, Ik, Jaqaru, Maidu, Quechua, Zulu, and !Xû. An analysis which postulates that ejectives in these languages were derived from clusters would lack plausibility.

Kuipers (1967:21) argues that it would be wrong to regard the Squamish ejectives as sequences of voiceless stop plus glottal stop in part because ejectives are just as frequent in the lexicon as plain stops, and /fs/' is twice as frequent as /fns/ (reason (1c)). Nater (1984) made the same argument for Bella Coola. Ford (1990) argues that Ko:reteno ejectives are units, since otherwise no consonant cluster appears initially (reason 1d).

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Hargus (1988:16) shows that in Sekani, the ejectives are not sequences of stop plus glottal stop because of differences in syllabification. For example:

(2)  gat.?alè?  ‘spruce branch’
     mə.t’ale?  ‘his, her zyphoid process’

Thus ejectives are shown to be units on the basis of (1f). There are, however, derived ejectives as well, discussed in §8.4. (Compare also Shaw’s 1980 analysis of Dakota underlying and derived ejectives, or Burquest and Payne’s 1993 analysis of Korean, which has both underlying and derived aspirates). We should therefore admit the possibility of both underlying and derived ejectives.

In sum, ejectives as units have been posited based on such arguments as phonotactics and syllabification. Next, we shall examine cases in the literature in which ejectives are argued to come from sequences of consonants. And it is from such sequences that we can examine fusion processes.

8.2.1.3. Electives as Clusters

Some of the reasons what are phonetically ejectives are posited as clusters is because of the lack of contrast between an ejective and a sequence of plain stop followed by glottal stop. Webb (1971:3) argued for the Pomo languages, which do have ejectives, that ‘a glottalized series seems unnecessary since never does the consonant with glottalization contrast with the plain consonant plus /ɬ/’. In other words, in such an analysis, ejectives and glottal stop are in complementary distribution: /ɬ/ has the allophone [ɭ] glottalization after voiceless stops and [ʔ] elsewhere. This line of thinking was common in structuralist analysis in order to economize on the number of phonemes in a language. Another more recent example is Claesson’s (1994) analysis of Mataco-Noctenes, with arguments that phonetic ejectives are derived from clusters based on pattern congruity, phoneme economy, and morphophonemic alternations. An argument that a cluster is not an ejective, based on syllabification, may be found in Gibson’s (1956) analysis of Pame, e.g. /sat.?èʔ/ ‘sheep (sg.)’ and not */sa.t?èʔ/, though initially and finally, ejective-producing fusion may take place.

As noted above, occasionally the same language is given different treatments by different authors. Once such case is Tonkawa, for which Charles Kisseberth and Elaine Phelps, who both use data by Hoijer, arrive at different conclusions. In Tonkawa, vowel
elision and shortening occur in contexts other than before or after glottalized stops. Phelps (1975) argues, contra Kisseberth (1970), that Tonkawa ejectives behave phonologically as clusters of stop plus /ʔ/. Kisseberth had claimed that Vowel Shortening does not occur in the environment C’-C as expected, e.g. ‘he is licking it’ /netalenoʔ/ → [netlenoʔ], vs. /we-s’akonoʔ/ → [wes’akonoʔ] ‘he is scraping them’. The first stem vowel does not elide after the CV prefix, as it does in other cases. Shortening does occur in the context C’-C (e.g. /ls’e:toʔ/ ‘he cuts him’ vs. /kes’e:toʔ/ ‘he cuts me’.

Phelps (1975) notes that ‘within an analysis that treats Cʔ as a single segment, C’, there is no explanation for the fact that some long vowels shorten before glottalized consonants while others do not.’ She proposes on this basis to treat them as a cluster. Kisseberth had advanced two arguments that ejectives are not clusters. First, that stems do not generally begin with clusters. Phelps counters that to declare this is to decide the question in advance. Also, intervocally, the segments in question syllabify differently, e.g. /xʷ’e:loʔ/ ‘he misses him’ vs. /kexʷ’e:loʔ/ ‘he misses me’. She compares this to languages she has observed as in Makah, Lummi, and Haida, which do not change syllabification according to position. Second, Kisseberth argued, in reduplication, ejectives behave as a single consonants, e.g. /jalxilna-ʔ/ ‘to run’ reduplicates as /jalalxilna-/, and /hes’eke-na/ ‘to stretch one’s neck (pl. subject) reduplicates as /hes’es’eke-na/ not /*heses?eke-na/ as a cluster analysis would predict. She counters with forms like Theses’eke-ʔ which show a cluster-type reduplication of the initial CV. I will not repeat here her complex argumentation on this point, nor will I attempt to reanalyze Tonkawa; instead I simply hope to have shown some of the complexities in determining phonologically what, exactly, is an ejective.

Another controversial language is Yuchi. According to Ballard’s (1975) analysis, the unaspirated obstruents (stops, affricates, and fricatives) occur in clusters before /ʔ/. Ballard notes that previous studies (Wagner 1934, Wolff 1948) treated these as a separate glottalized series. He opposes this view, asking, ‘to what extent are we led to posit /Cʔ/ as a co-articulation because of the existence of the notion of glottalization? Why don’t we posit dentalized [sic] stops for [ækʔ] ‘act’ and [æpt] ‘apt’ in English?’ (1975:185). One reason is that such segments would never occur initially in English: *kī, *pī; languages usually have more phonotactic restrictions in coda position than in onset position. Another reason has to do with stress placement in words such as distract and corrupt. Assuming extrametricality of the final consonant, stress is still generally placed on a
heavy ult for verbs. There are many other reasons one could offer, but Ballard's point does not seem to a valid one. Few, if any phonologists try to fit the data into a category simply because a category exists. One must look at the language as a whole. Steriade (1994) provides a formalized response against positing 'dentalized stops' for [kt], discussed below.

Steriade (1994) offers a reanalysis of pre- and post-glottalized plosives in Yuchi (based on Wolff 1948) using her system of aperture nodes (§2.3.3 and §8.2.2). Wolff had decided to phonemicize all consonant sequences as clusters rather than unit phonemes. Onsets with postglottalization include: /pʔ tʔ tsʔ tʃʔ kʔ bʔ dʔ gʔ tɬʔ fʔ sʔ jʔ/. There are also preglottalized clusters: /ʔp tʔ, tsʔ kʔ lʔ ʃʔ/ and the aspirates /ph th kh/. Steriade admits that 'most of these phonetic sequences could be analyzed as monosegmental at all levels of the derivation' (274). She posits a rule of bidirectional merger (3):

(3) Merge $A_{\text{max}}$ with adjacent A position

\[
\begin{array}{c}
\text{[c.g.]} \\
\text{[c.g.]} \\
\end{array}
\]

An example of ejective fusion in her system would be represented as follows:

(4) \[p + ? A_0A_{\text{max}} A_{\text{max}} \rightarrow p' A_0A_{\text{max}} \]

\[
\begin{array}{c}
\text{[c.g.]} \\
\text{[c.g.]} \\
\end{array}
\]

In Steriade's analysis, two distinct aperture positions are merged into one segment because they are nondistinct (they have only one place node and only one basic A-position). The formal definition of a monosegment given by Steriade (1994:217) is found in (5):

(5) Single segments in derived representations

A string of adjacent A-positions and associated autosegments is a single segment iff:

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(a) It contains at most one basic A-position
(b) Any derived A-positions it contains are attributable to projection by the basic A-position
(c) It contains at most one place node
(d) For any pair of autosegments F and G that it contains, F and G are compatible.

In short, a new notation has helped solve some of the ambiguities regarding the cluster vs. unit debate.

In sum, linguists have argued that ejectives may be analyzed as a sequence of two different consonants using such reasons as outlined in (1). A host of potentially valid arguments can be made, though we should never forget that sometimes it is simply the personal preference of the linguist, or the prevailing theoretical winds, which tip the balance between genuine cases of indeterminacy.

8.2.2. Fusion
The formalism of fusion has long been dominated by this phenomenon in vowels. Fusion, or contraction, was treated in Chomsky and Halle’s The Sound Pattern of English (SPE) as the result of a type of transformational rule which deleted one component, and changed the feature specification of another so that it was more like the second. The change from /ai/ → /æ/, for example, is realized as a transformational rule in which /a/ is rewritten with the [-back] of the /i/, and then /i/ is deleted (1968:360).

Stahlke (1976) addressed the possibilities of consonantal fusion by analyzing the Tswana causative. Stem-final /i/, for example, followed by the causative /ja/ becomes fused to /i[bf]wa/, as in /lêofa/ ‘sin’, /lêo[tj]wa/ ‘cause to sin’. In this analysis, the labial element originates from the labiodental fricative. Stahlke also provided evidence of other fusions, both consonantal and vocalic, and is noteworthy in the classical generative literature for attempting to treat such phenomena, arguing especially against a solution involving rule ordering, and against a strictly segmental view, though still with transformations. Herbert (1977a) reanalyzed some of Stahlke’s data, pointing out their morphophonemic character, and along with Herbert (1977b), is also an important early contribution to consonantal fusion.

SPE transformational rules have been criticized on the grounds of being excessively powerful in phonology. Also, the representation is ‘hardly transparent’ and
the transfer of certain features but not others is arbitrary (Durand 1990:291). Therefore, phonologists have attempted to avoid such notation, also used for metathesis, and look for other ways of expressing such processes, though as recently as 1986 (Michelson; McCarthy), vowel coalescence was still expressed in the SPE fashion.

With the advent of autosegmental phonology, fusion was used as a device for merging association lines. Leben, for example, proposes an analysis of fusion as the ‘prephonological adjustment’ which reinterprets ‘a sequence of identical consonants as a single long consonant’ (1980:507). Such a formalism helped to account for the avoidance or repair of OCP violations and was important in developing ideas of geminate integrity (Schein and Steriade 1986). Concepts related to fusion include Steriade’s (1982) Twin Feature Convention (see also Clements (1985)) and Tier Conflation (Mester 1986, McCarthy 1986).

Wetzels (1986) proposed a nuclear fusion principle to account for vowel coalescence in Ancient Greek, though fusion itself was accomplished through delinking and spread. Haas (1988) is a thorough attempt at constraining processes of vowel coalescence, arguing that coalescence is bidirectional and thus distinct from assimilation as spreading, which is unidirectional.

The only framework specifically designed to handle fusion and fission is particle phonology, in which particles, not features, are the atoms of sounds. Schane (1984, 1995) outlines his framework of particle phonology, which was developed in part because of his dissatisfaction with standard characterizations of the relationships between vowels and diphthongs. Among particle phonology’s basic operations are fusion and fission, which affect the sequencing of particles. In his words, ‘fusion accommodates those processes where diphthongs become monophthongs. The separately occurring particles of a diphthong fuse or combine into a single complex configuration for the monophthong’ (1984:133). For similar ideas in Dependency Phonology, see Anderson and Ewen (1987:129), Durand (1990:291-5), John Harris (1994:99), and Ewen (1995:575).

