ANALYSIS OF SELECTED PROSODIC FEATURES IN THE SPEECH OF BLACK AND WHITE CHILDREN

DISSERTATION

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By

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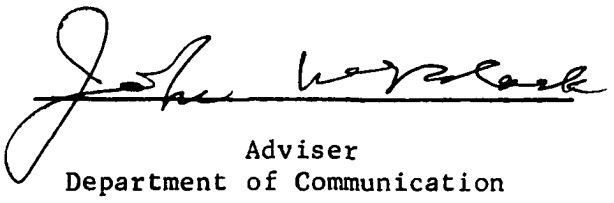

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CHAPTER I

INTRODUCTION

Purpose of the Study

The purpose of the study under discussion was to expand the information available on selected prosodic features of speech which may differ among social dialects, specifically black and standard white English dialects of children in central Ohio. Interdisciplinary approaches for identifying and analyzing communication samples were used.

Although prosodic features have been alluded to as dimensions of dialects, they have received minimal descriptive study. For example, Chomsky and Halle state, "Our investigations of these [prosodic features] have not progressed to a point where a discussion in print would be useful."[1] Dillard comments that there appears to be a difference in the function and use of stress[2] and range of vocal pitch in Black English from that used in Standard English; however, he adds that these differences have "...not been seriously investigated..." and rest with "...the collection of a few impressionistic statements."[3] Adler says, "To map out these sound variants

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[1]Noam Chomsky and Morris Halle, Sound Pattern of English (New York: Harper & Row, 1968), 329.

[2]A principal component of stress, intensity, is not included in the three topics under study; however, as Ronald W. Langacker notes in Language and Its Structure (New York: Harcourt, Brace & World, Inc., 1968), 151, intensity interacts with both fundamental frequency and duration.

[3]J.L. Dillard, Black English (New York: Random House, 1972), 310.

(phonological, grammatical, and lexical) and their intonational patterns for each of the different linguistic communities is now the task before the sociolinguist."[4]

Much literature treating the language of children represented by McCarthy[5], Luchsinger and Arnold[6], Lenneberg[7], and McNeill[8], describes children's speech at 18 months as that of a universal dialect of children. In the year or two that follow, the language of the child progresses toward the patterns of language and speech of the children's adult speech models. This provides the rationale for a study of possible changing prosodic features of children during this transitional period for linguistic development, i.e. 19 - 27 months.

Two methodologies were selected, a) the judgmental responses of listeners, and b) instrumental analyses of fundamental frequency, duration, and "contours" of successive fundamental frequencies. The listeners were asked to identify each of 12 speech samples as those having originated with a "black" or with a "white" speaker. The physical analyses were restricted to fundamental frequency and duration. These measurements could

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[4]Sol Adler, "Social Class Bases of Language: A Reexamination of Socioeconomic, Sociopsychological and Sociolinguistic Factors," Asha, 15 (1973), 6.

[5]Dorothea McCarthy, "Language Development in Children," in Manual of Child Psychology, ed. by Leonard Carmichael (New York: John Wiley & Sons, Inc., 1954), 499-502.

[6]Richard Luchsinger and Godfrey E. Arnold, Voice-Speech-Language, Clinical Communicology: Its Physiology and Pathology (Belmont, California: Wadsworth Publishing Company, Inc., 1965), 348-351.

[7]Lenneberg, Eric, Biological Foundations of Language (New York: John Wiley & Sons, Inc., 1967), 125-135.

[8]David McNeill, "The Development of Language," in Carmichael's Manual of Child Psychology, ed. by P.A. Mussen (New York: John Wiley & Sons, Inc., 1970).

be taken from recordings made in the environments of the children's homes, at play. This would not have been the case with analyses of intensity or spectra.