We turn next to the few proposals for laryngeal fusion. McCarthy (1989:51-2) analyzes cases of fusion to support the idea that laryngeals are specified with [pharyngeal] place (with dependent [+glottal]). He analyzes the change of /lʔ/ to /l’/ as follows:
As McCarthy notes, his account assumes that aspirated and glottalized segments are complex segments with [pharyngeal]. It is interesting that he analyzes these with respect to a merger of place, rather than laryngeal features. Usually, fusion seems to occur because a segment without a Laryngeal node (a voiceless stop) occurs next to a feature with no place features but which has a Laryngeal node. The two complementarily specified segments fuse to create one unit with both laryngeal and place features. In McCarthy’s analysis, however, there is no formal difference between /t-ʔ/ → [t’] and other place fusions which create complex segments, e.g. /p-ʔ/ → [pʰ], [t-k] → [f], and /p-k] → [pʰk] or [kp]. Furthermore, it is not clear whether languages without pharyngeals actually specify glottals for [pharyngeal] place; Rose (1996) has argued for such representations only when the language has uvulars or pharyngeals. Yet fusion takes place both in languages with uvulars (Kashaya) and without uvulars or pharyngeals (Mazateco), and thus there would need to be two accounts for the same phenomenon.

Lombardi (1991:54) assumes a process of fusion which is distinct from spreading. She says the two processes are connected in that they both allow multiply-linked laryngeal features like [voice]. However, Lombardi claims that ‘fusion is a result of well-formedness conditions’ due to a repair of an OCP violation. Spreading, in her view, is a separate rule because its description involves spreading of the laryngeal node to segments without such a node. While spreading may be involved in fusion, it is distinct from assimilative spreading since two segments merge into a single unit with one, not two root nodes. Also, this broader view of fusion cannot always be viewed as OCP-driven, since in ejective fusion the segments share no features. Instead, it must be driven by some sort of well-formedness conditions, or favoring of complete structure—the optimal segment, in a sense, has both a Laryngeal node and a Place node (cf. Steriade’s condition for monosegments in (5c)). When two adjacent segments lack the complementary node, they tend to symbiotically merge through fusion.

Recent treatments of fusion in a framework of Optimality Theory may be found in Lamontagne and Rice (1994, 1995), who do not treat laryngeal features in detail, and in
McCarthy and Prince (1995), who sketch an approach based on constraints of IDENT-IO (Laryngeal) and IDENT-IO (Place).

One of the most innovative ways of accounting for fusion comes from Steriade's (1993, 1994) work on closure and release nodes. Released stops and all affricates carry two A-positions (where A stands for aperture), while other segments like fricatives and continuants have only one A-position. Each A-position is specified for a degree of aperture, from $A_0$, which represents stop closure, to $A_r$, which is used for fricatives and the release portion of an affricate, to $A_{\text{max}}$, which represents full release for consonants and is used for approximants. (Steriade also suggests $A_{\text{vowel}}$ for vowel positions, but is not firmly committed to this construct).

Steriade proposes that the distinction between underlying /pʰ/ and an onset sequence /ph/ is in their underlying representation, since they are non-distinct on the surface. No language, she notes, has an underlying contrast between aspirated stops and a sequence of stop plus glottal fricative:

(7) Unattested contrast

```
         p  h    pʰ
          \  |    |
            rt rt rt
              \  |
       Onset Onset
```

The absence of this contrast is left unexplained in standard feature geometry, and she makes the explicit parallel to sequences of stop plus glottal stop (vs. ejective C')\(^1\).

Steriade explains that "(a) syllable structure is defined on A positions and (b) the merger of non-distinct A-positions (such as the $A_{\text{max}}$ release of /p/ and the $A_{\text{max}}$ position carried by /h/) is obligatory, at least in the case of tautosyllabic sequences" (215).

Steriade formalizes the release merger in /ph/ clusters as follows:

---

\(^1\) Some linguists have, however, posited distinctions between ejectives and medial consonant + glottal stop sequences: e.g. Kabardian (Kuipers 1960) and Dakota (Boas and Deloria 1941), but these are not in onsets.
(8) Release merger in /ph/ clusters

\[
p h \rightarrow p^h
\]

\[A_0, A_{\text{max}} \leftarrow A_{\text{max}}, A_0\]

'Once concatenated, the approximant releases...can merge, given that they are identical in type, non-distinct in feature composition and adjacent' (1994:213). In this case, the output is 'an onset that is both featurally and structurally identical to a single segment' (214). It is featurally identical because there is one set of place of articulations features, and one set of laryngeal features. It is structurally identical because it contains the same sequence of aperture positions. (For more on this formalism, see Steriade 1995:216-7).

Steriade's approach shows much promise, and it has begun to be adopted by some phonologists (e.g. Blevins 1993). However, it is unclear how features are to be integrated into the aperture node approach. Laryngeal features, for example, as well as features like [nasal] are shown to attach directly under the aperture node. If one uses A-positions, what about the formal class nodes of feature geometry? Steriade's approach shows potential and has proven its usefulness, but it needs to be more fully integrated into a theory of phonological representations.

8.2.3. Fission

Unlike fusion, where transformational rules changed two segments into one, fission or diphthongization was handled in SPE as the insertion of material with some formal similarities to an adjacent segment (though in principle, the process could have been expressed as a transformation as well). Chomsky and Halle give the example of English glide formation after tense vowels (1968:243, 183).

In autosegmental phonology, Leben (1976, cited in Leben 1980) invoked a convention breaking up linked structure to account for a Mid tone inserted in a sequence of linked High tones, in part to avoid violation of the No Crossing Constraint.

Clements and Keyser (1983:91) handled diphthongization in Chicano allegro speech by the deletion of the second of two V slots, with subsequent spreading of the second element's segmental content onto the first V slot. Thus a fission-like process was thus analyzed by delinking and reassociation.

Hayes (1990) discussed what he called the diphthongization paradox, which arises from the conflicting claims of feature geometry and the prosodic representation of
length as double linking. He criticized Clements' (1985) representation of Icelandic
preaspiration, which required not a doubly linked root node, but doubly linked laryngeal
and supralaryngeal nodes. Hayes advocated a return to a model similar to the Bottlebrush
Model, which undermines the tenets of feature geometry assumed here, though through
co-indexing of features he attempts to capture classes of features. Selkirk (1988), like
Clements, proposes a two-root theory of length, in part to account for so-called
'laryngeal fission' in which the two halves of geminates are specified for different
laryngeal features.

A recent treatment of fission is Calabrese (1995), who defines fission as 'an
operation that splits a feature bundle containing a disallowed configuration into two
successive bundles, each containing only one of the features of the disallowed
configuration'. This work concentrates on vowel fission and is particularly interesting in
its application of fission to cross-linguistic perception, where German /y/, for example, is
pronounced in Italian as [iu].

Particle phonology is also designed to handle diphthongization. Its formalism
may be found in Schane (1984, 1995). Harris (1994) contains a Dependency Phonology
account of fission, and for its formalism in Charm and Government Theory, see Kaye,
Lowenstamm, and Vergnaud (1985).

A brief account of fission in Dependency Phonology is found in Smith (1988:229-
30), who has proposed a 'Manner-Place Fission' in which a consonant or vowel splits
into two portions, one with manner features and the other with place features. As
consonantal examples, he gives Proto Polynesian *f > Moriori/Tokelau /hw/, *s > /hj/
(citing Biggs 1971, though Smith provides no actual data). In Moriori and Tokelau, the
primary place has survived as a postglottal glide: thus the labial component of /f/ becomes
the glide /w/, while the laryngeal feature (or the continuancy) is represented by the glottal
/h/. The coronal /s/ yields its place as the coronal glide /j/, confirming Hume's (1992)
thesis on the affinity between front vowel and coronals.

In another example, in the Khawa dialect of Bantawa (Smith 1988, using data
from Michailowsky 1975, but with no glosses), final /t/ diphthongizes to [i] + [ʔ], e.g.

(9) Dilpa           Khawa
   set             seiʔ
   sat             saiʔ
   tit             tiʔ
This is a type of fission which bears a certain affinity with debuccalization because of the loss of oral articulation and its substitution with a glottal. However, the oral articulation was preserved as a preceding vowel. The relation of the front vowel and the coronal stop again confirms that front vowels are coronal.

In sum, fission is generally regarded in the current generative literature to be a process in which one phonological entity is broken up into two entities which share certain properties of the original one. It is generally rather rare, and is certainly more common in vowels than in consonants. In the next section, we examine cases in which ejectives break apart into two segments.

8.3. Fission

8.3.1. Synchronic Data

In contrast with the abundance of evidence for fusion processes (§8.4), even where such analyses may involve low-level phonetic realizations, it is striking that there is a paucity of strong evidence for fission processes involving ejectives, in which an ejective breaks up its component parts into a plain obstruent and a glottal stop. This may be due to a function of the overall rarity of consonantal fission (compared to vowel diphthongization/fission) and the fact that ejectives occur in less than 20% of the world’s languages, and most of these are poorly documented. Thus cases of fission are difficult to find in the literature. The synchronic data which I present here are a process of fission in Takelma, free variation in Tsimshian, and a minor case in Yana.

Sapir (1922:36) describes a process in Takelma, the subject of his doctoral dissertation, which may best be described as fission. Takelma has three phonemic series of stops: voiceless unaspirated, voiceless aspirated, and ejective, two series of affricates, and voiceless fricatives (see also Shipley 1969): /p t ɨs k kʰ kʰw, pʰ tʰ ɨsʰ kʰ kʰwʰ, s x h/. Syllable-final ejectives undergo fission such that the result is two segments: a glottal stop followed by an aspirated counterpart of the ejective. In other words, the Laryngeal node of the ejective breaks apart and is assigned its own Root node, while the remaining place features function as an independent plain voiceless consonant. (Aspiration is assigned later). The affricate preserves its sibilant component. Here follow Sapir’s (1922:35) data (which I have retranscribed following Shipley 1969):
The change to aspirated status may be explained by the fact that all syllable-final stops in Takelma are voiceless aspirated. There are alternations like [se:pâ?n] ‘I roasted it’ vs. [sëpʰ] ‘he roasted it’ and [xêpʰk-a?] ‘I did it’ vs. [xêpʰkʰ] ‘he did it’. Thus, [s.g.] may be assigned redundantly in syllable final position. The laryngeal-less segment created from fission acts the same as the underlying voiceless unaspirates, thereby supporting Lombardi’s (1991) idea that voiceless unaspirated stops have no Laryngeal node.

Fission seems to be an end-run around the typical Laryngeal Constraint, which prohibits ejectives syllable-finally (see Chapter Four). Although the feature [c.g.] is not syllable-final, it is tolerated within the coda as a glottal stop. The change of the affricate to the sibilant fricative may have to do with the fact that there is no aspirated affricate. Since all obstruents must bear [s.g.], but the affricate cannot, it is repaired as a fricative. (See the Ahtna data below for a similar phenomenon). Takelma fission may be roughly represented as follows, by delinking (11a) followed by association of the floating laryngeal node to a new Root node (11b):

(11) a. Fission Pt. 1
    Root[σ]  
    Lar  OC  →  Lar  OC
    [c.g.]  C-Place

b. Fission Pt. 2
    Root[σ]  
    Lar  OC  →  Lar  Lar  OC
    [c.g.]  C-Place  [c.g.]  C-Place

c. Aspiration
    Root[σ]  
    Lar  Lar  OC

    [c.g.]  C-Place  [s.g.]  C-Place

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Another case of fission involves free variation, often accompanied by debuccalization and other processes. In Tsimshian, Dunn and Hays (1983) note that 'vowels preceding glottalized segments, whether uvular or other, often assimilate a laryngeal constriction and become creaky. But they may be more than just creaky, they may also be rearticulated. This rearticulation of laryngealized vowels can be quite pronounced or so slight as to be barely noticeable.'

This rearticulation apparently involves a shift in the timing of the laryngeal gesture.

Dunn and Hays present the following evidence from dialect and other variants:

(12) haq' - haq' - haʔχ - hɑχ - hɑ 'goose'
soq' - sʔχ - sʔaχ - sʔeqʰ - sʔeqʰ 'early; robin'
naq' - naʔca - naːa - naʔχ - na 'dress; skirt'
neq' - neq' - neiχ 'anal and dorsal fins'

They argue that 'the laryngeal feature has not been assimilated from the uvular consonant; it has been removed from the uvular consonant and placed on the vowel.' The uvular then lenites in various stages. Indeed, if we can trust their transcriptions, ejection and laryngealized vowels never occur in the same form. Apparently the uvular ejective undergoes fission. The laryngeal features can be realized as glottal stop, or as the feature [e.g.] in a laryngealized vowel.

Finally, I briefly mention two additional cases of possible fission. Nater (1984:18) notes in passing that in Bella Coola, an ejective stop, which he symbolizes as T' may freely vary with a glottal stop + stop sequence or with a lengthened vowel followed by a plain stop (T); in his notation: T'  ~ ?T - :T. For example, /luʔk’  ~ luuk/.

The vowel lengthening may be due to compensatory lengthening of the fissioned glottal stop position. Bagemihl (1991:641), however, assumes underlying forms like /ʔT/, and views the variants as attempts to avoid a moraic glottal stop. Deleting the mora triggers fusion with the stop, while deleting the glottal stop induces compensatory lengthening. If we accept this analysis, then one of the variants is the results of fusion, not fission (see §8.4.1.4).

Another possible case of fission is in Yana (Sapir 1929). As Sapir observes, 't' and p' become voiceless nasals plus glottal stop before nasal consonants' (1929/1949:209). A relevant example is the female form for 'grizzly bear' /tʰet', which
is pronounced [tʰeŋ?-na] in male speech. I speculate that this could result from regressive spreading of the feature [nasal] onto the ejective; however, since [nasal] is incompatible with ejectives, fission results. The voiceless initial nasal may be due to the voicelessness of the following glottal stop, itself the only relic of the ejective. However, without more data, this remains speculative.

8.3.2. Diachronic Data

The best documented case of diachronic fission is apparently in dialects of Athna. The only other case of diachronic ejective fission is based on a reinterpretation of Lachmann’s Law in Latin.

In Athna (Kari and Buck 1975), there are several variants on pronouncing the glottalized consonants at the end of a word, including a type of debuccalization or fission which was mentioned in §5.8.3. It is unclear whether this has created alternations and thus may be synchronic, or whether this change has taken place and the final ejectives have been restructured. The Central (C) and Western (W) dialects maintain the glottalized sounds /t', d', ts7/, but ejectives in the Lower (L) Athna dialect undergo fission to a glottal stop, generally preserving the continuant component of any affricate (recall the Takelma data above). Thus the sibilant affricate preserves /s/ after the glottal component (13a), the lateral affricate preserves /l/ (13b), while the nonaffricate velar stop simply debuccalizes (13c).

(13)   C, W       L       Gloss

a.  kefts'  kefts  'mittens'
    t²ehits'uuts'ii  t²ehits'uuts'is  'mink'

b.  /hairs'uka[u]i'  /hairs'uka[u]li  'ball game'
    /χ²iti[i]  /χ²iti[l]  'potlach'

c.  t²aak'i (W)  t²aaʔi  'three'

Some of the Athna data show that fission cannot be attributed to word-final position, since it occurs even prevocally, nor can it be considered dissimilative as the first form in (a) and (c) show.

The final case of diachronic ejective fission assumes a Glottalic version of Proto-Latin, in Baldi’s (1991) attempts to reinterpret Lachmann’s Law. Lachmann’s Law in the traditional sense refers to ‘the lengthening of the nuclear vowel in the past participle of
verbs whose roots ended in a plain voiced stop’ (1991:6). For example, the lengthening contrast in the pairs *fāciō : fāctus* vs. *rēgō : rēctus* is due to Proto-Latin lengthening before clusters of voiced plus voiceless consonant (followed by devoicing assimilation in the cluster). Baldi asserts that vowel lengthening before voiced consonants is ‘phonetically unmotivated’ (1991:18), ignoring a long tradition of phonetic studies which show otherwise (see, e.g. Lehiste 1970, and the excellent summary in Laver 1994:445-8), including the dramatic lengthening found in English. In Baldi’s reanalysis, the data which do show lengthening are due to an ejective being ‘broken into the sequence of glottal stop plus consonant, i.e. \( k' + t^h \rightarrow ʔk + t^h \)’ (1991:18). The glottal stop is then deleted, which triggers compensatory lengthening in syllable-final position (but not in word-final position to account for forms like *grex, gregis* ‘flock’). Baldi’s solution proposes an extremely rare process of fission. Pure debuccalization or deglottalization would have been more natural processes in such an environment. However, if fission did take place, then compensatory lengthening due to the placeless glottal does have some precedent, e.g. in Bella Coola. Baldi’s solution, while clever, relies on an extremely rare process of ejective fission that casts doubt on this particular version of Lachmann’s Law.

8.5.3. Summary
The literature involving fission of ejectives is nowhere near as impressive as that of fusion. Its rarity will be discussed in the conclusion. It is interesting, however, to note that the glottal stop always appears to the left of the other segmental material, far from the release portion of the original ejective. This might be motivated by perceptual reasons, since, as Ladefoged and Maddieson (1996) noted, there is relatively little phonetic difference between an ejective and a stop followed by a glottal stop. Whatever pressures trigger fission make it maximally distinct from ejective release by placing the glottal stop before the onset of stop closure, rather than at stop release. There may be cases of fission in which the glottal element ends up on the right of the oral segment, but this would be perceptually difficult to hear in final position, and could be interpreted as either deglottalization, or as a type of ejective.

8.4. Fusion
8.4.1. Synchronic Data
In this section we will survey synchronic data from a number of languages, beginning with Kashaya. We then turn to Bella Coola, Yurok, and Athapaskan cases of fusion.
Klamath, analyzed in §8.4.5, displays fusion-like behavior, but given Blevins' recent analysis, it turns out to be association of a floating feature and not fusion per se. In contrast, Mazateco has fusion, but the end result is apparently not a phonetic ejective, but a different type of post-glottalized consonant (§8.4.6). Reports of other fusion processes from Native American languages are collected in list form in the next section. Cases of fusion from outside the Americas are analyzed in §8.4.8.

8.4.1.1. Kashaya

A well-documented case of fusion is found in Buckley's (1994) grammar on the Pomo (Hokan) language Kashaya. Buckley proposes rules which fuse a following /h/ and /ʔ/ with a preceding stop with no laryngeal features (i.e. a voiceless unaspirated stop) to form aspirates and ejectives, respectively (see also Oswalt 1964 and the discussions in §5.3.5 and §5.6.2). After plain sonorants, fusion results in a glottalized sonorant. Buckley terms this 'Glottal Merger', which is essentially what I call fusion. As an example, take the future suffix /-ʔkʰe/; its underlying form is shown by its postvocalic form in (14a). Fusion with plain stops is shown in (14b), and in unmarked sonorants in (14c). Failure to induce fusion with fricatives is shown in (14d); Buckley argues that the fricatives are specified for [s.g.] since Kashaya does have an ejective fricative /s'/, which is not created through fusion.

(14)

<table>
<thead>
<tr>
<th>UR</th>
<th>PR</th>
<th>Gloss</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. qa-ne-ʔkʰe</td>
<td>qanėʔkʰe</td>
<td>'will bite'</td>
</tr>
<tr>
<td></td>
<td>ʔʔkʰe</td>
<td>'will stay'</td>
</tr>
<tr>
<td>b. ʔa-hjut-ʔkʰe</td>
<td>ʔahjút'kʰe</td>
<td>'will rub'</td>
</tr>
<tr>
<td></td>
<td>s'uwɑ̃-ʔkʰe</td>
<td>s'uwáʔkʰe</td>
</tr>
<tr>
<td>c. t'unuʔ-ʔkʰe</td>
<td>t'unúkʰe</td>
<td>'would get tired'</td>
</tr>
<tr>
<td></td>
<td>pʰak'um-ʔkʰe</td>
<td>pʰak'umkʰe</td>
</tr>
<tr>
<td></td>
<td>ɡa-hal-ʔkʰe</td>
<td>ɡahálkʰe</td>
</tr>
<tr>
<td>d. nu-k'is-ʔkʰe</td>
<td>duk'ískʰe</td>
<td>'will scratch'</td>
</tr>
<tr>
<td></td>
<td>ʃubuʃ-ʔkʰe</td>
<td>ʃubúʃkʰe</td>
</tr>
</tbody>
</table>

Another suffix which induces fusion is the Assertive clitic /=ʔ/. Prevocalic examples are in (15a), while examples of obstruent fusion are in (15b), and sonorant fusion in (15c). The fact that this fusion applies only to consonants without a Laryngeal
node is illustrated in (15d), in which the Assertive is lost, and does not induce glottalization or ejection.