The sequential steps of the study under discussion were:

1) making acoustic recordings of four black children each month for nine months, commencing with their 19th month of age,
2) making acoustic recordings of two white children during their 19th month, and two white children during their 27th month,
3) editing the recordings of 1 and 2 to obtain representative 12-second speech samples for each child, each month,
4) playing back samples recorded at 19 and 27 months to panels of listeners and asking whether the speaker was "white" or "black",
5) treating the data, i.e., testing the hypotheses,
6) determining the mean fundamental frequency over 50-msec. intervals for each speech sample,
7) determining the length of voiced and unvoiced segments of the utterances over 50-msec. intervals for each speech sample,
8) comparing the selected features of frequency, duration, and contours of frequency of the judged "white" speech samples with the "black" samples irrespective of the age and race of the speaker,
9) identifying the selected features of frequency, duration and contours of frequency, which appeared to have changed during the interval between the 19th and 27th months of the four black children.

Definition of Terms

Terminology, definitions, descriptions, and the role of prosodic features in language and communication vary from source to source. Scholars

from various academic disciplines often use differing terminology to describe a common event. Each is viewing that event from a unique perspective and with a unique purpose in mind. This is apparent in the literature on prosodic features. Although not direct synonyms, "prosodic features" and "suprasegmentals" refer to the non-segmental features of vocal utterances. "Intonation contours", and "melody curves" refer to a common prosodic feature, that of sequences of fundamental frequencies. "Stress" generally refers to a point of emphasis or prominence, usually measured by greater length, higher pitch, and greater articulatory force.[9]

Specific usages in this report follow.

An inflection is a change in fundamental frequency of at least one semitone, either upward or downward, without interruption of phonation.[10]

A contour of frequency is a sequence of fundamental frequencies.[11]

Phase is a voiced segment of an utterance characterized by one of three patterns of intonation:

Monophasic describes a single-direction pattern of intonation (/, –, \).

Biphasic describes a two-direction pattern of intonations (∧, ∨, /, –/, ¯\, _).

Polyphasic describes a three- or more-direction pattern of intonations

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[9] Langacker, Language and Its Structure, 151.

[10] Grant Fairbanks, "Recent Experimental Investigations of Vocal Pitch in Speech," Journal of the Acoustical Society of America, 11 (1940), 457.

[11] Michael Studdert-Kennedy, "The Perception of Speech," Status Report on Speech Research (1970).

which result in a complex pattern comprised of combinations of /, —, \.[12]

Prosodic features are those non-segmental aspects of voice, specifically of frequency, amplitude, and duration which affect meaning.[13]

A speech sample is a 12-second recorded selection of a child's utterances selected as representative of his speech for a designated month.

A syllable is a) an utterance with separate stress, or b) a "movement" containing a vowel phoneme, a vowel in combination with one or more consonants, a syllabic consonant, or a syllabic consonant plus another consonant.

A voiced segment is a voiced portion of an utterance bounded by zero fundamental frequency readings representing momentary or prolonged pauses.

An utterance is a complete message by one person, before and after which there is silence on the part of the speaker.[14]

"Black" and "white" (with quotation marks) refer to a judgment of race made from a speech sample by a listener. White and black (without quotation marks) refer to the apparent generic racial grouping of an individual.

Organization of the Report

In this chapter, Chapter I, the purpose of the study under consideration was stated: to expand the information related to selected prosodic

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[12] Claes Witting, "A Method of Evaluating Listeners' Transcriptions of Intonation on the Basis of Instrumental Data," Language, 5 (1962), 141.

[13] David Crystal, Prosodic Systems and Intonation in English (Cambridge: Cambridge University Press, 1969), and Philip Lieberman, Intonation, Perception and Language (Cambridge, Mass.: The M.I.T. Press, 1967).

[14] Zellig S. Harris, Structural Linguistics (Chicago: The University of Chicago Press, 1951), 14.

features of speech which may differ between black and standard white English dialects. Definitions of technical terms used in this report were stated.

In Chapter II a review of the literature on prosodic features is presented. This review focuses in three areas: a) studies of prosodic features by auditory analyses, b) studies of prosodic features by instrumental analyses, and c) studies of the development of prosodic features in children's speech.