(15) | **UR** | **PR** | **Gloss**
--- | --- | --- | ---
| a. | haju=? | hajúʔ | 'it's a dog'
|  | k'ili=? | k'iliʔ | 'it's black'
| b. | qahmaʔ=? | qahmáʔ | 'he is angry'
|  | jeʔet=? | jeʔéʔ | 'it's a basket'
|  | siqʰot=? | siqʰót | 'it's acorn grounds'
|  | wataʔf=? | wataʔf | 'it's a frog'
|  | mihjoq=? | mihjóq | 'it's a woodrat'
| c. | jéʔahaw=? | jéʔaháw | 'it's a boil'
|  | tjʾifkan=? | tjʾifkan | 'it's pretty'
| d. | botʾ=? | bót | 'it's soft'
|  | dolom=? | dolóm | 'it's a wildcat'
|  | kilakʰ=? | kilákʰ | 'it's an eagle'
|  | hotʰ=? | hótʰ | 'it's warm'

Fusion takes place as two separate segments, a plain stop or affricate (or sonorant), and a glottal stop, have fused to become an ejective (or glottalized sonorant) through the sharing of laryngeal and place features. The forms in (15d) show that segments with a Laryngeal node are not subject to fusion and thus the process of fusion is primarily structure-building, not structure-changing.

Recall also the process of Glottal Transfer, discussed in §5.3.5 and §6.3.2, in which complex sonorants in an onset transfer their glottal feature to a preceding voiceless stop to create an ejective: /s'uwatj-ma/ → [s'uwáʔt'ba] ‘after drying’. Although this process is not fusion, since two segments result, the effect of Glottal Transfer bears a similarity to fusion in that one segment loses a laryngeal feature that the other gains to form an ejective. The difference is that each has a separate place node and therefore their own root nodes throughout the derivation. True fusion, as in (15) and (16) involves the loss of a root or timing slot, in addition to the blending of laryngeal and place features.

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2 In Buckley's notation, the = sign indicates a clitic boundary. In this set of examples, the clitic is the Assertive clitic.
8.4.1.2. Bella Coola

Nater (1984) argues that glottalized consonants in Bella Coola cannot be regarded as a sequence because ejectives are common in the lexicon; because an ejective can be reduplicated while $C_1C_2C_1C_2$ reduplications do not occur in Bella Coola; and because $/\text{D}/$ would have to be viewed as a hypothetical $*\text{D},$ a cluster type that violates general phonotactic constraints. Regarding fusion, Nater (1984:127) says that 'unless elided, the initial ? glottalises a directly preceding plain occlusive...'. Later he says, 'occlusives bordering on ? are, unless elision takes place, phonetically glottalised...—acoustically, there is no difference between T?, T'?, and T'' (139) (where T stands for a stop). Galloway (1989:100), however, has called this discussion 'sketchy', adding that 'it is not clear when this occurs, it cannot everywhere as is implied'. Nater does not provide specific examples to illustrate this point. Fortunately, Nater’s monograph has inspired two recent phonological studies.

Bagemihl (1991) examines an alternation in Bella Coola in which long vowels plus plain consonant alternate with short vowels followed by glottalized consonant, i.e. $VVC \sim V'C'.$ He posits an underlying form $/V?C/$, which varies between a long vowel and an ejective or glottalized resonant ($R'$), as the following examples show:

\[
\begin{array}{cccc}
\text{UR} & VV & C'/R' & \text{Gloss} \\
\text{lu?k} & \text{luuk} & \text{lu?k'} & \text{repulsive'} \\
& \text{-lii?is} & \text{-lii?is'} & \text{skin; bark'} \\
\text{la?laj} & \text{laalaj} & \text{lalaj} & \text{a woman's name'} \\
\text{pu?jaas} & \text{puujaas} & \text{pujaas'} & \text{Labrador (Indian) tea'} \\
\end{array}
\]

In Bagemihl’s analysis, there are two strategies to ‘avoid moraic ?’: one is ?-Deletion, which triggers compensatory vowel lengthening, and the other is Mora Deletion, which triggers fusion and is schematized as follows:

---

3 This statement regarding acoustic difference does not seem to be entirely accurate for such sequences in general. Through acoustic, physiological, and aerodynamic measurement, one should in principle be able to distinguish among the contrasts listed (cf Ladefoged and Zeitoun 1993). Perhaps Nater means that Bella Coola has no such contrast.
Cook's (1994) reanalysis takes the same underlying structure as Bagemihl, and shares the observation that glottal stops cannot be moraic. However, he takes issues with Bagemihl's strategies to avoid moraic ?. In his view, there is no need to stipulate mora loss, which is an automatic consequence of the syllabification algorithm. Since glottal stop cannot be moraic, another consonant is associated with the mora to which the glottal stop is associated. The phonetic result is a fusion of glottal stop plus consonant – a glottalized consonant, ejective in the case of obstruents. Cook's derivation is illustrated as follows:

\[
\begin{array}{cccc}
\sigma & \sigma & \sigma & \sigma \\
\mu \mu \mu \mu & \mu \mu \mu \mu & \mu \mu \mu & \mu \mu \\
\mu \mu \mu \mu & \mu \mu \mu \mu & \mu \mu \mu & \mu \mu \\
\end{array}
\]

Fusion is thus triggered by reassociating a syllable with an illicit coda to one with a licensed coda. Cook proposes a different solution for glottalized resonants, which is not relevant to the point here, which is that ejectives are formed by the fusion of glottal stop and an obstruent. It is somewhat unusual, however, for the fusion to take place with a preceding glottal stop. The normal pattern for fusion is when the glottal stop follows.

8.4.1.3. Yurok

Yurok has only a plain voiceless and an ejective series of stops. Robins (1958:33) describes the fusion of glottal stop to a preceding voiceless stop or affricate in Yurok. One example is the third person singular suffix for e-class verbs and for the first type of o-class verbs. In the following example, the stem-final consonant /-t/ is realized as the ejective [-t'] in the third person singular of the paradigm as the result of fusion with the glottal stop suffix:
Compare also the stem /sanut-/ 'to beat, to kill', /sanutuʔ/ 'you pl. beat, kill' and its third singular form /samat/ (37). The glottal stop of the third person singular suffix surfaces after the palatal glide, with which it undergoes metathesis: compare /koʔmoʔ/ 'to hear' with /koʔmoʔj/ 'he hears'.

A similar process of fusion occurs for the imperative singular, which has the form /-ʔes/. For example, /hoʔop-/ 'to make a fire' vs. /hoʔopʔes/ 'make a fire!', and /soʔt-/ 'to go away' vs. /soʔʔos/ 'go away!' (44).

Yurok fusion involves the merger of glottal stop with a preceding obstruent when they are concatenated.

8.4.1.4. Athapaskan

Another of the better-known processes of fusion comes from a rule found in many Athapaskan languages, the D-effect rule (Rice 1994:117). There is a morpheme known as the D classifier (phonetically a voiceless unaspirated dental), which combines with following consonants in an interesting manner. It forms a glottalized (ejective) dental stop when followed by a glottal stop (a); it preserves the manner feature of the stop with the place features of a following fricative to yield a voiceless unaspirated stop or affricate (b); and it is lost with other consonants (C). Rice's summary is given below, where capital letters (besides D) represent fricatives unspecified for laryngeal features:

(20)

a. D + ? → t'

b. D + fricative → plain stop (of same place of articulation)

   e.g.  D + S → dz ([ʦ])
       D + ŧ → j ([tʃ])
       D + X → ɡ ([k])
       D + L → dl ([l])

(20)  c. D + C → C  (Rice 1994:117)
For example, in Navaho, 'we two go off with the round object' /t-î:t-?à:h/ → [tî:t’à:h] (Sapir 1938/1949:228). In Slave, for example, Rice (1989:444) gives the contrast between /ja-te-t-ô -?âh/ 'to be fooled' and [jâteht’ô] 'I was fooled', vs. /ja-te-ô-ô?âh/ and [jâte?ô] 'I fooled him/her'.

In addition to the D-effect, several Athapaskan languages also have a process of phonetic fusion. In Navaho, for example,

'A phonetically glottalized consonant is produced when any stop, except the glottal stop, or an affricate is followed by a glottal stop. The velar release of k, for example, is approximately simultaneous with the glottal release in k’ola chile; and, similarly, the affricative and glottal stop are released as a fused phonetic element in japts’ika he cut himself. This fusion takes place across word boundaries as well as within word units: the t and ? form a unit phonetically in ?imat ?an tenatuka it-seems for-him he-sang, as does the t? and ? in ?a:t?j ?uluka they-two put-it-in..' (Hoijer 1945/1977:13).

Hoijer was assuming an analysis with no underlying ejectives; all were derived from clusters through the process he mentioned above, but the only initial clusters in this analysis contained glottal stop as a second member. Hoijer observes that [k’ k’’’ ts’ tf’] occur frequently within morphemes, both initially and medially, and their 'close-knit, unitary character distinct from all other glottal clusters' suggests that 'they may have been unit phonemes at an earlier time' (1945:18-19).

However, the fusion process may also apply postlexically, since it is said to apply across word-boundaries, as shown above. Hoijer also notes that in rapid speech, /t. n, ï/ 'tend to become' [t’. n, ï’] (1945:25). For example,

(21) ?é:-hi-î:t-?â:j → ?é:-hî-î:t’à:j 'we two put on clothes' (1945:45)

Thus in Navaho, there is the D-effect process, and a process in which fusion takes place across word boundaries.

8.4.1.5. Klamath

One of the better-known processes of fusion occurs in Klamath (Penutian; Barker 1964). In Klamath, the addition of the diminutive suffix /-?â:k/ induces glottalization of stem-final consonants. Stops and affricates become ejectives (22a); while sonorants become laryngealized (glottalized) (22b); vowel-final stems are followed by the glottal stop of the underlying form (22c); Barker notes that it is represented by /Ø/ in other environments.
(22) | Root + Dim. | Diminutive | Gloss of Root |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>a. /nep + ?a:k/</td>
<td>[nep’a:k]</td>
<td>‘hand’</td>
</tr>
<tr>
<td>/dot/</td>
<td>[dott’a:k]</td>
<td>‘tooth’</td>
</tr>
<tr>
<td>/welot’/</td>
<td>[welot’a:k]</td>
<td>‘pup’</td>
</tr>
<tr>
<td>/p’et’/</td>
<td>[p’ep’et’a:k]</td>
<td>‘foot’</td>
</tr>
<tr>
<td>/bok/</td>
<td>[bopk’a:k]</td>
<td>‘book’</td>
</tr>
<tr>
<td>/weleq’/</td>
<td>[wekeq’a:k]</td>
<td>‘old lady’</td>
</tr>
<tr>
<td>b. /wan/</td>
<td>[wawna:k]</td>
<td>‘red fox’</td>
</tr>
<tr>
<td>/qp’al/</td>
<td>[qp’ala:k’itk]</td>
<td>‘curled up (one)’</td>
</tr>
<tr>
<td>c. /k’howe/</td>
<td>[k’hokwe?a:k]</td>
<td>‘frog’</td>
</tr>
<tr>
<td>/juhu’/</td>
<td>[juhu’?a:k]</td>
<td>‘buffalo’</td>
</tr>
</tbody>
</table>

(Kenstowicz 1993:55 and Blevins 1993:264)

Blevins distinguishes between a floating [e.g.] feature, posited for the diminutive suffix, and an underlying glottal stop since the diminutive causes glottalization, e.g. /q̃b’u-q̃b’ul-?a:k’/ → [q̃b’uq̃b’ul?a:k] ‘little stars’, while underlying glottal stop does not, e.g. /q̃b’u-?m/ → [q̃b’u?am] ‘star’s’. The two sounds are in near complementary distribution: the floating feature is initial in nominal and verbal suffixes, while glottal stop is initial in nominal and verbal stems. In addition, two suffixes show variation between the two. But because of their different behavior, she argues that they are distinct. If we accept her hypothesis of a floating glottal feature, then this case is not one of true fusion, but simply association of a floating feature to a docking site. A true fusion would involve loss of a root node or timing element. Since the diminutive apparently begins with a floating feature with no root node, it is not a prototypical case of fusion, though the end

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4 Blevins posits that this form ends in an underlying aspirated stop and thus in her floating feature association, such specified laryngeal features are delinked.

5 Note in Barker’s transcriptions, the ejective apostrophe is written above the letter, so the graphic distinction cannot be represented here. For a velar ejective, for example, the distinction would be morphophonemic /lk’əl/ vs. phonemic /k/.
result is the same: merger of a pulmonic consonant with a glottal element to form an ejective (or glottalized consonant).

8.4.1.3. Mazateco
Additional evidence for fusion comes from Steriade's (1994) analysis of Mazateco, although actual ejectives are apparently not created. In Mazateco, Pike and Pike (1947) assume that consonantal sequences are surface clusters. Steriade argues against this because the clusters violate the Sonority Law and /h/ and /ʔ/ do not occur within a Mazateco onset. If /ht/ and /tʔt/ are clusters, Steriade observes that we would expect to find /htʔt/, which is not attested. Instead, Steriade proposes a rule called Merger in which one must ‘merge any adjacent pair of A- positions if the immediate output is monosegmental’ according to a set of principles ((5) above) which stipulate that a string of A-positions is monosegmental if there is one basic A-position, with at most one place node and for any pair of autosegments, they are compatible.

There are several ‘postglottalized clusters’. These include /tʔ tςʔ tʃʔ kʔ mʔ nʔ pʔ sʔ jʔ lʔ bʔ jʔ ntʔ ñtsʔ ñtʃʔ ñʔʔʔ/. Steriade cites Pike and Pike, who state that

‘there is usually a very slight open transition between the stop and the /ʔ/ in the same syllable, so that the stops are not phonetically realized – i.e. they are not made with egressive pharynx air [...] and [...] this phonetic gap between the stop and the /ʔ/ in clusters is often further accentuated in that /ʔ/ may be actualized as the laryngealization of the following vowel rather than as a separate stop, while often there is a slight prearticulation of the vowel before the /ʔ/ (but after the glottal stop in the sequence of oral plus glottal stop)’ (1947:81).

It would be interesting to get hard phonetic data from this language and compare it to the fortis ejectives mentioned in Chapter Seven. Steriade interprets the Pikes’ statement to mean that the glottal gesture is phonologically aligned with the stop release, but phonetically realized at the boundary between the release interval and the following vowel. Thus the language does not have true ejectives, though fusion with glottal stop apparently does take place. Steriade says the ‘slight prearticulation of the vowel’ occurring at the end of stop closure and the glottal is simply ‘an indication that the phonetic transition between the oral constriction of the stop and that of the vowel takes place simultaneously with the glottal gesture.’ A few examples are provided below:
Steriade's representations after merger are given as follows:

(24) Phonological representation of C? onsets in Mazateco

<table>
<thead>
<tr>
<th>Plosive -?</th>
<th>Continuant-?</th>
</tr>
</thead>
<tbody>
<tr>
<td>A₀Aₙ</td>
<td>A_max</td>
</tr>
<tr>
<td></td>
<td>A_f</td>
</tr>
<tr>
<td>[c.g.]</td>
<td>[c.g.]</td>
</tr>
</tbody>
</table>

Because the plosive representations are monosegmental, the two A-positions are merged, and fusion takes place, creating a glottalized but apparently not ejective segment.

8.4.1.6. Other Native American Languages

In Barbareño Chumash (Hokan; Beeler 1976, Applegate 1976), which has unit ejectives, the final consonant is frequently glottalized in final -VC reduplication, but such fusion is rarer in the medial consonant. As Beeler notes, a stem-initial glottal stop coalesces with an immediately preceding consonant to form a derived ejective, which is reduplicated as a unit.

(25) Base Reduplication

<table>
<thead>
<tr>
<th>Base</th>
<th>Reduplication</th>
</tr>
</thead>
<tbody>
<tr>
<td>k-?anif</td>
<td>k’ank’anif ‘my paternal uncles’</td>
</tr>
<tr>
<td>p-?ajakuj</td>
<td>p’aijp’ajakuj ‘your baskets (p- 2nd person)’</td>
</tr>
<tr>
<td>s-?amin</td>
<td>s’ams’amin ‘he is naked’ (279)</td>
</tr>
</tbody>
</table>

The process of reduplication exactly parallels underlyingly glottalized consonants; for example, /t’at’ajaʔ/ ‘abalones’. Beeler concludes that the fusion of a consonant and a following glottal stop precedes the process of reduplication. For an OT treatment, see McCarthy and Prince (1995:318-20).

Because the remaining reported cases of fusion are so numerous, I provide here simply a list of the languages in which they are reported. In some cases, fusion appears to be a low-level phonetic phenomenon. In others, there are morphophonemic
alternations. Some of the processes are reported to take place even across word boundaries.

(26) **Language**        **Source**
Acoma                      Miller (1965)
Coeur d'Alene               Thompson (1979:707), citing Vogt (1940b)
Colville                    Mattina (1973)
Cowichan Halkomelem        Hukari (1981)
Huamelultec Chontal         Waterhouse (1967)
Kalispel                    Thompson (1979:707), citing Vogt (1940b)
Jacalteca                   Day (1973)
Makah                      Jacobsen (1969)
Mazahua Otomi              Spotts (1963)
Nez Perce                  Aoki (1963, 1970)
Nootka                     Jacobsen (1969)
Okanagan                   Thompson (1979:707), citing Vogt (1940b)
Pame                       Gibson (1956)
Takelma                    Sapir (1922)
Tzeltal                    Kaufman (1971)
Tzutujil                   Dayley (1985)
Zuni                       Newman (1965, 1996)

8.4.1.8. Fusion in Other Language Families

Turning to the Afro-Asiatic languages, we find in Aari (Omotic; Hayward 1990c:480), that stem-final implosives before the formative of the perfect 1/-se(qe)/ optionally either debuccalize or fuse to create an ejective. For example:

(27) wod-                wó[?]se(qe) ~ wó[tīš']e(qe) ‘he trapped something’
?ojd-                  ?ōj[?]se(qe) ~ ?ōj[tīš']e(qe) ‘he heated something’

There is a similar phenomenon with stem-final implosives and the causative suffix -s/:  

(28) ?ad-                ?a[?]sis- ~ ?a[tīš’]is- ‘cause to give birth’
sud-                    su[?]sis- ~ su[tīš’]is- ‘cause to collect; store’ (468)
In sum, Aari has an optional rule of fusion in which the trigger is the perfective suffix concatenating with stem-final implosives, or the causative suffix (which also starts with /s/) acting with stem-final implosives. The result is an alveolar affricate ejective; here because fricative ejectives are difficult to produce, and therefore marked and rare, affrication accompanies fusion.

We turn next to the languages of the Caucasus. A brief example is found in the Lezgian language Rutul described by Alekseev (1994a). In Rutul, Alekseev notes that C + ? > C'. The only example given is /ši + b + ?ir/ → /šip'ir/ ‘it moved (class III)’. Here we apparently have loss of the specified laryngeal feature [voice] of the /b/ accompanied by ejective from fusion with the following glottal stop. This is the only synchronic case I know of in which voiced consonant plus glottal stop yields an ejective. In Mingrelian (Harris 1991c), the person prefix /v-/ (often pronounced as a labiovelar glide) followed by glottal stop yields /p'/, probably via sonorant fortition; see Chapter Three.

In the Gurian dialect of the Georgian (Lomtatidze 1986), usually the 3rd person object marker (ending in a sibilant fricative) combines with the affricates /š/t/ and /š/ of verb roots ‘causing mutual assimilation and fusion of the prefixal and root element: /mis-š'tera/ → [mis'era] ‘he/she wrote to him’, /š/t'iria/ → /ʃ'iria/ ‘he/she needs it’. From these examples, however, the first sibilant fricative could delete and the affricate could undergo deaffrication, leaving an ejective fricative. Without more data, it is difficult to accept this as a true case of fusion.

Finally, Ladefoged and Zeitoun (1993) describe a controversial sequence of voiceless fricative followed by glottal stop in Tsou, an Austro-Asiatic language spoken in Taiwan. Fuller (1990) had earlier claimed that Tsou had pulmonic ingressive phones based on the speech of a single informant. This appeared to be idiosyncratic, however, and more detailed examination of other speakers found labiodental ejective fricatives in words such as /f?ue/ ‘sweet potato’ and /f?isi/ ‘hair’. According to Ladefoged and Zeitoun, phonologically /f?/

‘is clearly a sequence of sounds (and can be heard to be so in intervocalic positions); but when word initial the sequence usually becomes integrated into an ejective in which there is friction throughout much of the period during which there is a glottal stop, which is then released directly into the vowel’ (1993:14).

Tsou is one of the only cases of fusion with a fricative which creates a phonetic ejective fricative.
Most of the cases of fusion I have documented are unusually concentrated in Native American languages. However, one reason they may have so much fusion is that these are generally well documented, compared to other areas. Another reason fusion elsewhere is relatively elusive may be because it assumes existence of a glottal stop, which often causes fieldworkers difficulty in hearing. Fusion may also be an areal trait, though the area is fairly wide-ranging and the process too common to leave the explanation at this.

8.4.2. Diachronic Data
8.4.2.1. Native American Languages
In contrast with the pervasive synchronic fusion of Native American languages, I have not been able to document a proportional number of historical cases. And what cases there are often lack several tokens per type. Below I will briefly highlight some of the reports for diachronic fusion.

Jacobsen (1977) proposes a change from Proto-Washo to Washo in which 'some glottalized stops, but by no means all, can be seen to have come from clusters with glottal stop either preceding or following plain stop (so p' would come from *?p or *p?)' (61). Some of these examples would involve the relatively rare or marked case of fusion in which the first member is glottal stop.