In Chapter III the procedures used in the study under discussion are presented. This chapter includes a) the methodologies of selecting the speakers, the listeners, the speech samples, and the listening task (steps 1-4, page 3), b) hypotheses to be tested (step 5, page 3), c) a methodology for relating measures of fundamental frequency and milliseconds to judgments of "white" and "black" (steps 6, 7, page 3), and d) a methodology testing changes in the selected features of frequency, duration, and contours of frequency over the nine-month period for the black speakers (step 9, page 3).

Chapter IV includes a report of the results of the procedures. Chapter V includes a summary, the conclusions to be drawn from the study, limitations of the study, and recommendations for further study.

CHAPTER II

REVIEW OF THE LITERATURE OF PROSODIC FEATURES

Scholars from diverse fields have been aware of the impact of prosodic features on communication for centuries. Likewise, they have been studying prosodic features scientifically for generations by auditory and/or instrumental methods.

Auditory Analyses of Prosodic Features

Published results of auditory analyses may have begun with Steele, who described characteristics of the human voice, using musical terminology.[1] This procedure was replicated and refined by Rush[2] and used much later by Jones[3]. Another procedure was initiated by Skinner, who used the judgments of listeners to identify emotional states of the speaker from recordings of the speaker's voice.[4] Fairbanks[5],

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[1] Joshua Steele, Prosodia Rationalis, or an Essay Towards Establishing the Melody and Measures of Speech, to be Expressed and Perpetuated, by Peculiar Symbols, 2nd Edition (London: J. Nichols 1779).

[2] James Rush, The Philosophy of the Human Voice (Philadelphia: J. Crissy, Printer, Minor Street 1827).

[3] Daniel Jones, Intonation Curves (Leipzig & Berlin: B.G. Teubnev 1909), 8.

[4] E. Ray Skinner, "A Calibrated Recording and Analysis of the Pitch, Force and Quality of Vocal Tones Expressing Happiness and Sadness, and a Determination of the Pitch and Force of the Subjective Concepts of Ordinary, Soft, and Loud Tones," Speech Monographs, II (1935).

[5] Fairbanks, "Recent Experimental Investigations," 170.

Knower[6], Davitz[7], Levy[8], and others also found positive correlations between the intended emotive meaning of a speaker and the perceived emotive meaning by the listener.

Beyond emotive meaning however, sociolinguistic researcher Labov stated that "...most people hear other people's speech and their own through a screen of preconceptions and stereotypes."[9] Numerous students note that these stereotypes involve judgments of speech and inferred personal characteristics of the speakers. Markel, Eisler, and Hayne concluded that regional dialects arouse stereotyped images of personality.[10] Anisfeld, Bobo, and Lambert found identifiable ethnic stereotypes from comparing responses to recordings of standard English with those of English with a Jewish accent.[11] Lambert, likewise, reported that French-Canadian and English listeners ranked speakers of English as possessing "higher personality traits" than those same speakers when they spoke French.[12]

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[6]Franklin Knower, "Analysis of Some Experimental Variations of Simulated Vocal Expressions of the Emotions," Journal of Social Psychology, 14 (1941), 372.

[7]Joel Davitz, The Communication of Emotional Meaning (New York: McGraw Hill Book Co. 1964).

[8]Phyllis K. Levy, "The Ability to Express and Perceive Vocal Communication of Feeling," in The Communication of Emotional Meaning, ed. by Joel Davitz (New York: McGraw Hill Book Co. 1964), 55.

[9]William Labov, The Study of Nonstandard English (Champaign, Ill.: National Council of Teachers of English 1970), 49.

[10]N.N. Markel, R. Eisler, and R. Hayne, "Judging Personality from Dialect," Journal of Verbal Learning and Verbal Behavior, 6 (1967), 36.

[11]M. Anisfeld, N. Bobo, and W.E. Lambert, "Evaluation Reactions to Accented English Speech," Journal of Abnormal and Social Psychology, 65 (1962), 231.

[12]W.E. Lambert, "Evaluation Reactions to Spoken Languages," Journal of Abnormal and Social Psychology, 60 (1960), 51.