As evidence, he discusses the attributive-agentive affix which was in part an infixed glottal stop in the allomorph used in stems with medial resonants or plain stops. The affix, among other things, derives reciprocal kinship for the descending generation. Take, for example, the form *ni-?áma? > di?áma? 'my father's mother' which yields /la?áma?/ 'my son's child (woman speaking)', which is derived from *?-na-?áma? in which the kinship infix can be seen before the medial /m/. 'When the underlying stem in this formation has a medial voiced stop (from plain stop), the derivative has the corresponding glottalized stop. Thus beside /dibá:ba?/ 'my father's father' (< *ni-pápa?) we have /labá:p’a?/ 'my son's child (man speaking)' (< *?-na-pá?pa?)' (62). Jacobsen thus assumes the ejective arose from the coalescence (what I term fusion) of the plain stop with the preceding infixed glottal stop. Jacobsen proposes several other cases which will not be detailed here because they seem to occur only with specific combinations of morphemes and do not reflect a more general process. Jacobsen (1969:132) also proposes the fusion of Proto-Wakashan *q? to q' in Nitinat-Makah.
In his study on Yana and Hokan stops, Jacobsen (1976) noted that in Washo, 'Regarding the glottalized stops, three separate patterns have been noted in which they seem to have arisen from combinations of plain (later voiced) stop with glottal stop, but these account for only a small fraction of their occurrences.' (207). He later mentions cases of fusion in syllable-final ejectives which arose from loss of a following short vowel, and subsequent fusion (233). For the most part, however, Jacobsen argues that ejectives must have been units, particularly since they do not act as clusters in shortening preceding vowels (220, fn 58).

In Levine's (1981) review of Lawrence et al.'s (1977) Haida (Na-Dene) dictionary, he notes that there is material in the dictionary which suggests that in the Alaskan Haida (AH) dialect, there was fusion between preceding stops and a following glottal stop, while Southern Haida (SH) preserves the stop sequence. (The plain unaspirated stops are usually transcribed with voiced stop symbols so that diacritics are not needed for the voiceless aspirates).

<table>
<thead>
<tr>
<th>Southern Haida</th>
<th>Alaskan Haida</th>
<th>Gloss</th>
</tr>
</thead>
<tbody>
<tr>
<td>t'ap?at</td>
<td>t'ap'?et</td>
<td>'snap, break'</td>
</tr>
<tr>
<td>k'at?ut</td>
<td>k'ut'?at</td>
<td>'die'</td>
</tr>
<tr>
<td>xajtqa-xajtqa- xa?itqa</td>
<td>hat'á</td>
<td>'person, Haida'</td>
</tr>
<tr>
<td>lkitqun</td>
<td>lkitq'-ón</td>
<td>'goose'</td>
</tr>
</tbody>
</table>

Levine notes that AH has acquired the phoneme /p'/ through such fusion processes, a phoneme which is not present in SH. In some idiolects of AH, fusion has not applied to all items, so that there are alternate pronunciations for the word 'goose', in which the nonfused pronunciation is conservative, and the fused pronunciation is innovative (Levine 1981:356).

McLendon (1973, 1976) proposes extensive fusion for the Pomo languages and Proto-Pomo, many with voiced stops:, e.g. the 3rd f. sg. subject pronoun is *[ham'ijd?] and it yielded Southern Pomo /háman/, Kashaya /-mán?/, Southeastern Pomo /-med/ and ejection in final position in Eastern Pomo /mi'.tV-

Chafe (1976) comments on the origin of Caddo ejectives: 'Whenever their origin can be reconstructed, it is clear that the glottalized consonants arose from a sequence of stop or affricate followed by ?.' For example, Chafe (1968:116) found that a sequence of voiceless velar stop followed by glottal stop historically fused to create ejectives, e.g.
*tʃipakʔanihnah > /tʃiwiʔkʔanihnah/ ‘I said’. The word for ‘liver’ comes from Proto-North Caddoan *karikʔuh, which became /kánk’uh/ in Caddo (1979:220). Chafe notes that there are many cases in which the reconstruction of a sequence is not supported because of lack of alternations and therefore in some cases ‘it would be best to assume an underlying’ ejective. Thus even when historic fusion has taken place, it is not safe to assume that all ejectives arose from clusters.

8.4.2.2. Diachronic Fusion in Other Language Families
Blust (1980) provides some fascinating historical data on the origin of Yapese ejectives. Yapese, to my knowledge, is one of only two (of over 900) Austronesian languages to have ejectives; the other is Tsou, spoken in Taiwan (Ladefoged and Zeitoun 1993) and mentioned in §8.4.1.8. In Yapese, loss of a medial vowel brought voiceless stops in contact with glottal stops. Blust notes the difficulties involved in Yapese reconstruction, but gives a few of the ‘better comparisons’:

(30) *bu(R)teʔ ‘earth, ground’ > buut’ ‘dirt, soil, earth, ground’

In two cases, glottal stop metathesized with a preceding vowel, resulting in glottalization of a medial or initial *t:

(31) *ma-taʔu > mat’aaw ‘right, right hand’
    *taʔi ‘feces, waste’ > t’aaj ‘its waste; rust; feces; guts; bilge (of a boat); filth’

Blust comments that since final vowels are generally lost, there is a possibility that ‘glottalization also resulted from the juxtaposition of consonants by metathesis’.

Skinner (1975:456) reports that in at least one case of Hausa loan adaptation from Arabic, a glottal stop merged with an obstruent to produce an ejective. The Arabic root /sʔa/, in its form /masʔala/ ‘problem, question, matter’ was adapted as Hausa /maʃʔala/. In this case, the fusion of glottal stop with a fricative yielded an ejective affricate. As Skinner notes, ‘So here you have an actual proven case where two phonemes in the loan language have gone to a single glottalized phoneme in the borrowed language’.

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Finally, in the languages of the Caucasus, nearly all of which have unit ejectives, there are some cases of historical fusion, due to syncope of an intervening vowel. Colarusso (1989b:37) provides the following examples from Proto Northwest Caucasian (PNWC) to Proto-Circassian (PC), with daughters West Circassian (WC) and East Circassian (EC); and to Proto-Abkhaz-Adyghe (PAA), with daughter Abaza; and in Bzhedukh (Bzh), a West Circassian (WC) language:

(32) PNWC */w-òso?à/ → PC */tsw?à/ → */tswɔ?à/ → /ɔwɔ̄a/ → WC /swɔ̄a/, EC /fɔ̄a/ ‘liver’
PNWC */j-òso?à/ → PAA */[j]i’a/ → Abz /[j]i’aj’i’a/ ‘liver’ (37)
PNWC */-pa-w-ɔò/ child-asp-rear → PC */-pa?ɔ̄ countries/ → */-pɔ̄ /-+ Bzh WC /-p’sɔ̄ / ‘to rear, educate a child’ (44-45)

In short, the diachronic cases do not begin to match the synchronic cases for quality or quantity.

8.4.3. Summary
By far the most common type of fusion involves a plain voiceless stop or affricate (rarely, a fricative), followed by a glottal stop. This type of process is found in many different language families throughout the world. Such fusion could be insightfully studied using Steriade’s aperture position approach, which obligatorily merges A-positions when they are non-distinct. Because glottal stops lack place features (Clements 1985) andBecause plain stops lack laryngeal features (Lombardi 1991), such a merger, or fusion, seems natural, especially given the lack of distinction between ejective onsets vs. stop + glottal stop onsets. In terms of directionality, most fusion takes place when a glottal stop follows the obstruent. Only in one analysis of Bella Coola and in some cases in Washo historically, does fusion arise from a preceding glottal stop. In this respect, fusion mirrors the tendency for assimilation to be regressive (Mohanan 1993, Kiparsky 1995).

There were a few cases, such as Aari, Rutul, and some Pomo languages, in which one of the fusing elements was voiced. In the case of Aari, the voiced implosives followed by a voiceless suffix fused to preserve glottal constriction of the first segment, while shedding the [voice] specification of the first, like the following segment. In other cases, a voiced consonant plus glottal stop combined to form an ejective. This is unusual
since fusion is typically structure-building—adding laryngeal features, not structure-changing.

Segments which fuse are always adjacent; cases of nonadjacency are described in the chapter on assimilation. Where consonants are non-adjacent, a process such as syncope or metathesis brings them in contact (as in Yapese).

In some languages, like Tsou, ejectives seem clearly to be at the phonetic level, since ejection is typical of fast speech, is variable, and phonologically, 'ejectives' seem to act as clusters. In fast speech, fusion can even take place across word boundaries, as Hoijer reported for Navajo and Apache.

I have documented in this section many cases of consonantal fusion, which testify as to the relative commonality of fusion. As such, it seems that phonologists should consider fusion one the elementary processes in their inventory of basic operations.

8.5. Conclusion

Although fusion and fission have long been noticed by phonologists, they have played second fiddle to spreading and delinking processes in current theory. In SPE, fusion (and to a degree, fission) were described using a powerful transformational device, which was later abandoned in an effort to constrain the theory. In autosegmental works, phonologists recognized a need to join and break up association lines through such processes as gemination and tier conflation. The majority of attention on fusion was devoted to vocalic processes of diphthongization and monophthongization, and Dependency and especially Particle Phonology were developed to account for such processes. In other generative frameworks, fusion and fission are gradually becoming recognized as necessary elemental operations on representations.

In studying fusion, where two separate segments merge into one segment with characteristics of both, we examined some of the problems associated with the non-uniqueness or indeterminacy of phonological representations, e.g. How does one know whether a phonetic ejective is a phonological unit or a cluster? We examined a variety of arguments which have been put forth and tested them with data. In those cases in which ejectives act phonologically as clusters, it is then possible to examine possible instances of phonological fusion.

In cases of ejectives arising from fusion, by far the most common type was voiceless obstruent (especially stops and affricates) followed by glottal stop. My data confirm a tendency for such assimilations (if fusion can be called that) to be regressive, in
which the laryngeal specifications of a placeless glottal segment link to a preceding plain consonant, one without laryngeal specifications. Such an overwhelming tendency to fuse is aptly captured by Steriade’s rule of merger, which states:

(33) ‘Merge any adjacent pair of A-positions iff the immediate output is monosegmental’ (Steriade 1994:244)

Her definition of monosegmental is given above in (5) above. In short, aperture positions must merge if they are not distinct segments; if they share only one basic A-position and only one place of articulation, they will merge. (Stop releases such as $A_{\text{max}}$ are derived from a rule of Release Projection and are not considered basic). Steriade’s formulation nicely captures the tendency for glottal stop to fuse with a preceding obstruent, especially those with no laryngeal specifications of their own. Such a merger is somewhat similar to feature-filling rules, in that original values are not changed.