In studies of reactions of listeners to black and white speakers in the United States, Putnam and O'Hern concluded that speech served as a mark of social class.[13] Harms concluded that dialect affects both credibility and comprehension in the listener.[14] Eisenberg, Berlin, Dill, and Sheldon noted that, regardless of race, educated listeners considered those of their own race to be most intelligible.[15] Wolfe concluded that intelligibility was uninfluenced, but that "acceptibility" of both speech and occupation were influenced by the race of the speaker.[16] Labov noted that listeners were not accurate in their identification of the race of the speaker; however, they responded negatively to Negro speech as a "social reality".[17]

Sociolinguists agree that the speech of black and white persons is different; however, as Wolfram states:

> Linguists take as axiomatic that...black-white speech differences... have nothing to do with the physical or mental attributes of Negroes, but with the historical origin of varieties of English used in the United States and the dynamics of social patterns affecting speech.[18]

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[13] G. Putnam and E. O'Hern, "The Status Significance of an Isolated Urban Dialect," Language, 31 (1955), 31.

[14] L.S. Harms, "Status Cues in Speech: Extra-Race and Extra-Region Identification," Lingua, 12 (1963), 306.

[15] L. Eisenberg, C. Berlin, Anne Dill, and F. Sheldon, "Class and Race Effects on the Intelligibility of Monosyllables," Child Development, 39 (1968), 1089.

[16] Virginia Smith Wolfe, "The Social Significance of Negro Speech" (unpublished Ph. D. dissertation, The Ohio State University, 1968).

[17] William Labov, "Some Sources of Reading Problems for Negro Speakers of Nonstandard English," in Teaching Black Children to Read, ed. by Joan C. Baratz and Roger W. Shuy, Washington, D.C.: Center for Applied Linguistics (1969), 37.

[18] Walt Wolfram, "Black-White Speech Differences Revisited," Viewpoints, 47 (1971), 28.

From field-study research, Stewart described the Negro "flavor" in speech as including a distinctive voice quality, syllable dynamics, special stylistic uses of pitch, deliberate use of ethnic slang, and occasional switching into dialect behavior of a less general type.[19] Roberts reported:

> Subjective cues reported by the listeners which enabled them to distinguish Negro from white speakers included nasality, vowel prolongation, lower pitch, and slower rate for the Negroes and higher pitch, faster rate, and precise articulation for the white speakers.[20]

Theorists Chomsky and Halle noted that dialects differ from the standard speech in the ordering of rules of stress.[21] Summarizing their conclusions on the features of stress of black English, Fasold and Wolfram stated:

> Stress or accent in Negro dialect operates quite like the stress patterns of standard English with several exceptions. One exception can be found when standard English words of more than one syllable have their stress on the second syllable rather than the first. In Negro dialect, some of these words may be stressed on the first rather than the second syllable...
>
> Another difference which can be traced to stress is the absence of the first syllable of a word when the first syllable is unstressed.[22]

Dillard commented on the function of stress for black English by saying that it differs from standard English, and, "The range of vocal pitch, excluding falsetto, is probably greater. However, these observations have not been seriously investigated experimentally."[23]

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[19]William Stewart, "English Teaching" Social Dialects and Language Learning, ed. by Roger Shuy, Champaign Ill.: National Council of Teachers of English (1965), 18.

[20]Margaret Roberts, "The Pronounciation of Vowels in Negro Speech," (unpublished Ph. D. dissertation, The Ohio State University, 1968), 72.

[21]Chomsky and Halle, Sound Pattern of English, 342.

[22]Ralph W. Fasold and Walt Wolfram, "Some Linguistic Features of Negro Dialect," in Teaching Standard English in the Inner City, ed. by R. Fasold and R. Shuy, Washington, D.C.: Center for Applied Linguistics (1970), 17.

[23]Dillard, Black English, 310.

Instrumental Analyses of Prosodic Features

Instrumental analyses of the physical elements of frequency, intensity, and duration, as parameters of prosodic features have dominated the research since the 1930's and 1940's. Reviews of this literature of the physical aspects of prosodic features are in writings by Pike[24], Crystal[25], and Lieberman[26].

As summarized by Lieberman, all auditory and instrumental studies agree that certain identifiable patterns occur in speech. Disagreement centers on 1) what acoustic parameters are important, 2) how these parameters are generated and controlled, and 3) the number of distinct, linguistically significant patterns.[27]

The bulk of the physical analyses seem to focus on the influences of fundamental frequency and particularly on contours described by successive fundamental frequencies. Studdert-Kennedy summarized numerous studies by saying that the primary distinctive prosodic features are a variation in fundamental frequency (contour) and a distinctive terminal glide (contour).[28] Using a Vocoder and analyzing intonation in whispered speech, Denes concluded that the frequency at selected points in the

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[24] Kenneth L. Pike, The Intonation of American English, Ann Arbor: The University of Michigan Press (1945), 3-11.

[25] Crystal, Prosodic Systems and Intonations in English, 20-96.

[26] Philip Lieberman, "A Study of Prosodic Features," Status Reports on Speech Research, 23 (1970), 203-208.

[27] Ibid., 182.

[28] Michael Studdert-Kennedy and Kerstin Hadding, "Auditory and Linguistic Processes in the Perception of Intonation Contours," Status Report on Speech Research, 27 (1971), 156.

intonational contour was the most important prosodic feature.[29] Morton and Jassem changed stress in nonsense syllables by changing fundamental frequency, intensity, and duration, concluding that variations in fundamental frequency produced greater effects than variation in either intensity or duration.[30] Takefuta analyzed five parameters of intonation and concluded that the patterns of pitch of each syllable and the relative level of each syllable were the most effective measures.[31] Lieberman stated that only a few gross factors are essential for synthetic speech when the contours of the fundamental of the frequency that accompanies an utterance is specified.[32]

Aspects of duration have also been considered of importance among prosodic features from the conclusions of several students. Fry, experimenting with word-pairs, concluded that increased duration of the vowel was of primary importance in marking stress.[33] From experiments with a computer program, Mattingly concluded that pausal, sense-group boundaries were most vital.[34] Jaffe, Breskin, and Gertsman compared spontaneous speech

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[29] Peter Denes, "A Preliminary Investigation of Certain Aspects of Intonation," Language and Speech, 2 (1959), 122.

[30] John Morton and Wiktor Jassem, "Acoustic Correlates of Stress," Language and Speech, 8 (1965), 181.

[31] Yukio Takefuta, "A Study of Relative Efficiency of Acoustic Parameters in the Intonational Signal of American English," (unpublished Ph.D dissertation, The Ohio State University, 1966), 102.

[32] Lieberman, "A Study of Prosodic Features," 194.

[33] D.B. Fry, "Experiments in the Perception of Stress," Language and Speech, 1 (1958), 151.

[34] Ignatius G. Mattingly, "Synthesis by Rule of Prosodic Features," Language and Speech, 9 (1966), 13.

and reading,[35] and Barik experimented with tones as substitutes for speech[36] as means of analyzing voiced and pausal duration features in speech. From work with synthetic vowels, Ainsworth concluded "...duration of a vowel sound does affect its perceived identity."[37]

Lehto seems to have taken a singular stand by designating intensity as the primary parameter of intonation.[38] Several of the above studies, and those of Hollien and Shipp[39] and Gilbert[40], concluded that the authors had studies under way to test the impact of what they suspected might be the most powerful prosodic feature, that of voice spectrum. This topic is beyond the scope of the measurements reported later.

Auditory and Instrumental Analyses of Prosodic Features in the Development of Children's Speech

Numerous writers describe characteristic prosodic features of the child developmentally from birth through three years of age. An awareness of this literature describing the prosodic features of the speech of the

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[35] Joseph Jaffe, Stephen Breskin, and Louis J. Gerstman, "Random Generations of Apparent Speech Rhythms," Language and Speech, 15 (1972), 70.