The preference of fusion to take place with stops and affricates in particular fits with Kingston’s (1985a, 1990) Binding Principle, which states:

(34) Binding Principle

1. Stops are much more likely to contrast for glottal articulations than either fricatives or sonorants, and
2. Glottal articulations in stops are much more frequently realized as modifications of the release of the oral closure than of its onset.

(Kingston 1990:407)

The second clause regarding glottalization appearing on the release, rather than the onset, helps to explain why fusion so often takes place with a following segment; preceding segments would more likely fuse with the closure portion, or would have to cross the first aperture node.

The near dearth of consonantal fission in which an ejective breaks up into an oral and a glottal component is surprising, given that fission is thought to be a mirror-image process of fusion. Why should two consonants fuse as one, but one consonant rarely, if ever, become two? I believe the answer lies in what Calabrese (1995) termed ‘disallowed
configurations'. If a language allows ejectives, there is no constraint against having laryngeal features specified for [constricted glottis]. In short, if a language has underlying ejectives, at some point in a derivation, they would have to be dubbed a disallowed configuration (or some other constraint would apply, as in syllable-final position in Takelma) in order to trigger a rule of fission. There seems to be a phonological preference for a segment to have place and laryngeal features bound in one segment, rather than create a plain segment and a placeless laryngeal segment.

In sum, fusion seems to be a necessary operation in phonological theory. I have provided ample evidence of fusions involving plain stops and glottal stop fusing into ejectives. Fission also seems to be a necessary construct of the theory, especially for diphthongization. Although consonants typically do not undergo fission and thus ejective fission is much less frequent a process, fission, especially given its utility in other non-linear processes, should also be considered a basic, if relatively marked, operation.
CHAPTER 9
CONCLUSION

This study is the first comprehensive, large-scale survey of the phonological behavior of ejectives, based on the grammars of over 150 languages. Although much recent work has been done on the patterns of inventories of ejectives (e.g. Maddieson 1984), little has been done on phonological rules involving ejectives. This study is thus a first step in Keating’s (1988) call to conduct surveys of groups of segments—in this case, ejectives—as a means to more firmly establish natural classes on which distinctive feature theory is based. Ejectives are characterized by the feature [constricted glottis], and while this survey concentrated on ejectives themselves, it also noted some interaction of other classes of sounds which share this feature (e.g. implosives and glottalized sonorants), as well as classes of sounds which shared the structural organization of the Laryngeal node (e.g. voiced and voiceless stops). As Ohala (1983) pointed out, to find sound patterns that are universal, it is necessary to look among unrelated languages and to use a variety of evidence. Thus in addition to the fundamental morphophonemic alternations and allophonic changes, I have examined free variation, historical and dialectal variants, loanword phonology, and phonetic descriptions in order to form a more complete understanding of the phonology of ejectives.

Lass (1997:221) said that ideally, data sets ought to be available for every suspected natural pathway, adding that ‘a transformation-series data-base would be a useful thing to have as a source corpus for guiding induction’. This echoes Ferguson’s (1990) desire for expanding the knowledge of relative probabilities and conditioning factors of sound change and explanation for them. This dissertation contributes to understanding of changes involving ejectives and can easily serve as a source corpus to guide historical reconstructions.

The Ejective Model of the Glottalic Theory of Proto-Indo-European requires two key changes in its proposed phonetic pathways for the ejective series: deglottalization and voicing. Both changes were confirmed, synchronically and diachronically. Although the Ejective Model as a whole could not be evaluated, this thesis contributes to the diachronic typology of ejectives. Ejective voicing in particular, thought to be the weakest part of the...
model by supporters and detractors alike, has been put on a more solid, empirical, cross-linguistic foundation. While it is perhaps not as common as the model requires, it is a well-attested change found in several different language families.

In addition to the empirical and historical contributions mentioned above, this study has provided substantial confirmation that the constriction-based model of feature geometry (Clements and Hume 1995), in conjunction with the primitive phonological operations of spreading, delinking, and fission and fusion, correctly predicts and accurately accounts for the major processes which ejectives undergo. Each chapter was organized around a given operation on a particular structure. For example, in Chapter Three, spreading of the Laryngeal node accounted for assimilation in which ejectives were the trigger. Also provided were examples of root spread and place spread in which ejectives participated. However, spread of the feature [constricted glottis] occurs only allophonically, illustrating the general preference for class nodes to spread.

Both the loss of the feature [e.g.] (deglottalization) and the Laryngeal node bearing [e.g.] and other features (delaryngealization) were formalized in Chapter Four as delinking of either the laryngeal feature or the Laryngeal node.

Chapter Five showed the need to recognize three (and possibly four) types of debuccalization, where previously only one was recognized. Individual Place Feature Debuccalization is found in languages which preserve secondary articulation but change primary oral articulation to a glottal one. Only the constriction-based feature geometry can account for this change, which argues for the structural independence of primary and secondary place features. Root Node Debuccalization is the delinking of the Root node, with a glottal segment as a default. Oral Cavity Debuccalization is the preservation of the original (or derived) laryngeal specifications on segments which lose oral place features. The last type of debuccalization, C-place Delinking, could not be empirically verified, given the controversial question of whether glottals may bear stricture features. Circumstantial evidence was provided which might suggest this type of debuccalization could exist but it awaits verification of the data and it requires certain theoretical assumptions.

The dissimilation of ejectives was examined in Chapter Six and analyzed as a delinking with default fill-in in response to OCP violations against [e.g.]. Ejectives may dissimilate to voiceless plosives, or on occasion undergo voicing.

Ejective voicing, discussed extensively in Chapter Seven, examined the voicing of ejectives by direct assimilatory spread from an adjacent vowel, indirect voicing by delinking and then default or spread, as well as implosivization. As mentioned above,
several synchronic and diachronic alternations illustrate the plausibility and precedents for this former stumbling block of the Ejective Model. A phonetic typology of ejectives provided a framework with which to examine the physical production of ejectives, and helped to account for the physiological and acoustic reasons for this change.

Finally, in Chapter Eight, the other basic operations of fission and fusion were examined. Ejective fission is extremely rare, though attested, and is a marked operation involving the break up of one consonant into two. Fusion, on the other hand, is quite common and typically blends a consonant with place but without a Laryngeal node with a segment which lacks place but contains a Laryngeal node. The result is the creation of an ejective from a plosive and a glottal stop.

While this survey has been comprehensive, it has not been exhaustive. Further questions for research include assessing the purported pharyngealization of ejectives in Semitic, the interaction between ejectives and vowels with respect to vowel quality (as in Tigre; Rose 1996) and tone (Kingston 1982), and the creation of ejectives after nasals in Southern Bantu or in loanwords in Georgian and Ethiopian Semitic, for example. Other studies could include detailed investigation on the frequency of ejectives in various languages, facts related to their acquisition, and the markedness of ejectives. However, in the words of John Lyons in his book *Semantics*, vol. 1, ‘sometimes one must stop even if one has not finished!’ Clearly, ejectives, and its fellow [e.g.] sounds are a very rich vein to mine for both empirical facts and theoretical testing.
APPENDIX

IMPRESSIONISTIC PHONETIC DESCRIPTIONS OF EJECTIVES

Organized by language family

ATHABASKAN

The Athabaskan languages are generally thought to have fortis ejectives, according to Sapir (1938) in his comparison of ejectives, though Sapir (1933/1972:28) notes that in the Athabaskan languages he has heard (Sarcee, Kutchin, Hupa, Navaho), "the aspirated voiceless stops and affricatives (of type \( t', k', ts' \)) are far more "fortis" in character than the corresponding glottalized consonants (e.g., \( t, k, ts \))."

Hupa

\( t', k', \) and \( q' \) are...somewhat weakly released in initial and medial position, where they are sometimes difficult to distinguish from the voiceless unaspirated stops \( t, k, \) and \( q, \) but released with a more distinct ejective quality in final position.' The same is true for the ejective affricates /ts', tʃ', tʃ'l (Golla 1996:367).

Slave

"ts' and tʃ' frequently have a glottalization so lenis in character as to escape notice" (Howard 1963:44).

Kiowa Apache

[\( t' \)] and [\( k' \)] 'are actualized with fortis glottalization in word initial position, but not in word medial position' (Bittle 1963:78).

WAKASHAN

Nootka

Nootka has "violently glottalized consonants" (S. Newman 1946: 224). Sapir (1933/1972:28) notes that in Nootka, "it did not seem to me that the glottalized
stops and affricatives (Boas' "fortes") were significantly different in emphasis from the ordinary stops and affricatives.'

SALISHAN
Bella Coola
Has 'violently glottalized consonants' (S. Newman 1946: 224).

Southern Puget Sound Salish
'The articulation of glottalized consonants is usually very fortis. Particularly when glottalized consonants are not followed by vocoids or junctural [l], the duration of exploded air often is marked.' (Snyder 1968:12-13).

Nooksack
Ejective stops and affricates have 'fairly strong glottalization' (Galloway 1984:17).

Tillamook
'Aspiration, voicing, and glottalizing are slight and sometimes indeterminate, as they are in northern California' (Reichard 1958:299).

Upper Chehalis
'Glottalized stops may also be aspirated, but are not so as consistently as non-glottalized stops. Although the glottal release of glottalized stops is usually quite distinct and sharp, it may sometimes be reduced, and is often rather slight in a consonant cluster, such as occurs in the morpheme /-tʃp/ 'fire', and in narrative speech. It is sometimes so slight that it is difficult to hear the glottalization.' (Kinkade 1963:190).

Colville
'The glottalized stops are fortis (strongly articulated), and, as a rule, they can be easily distinguished from their plain counterparts.' (Mattina 1973:7).

Kalispel
'The glottalized stops are usually "fortis"' (12), but later Vogt notes that 'The glottalization is relatively weak, and the distinction between the glottalized and the non-glottalized series is not always easy' (Vogt 1940: 12).

Thompson
'the contrast between p and p' is particularly hard for the nonnative ear to discern (especially via-à-vis postvelars q and q', which are easily distinguished)' Thompson, Thompson, and Egesdal (1996:610).

KERESAN
Acoma
Acoma is a 'lenis language'. 'The glottalization of obstruents is light and follows the consonant' (Miller 1965).
PENUTIAN

Tsimshian

Boas (1911c) reports that ‘in the Tsimshian dialect the fortis survives clearly in the t and p; while the ts and k fortis have come to be very weak’ (288). It is somewhat unusual for posterior ejectives to become weak. In the Nass River dialect, however, speakers ‘used the hiatus frequently, without, however, giving the preceding stop enough strength to justify the inclusion of a fortis’. In this dialect, Boas called these stops ‘surd followed by hiatus’ (289).

Gitksan

‘The glottalized stops of Gitksan (and Nisgaha...) ... when compared to those of other Pacific Northwest languages such as Sahaptin and Kiksht (Upper Chinookan), have a definite lenis character’ (Ingram and Rigsby 1990:259). Hoard (1978:115) agrees on this, noting that final glottalized stops ‘are only weakly ejective (i.e. there is little or no larynx movement)’.

Chinook

Chinook has been analyzed as having ‘fortis’ ejectives (Sapir 1938).

Takelma

‘The fortes (p’, t’, k’, ts’; ...) are pronounced with the characteristic snatched or crackly effect (more or less decided stress of articulation of voiceless stop followed by explosion and momentary hiatus) prevalent on the Pacific coast’ (Sapir 1922:33).

Siuslaw

‘Clayton Barrett, in whose statements I have confidence, volunteered the remark that the old people differed widely in the forcefulness of their pronunciation. He said that some would talk like ..., demonstrating with a hilarious use of fortissimo glottalization. From his comments, I infer that force of glottalization was in part an individual characteristic, and also that it might vary for reasons of a joke, clarity, or the like; in short, the degree of glottalization could be metalinguistic, expressive, etc., in function, but not phonemic in the ordinary sense.’ (Hymes 1966:336).

Klamath

Intervocalic glottalized stops ‘are less fortis and in early recordings were sometimes written [p?], [t?], etc. Further examination revealed that the glottal closure, though simultaneous, is released later than the stop occlusion’ (Barker 1964:22).

Northern Sahaptin

‘The glottalized sounds are on the whole uttered with almost as startling a crackle as the fortis glottalized sounds of the Salish language to the west and north. They are given far more explosive effect than is found in the coast Oregon languages such as Kalapuya and Athabaskan’ (Jacobs 1931:106, cited in Sherzer 1976b:127).

Umatilla Sahaptin (a Southern Sahaptin dialect)

Ejectives have ‘degrees of “popping” dependent on dialect and speaker, as well as speech situation’ (Rigsby and Rude 1996:667). ‘On the whole, the
glottalized obstruents are strongly articulated and easily heard as compared with the more lenis pronunciation of cognates among the Nez-Perce-speaking Cayuse around Pendleton, Oregon' (1996:671).

Wintu

/p'/ (and the other ejectives) are ‘glottalized, fortis among some younger informants and in citation forms, but lenis in normal speech.’ (Pitkin 1984: 27-8).

‘Note also that the glottalized phonemes are normally articulated in a lax manner, particularly when they are not post-junctural, although some slight glottal co-articulation is never absent, and the acoustic quality of these stops is often quite similar to that of voiceless unaspirated stops. Only in some idiolects or in emphatic speech is fortis glottalization employed’ (1984:30).

‘The greater the magnitude of the preceding juncture, the greater the intensity of the stress; the more fortis the glottalization of a preceding consonant or the articulation of a preceding /p/, the stronger the stress. This factor of glottal stricture varies with the idiolect, but appears consistent within each idiolect.’ (1984:19).

Maidu

‘The glottalized stops are normally lax, particularly when they are not word-initial. Although some slight glottal coarticulation is never absent, the acoustic quality of these stops is often similar to that of voiceless unaspirated stops. Only in some idiolects or in emphatic speech is fortis glottalization employed’ (Shipley 1964:7). And also: ‘the glottalized stops become very weakly glottalized so that the aspirated and glottalized series fall together to some extent. The merging in incomplete, but only a practiced Maidu ear can clearly distinguish a glottalized from an unglottalized stop in an allegro utterance’ (Shipley 1956:236). Paul (1967:15) reports that in Auburn Nisenan, a Maidu dialect, [k'] and [ts'] ‘when followed by syllables, and especially in medial position, often sound like [g] and [dz].’ Furthermore, the few word-final tokens involving ejectives were ‘extremely lenis’.

Yawelmani

‘A light degree of glottal plosion characterizes the glottalized stops and affricatives of Yawelmani; in acoustic effect these consonants are markedly different from the violently glottalized consonants which occur in the languages of the Northwest Coast, such as Nootka or Bella Coola.’ (S. Newman 1946: 224).

Chitimacha

Chitimacha has ‘lenis’ ejectives according to Sapir (1938). Swadesh (1946:314) agrees, and elaborates that ‘Those called ejectives are lenis in articulation and marked by glottalization only in syllabic initial position; in syllabic final position, in which they occur only after vowels and sonorant consonants, the glottal closure comes before the oral closure.’
Quiche
Edmonson (1967:252) reports that in Classical Quiche, ‘articulation of the
glottalized series is often lenis intervocally and often fortis in initial and final
positions.’

HOKAN
Yana
Yana has ejectives of ‘fortis articulation with concurrent glottalization, and are
distinct from /b? d? ð3? g?/ sequences’ (Sapir and Swadesh 1960:3).

Eastern Pomo
The glottal closure and release ‘except in reiterated citation contexts, is rather
lenis’ (McLendon 1975:16).

Southeastern (Sulfur Bank) Pomo
The glottalized stops ‘may be ejected with moderate or considerable force,
varying from speaker to speaker’ (Moshinsky 1974:6).

TIWA
Taos
‘Sound made with lenis closures in both the glottal and other positions, and
nonforceful releases, the glottal release following the other at an appreciable
interval. There is none of the snapping or cracking effect found in the
glottalized phonemes of some other languages (“explosive glottalized”), and
often, especially between vowels, the effect is that of a nonglottalized voiceless
lenis (“intermediate”)’ (Trager 1946: 196). Trager (1948:159) however
observes that ‘the glottalized sounds are lenis (in release, however, rather than in
closure’). Trager (1948:158-9) adds that ‘the “glottalized consonants” are
released with the same variation from mere hiatus before the next sound (always
a vowel) to an actual glottal release’. Sapir (1938) also commented on the lenis
nature of Tanoan ejectives.

SOUTHERN ANDEAN
Qawasqar
‘The glottalized sounds have a very weak phonological realization’ (Clairis

NORTHWEST CAUCASIAN
‘The glottalic members can be either true glottalic ejectives with complete glottal
closure, or forms with slight glottal trilling, or even, on occasion, forms with
weak glottal closure and no ejective airstream, closely resembling unaspirated
stops.’ (Colarusso 1988:1).

Cicassian
‘East Circassian /q’/ and /q“’/ are not strongly ejective and are comparable to the
unaspirated uvulars of West Circassian, rather than to true ejective uvulars, such
as are seen in Hakuchi /q’/ and /q“’/’ (Colarusso 1988:92).
Kabardian (an East Circassian language)

'In Kabardian the glottal series is very lightly ejective or made with glottalization, i.e., glottal trilling (Kuipers 1960, 19-20)' (Colarusso 1988:81).

Ubykh

In clusters, ‘Ubykh ejectives are either glottalized or weakly ejective’ (Colarusso 1988:169).

INDO-EUROPEAN

Armenian

‘In the ejective series, the glottal plosion is never very strong, and is weakest at the commencement of a medial unstressed syllable; in such cases it might in fact be more accurate to speak of it as potentially rather than actually present, being audibly realized only in careful utterance. At the commencement of initial and stressed syllables, however, glottalization is clearly present, and is particularly marked (though not violent) in final position.’ (Allen 1950: 188). Colarusso (1988:114 fn 1), however, claimed that Armenian has strongly ejective glottalic sounds. Khachatryan (1996) notes that there is weak and variable ejectivity, which is more noticeable in isolated words and in certain dialects.

KARTVELIAN

Georgian

Kingston (1985a) reports that in a personal communication with Johanna Nichols, Georgian ejectives are not very noticeable. But when Georgian speak to non-Georgians, ‘they produce more noticeably glottalized consonants’ (53), indicative of style shifting.

Robins and Waterson (1952:65-6) observe that ejectives are marked by ‘fortis articulation’; the aspirated and unaspirated series are by comparison lenes. There are positional allophones of ejectives: marked ejection (‘initiation of the airstream by an upward movement of the closed glottis against closure at some point in the mouth’) is only in initial position of members of initial clusters. Medial and final consonants are articulated with ‘simultaneous glottal closure or constriction, but little or no ejective release’.

Svan

Hewitt (1981:200) observes that ‘ejectives in Svan are pronounced with greater intensity than in Georgian’.

DAGHESTANIAN CAUCASIAN

Udi

Recall Schulze-Fürhoff’s (1991) observations that ejectives in Udi were realized differently according to the degree of aspiration of the aspirates (see §4.5.1).

1 Colarusso (1988: 114, fn 1) notes that Armenian has strongly ejective glottalic, laryngealized glottalic, and unaspirated realizations of the unaspirated, unvoiced series.
SEMITIC
Modern South Arabian
'The glottalization in the realization of these consonants seems not to be as strong as in the equivalent consonants in, say, Amharic and it does seem to be true that the aspiration of most of the corresponding non-glottalized consonants constitutes an important element in the distinction of glottalized/non-glottalized pairs.

'Nevertheless although the degree of glottalization can vary in strength, dependent on a number of factors, such as whether a consonant is initial, medial or final and the effect of contiguous consonants, it is a distinctive feature of some importance' (Johnstone 1975:6).

The Mehri of Jādib is reported to have strong ejectives (Simeone-Senelle 1991).

CHADIC
Hausa
'3', g', etc. seem preferable to the usual writings ts', k', to distinguish these sounds, which are lenes, from the fortis type found, e.g. in r', a sound used with learned connotations by some speakers in the place of 3' to represent the emphatic t in Arabic loan words' (Greenberg 1941).

'The Hausa /k'/ is simultaneously glottalized, with fairly light ejective release most prominent before front vowels' (Welmers 1973).

CUSHITIC
Saho
'Strongly ejective glottalized h', tʃ', k', s'/ have been recorded' in Saho, though Welmers (1973:50) notes that many of these sounds must be adaptations.

BANTU
Tswana
The voiceless explosives and affricates in Tswana are usually Ejective, i.e. articulated with simultaneous closure of the glottis or vocal cords, which produces are sharp explosive effect. However, the ejection is normally very slight in Tswana, and is not actually essential to the pronunciation of these sounds. It is strongest in the case of the lateral explosive tl, and is otherwise most noticeable in emphatic speech' (Cole 1955:19).

Venda
Poulos (1990:497) notes that in Venda, the dental ejective /tʃ/ 'appears to be pronounced with very little ejection'.

Zulu
Series 2 is always voiceless. It is 'frequently non-ejected (cf Doke 1926:46-7). Non-ejectives are judged as more acceptable than ejectives which are associated with a slow, precise, highly formal style of speech' (Lanham 1969:157).
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Abbreviations:
BLS  Proceedings of the xth Annual Meeting of the Berkeley Linguistics Society
CLS  Papers from the xth Annual Regional Meeting of the Chicago Linguistic Society
IJAL  International Journal of American Linguistics
JIPA  Journal of the International Phonetic Association
LI    Linguistic Inquiry
UCLA WPP  UCLA Working Papers in Phonetics
UCPL  University of California Publications in Linguistics


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