[36] Henri Barik, "Some Innovations in a Computer Approach to the Analysis of Speech Patterns," Language and Speech, 15 (1972), 206.

[37] W.A. Ainsworth, "Duration as a Cue in the Recognition of Synthetic Vowels," Journal of the Acoustical Society of America, 51 (1972), 651.

[38] Ilse Lehiste, (Review of unpublished Ph.D. dissertation, Helsinki, 1969) "English Stress and its Modification by Intonation: An Analytic and Synthetic Study of Acoustic Parameters," by Leena Lehto, Language, 48 (1972), 190.

[39] Harry Hollien and Thomas Shipp, "Speaking Fundamental Frequency and Chronologic Ages in Males," Journal of Speech and Hearing Research, 15 (1972), 159.

[40] John H. Gilbert, "Formant Frequency Measurement in Spontaneous Speech of Children 0-6 Year Chronological Age," Journal of the Acoustical Society of America, 48 (1970), 130.

child from birth to 27 months is vital to the present review.

While there is some evidence that a few infants have vocalized in the uterus,[41] most researchers begin with the soundmaking of the neonate. Ostwald states that this "Soundmaking is an activity as necessary to human survival and comfort as breathing, feeding, sleeping, and the other vital processes."[42]

Sheppard and Lane made continuous recordings of all vocalizations of two infants during their first five months of life. From these data they determined the fundamental frequencies, the relative amplitude, and the duration of the vocalizations. Sheppard and Lane noted, as have Lieberman and others[43], a decrease in mean fundamental frequency from birth until the twenty-first day in both infants. Subsequently the mean frequency became higher until it passed the "birth frequency", and then it became constant.[44]

Wolff, as reported by Lieberman, observed that the non-crying vocalizations of an infant after age three weeks end with falling inflections.[45]

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[41] Peter F. Ostwald, Soundmaking, The Acoustic Communication of Emotion, Springfield, Ill.: Charles C Thomas (1963), viii.

[42] Ibid., ix.

[43] Philip Lieberman, Katherine Harris, Peter Wolff, and Lorraine Russell, "Newborn Infant Cry and Non-Human Primate Vocalization," Journal of Speech and Hearing Research, 14 (1971).

[44] W.C. Sheppard and H.L. Lane, "Development of the Prosodic Features of Infant Vocalizing," Journal of Speech and Hearing Research, 11 (1968) 107.

[45] Lieberman, Intonation, Perception and Language, 41.

Pike reported that she and her husband, by their controlled voice models, were able to induce a rising final inflection in the speech of their young daughter.[46]

Babbling, which usually begins at three months, is "...the undifferentiated and neutral language potential of all nations and races."[47] Lenneberg notes:

> The first feature of natural language to be discernible in a child's babbling is contour of intonation...The linguistic development of utterances does not seem to begin with a composition of individual, independently, moveable items, but as a whole tonal pattern.[48]

A child's first "primitive sentences" occur between six and twelve months. Crystal describes these as prosodic contours surrounded by silence. He continues by saying:

> In general, when a child's utterance displays some formal and functional independence, in that it can be consistently assigned a specific semantic interpretation, is no longer wholly affective in character, and has a stable phonological form, then I would call it a sentence.[49]

At this time the child is experimentally using contrasts in loudness, pitch-range, duration, tension, and rhythm. The child's first adult-like words occur during this time also.[50]

Around 18 months, the child begins to group his "primitive sentences", uses tonicity to control emphasis, and increases his range of sequential

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[46]Evelyn G. Pike, "Controlled Infant Intonation," Language Learning, 2 (1949), 24.

[47]Luchsinger, Voice-Speech-Language, 348.

[48]Lenneberg, Biological Foundations of Language, 279.

[49]David Crystal, "Prosodic Systems and Language Acquisition," Prosodic Feature Analysis, Ed. by Pierre Leon, Georges Faure, and Andre Rigault, Montreal: Librainie Didier (1970), 81.

[50]Ibid., 81.

rhythmic contrasts, and ones of pauses and speed. Then, by two and one-half years of age the child's prosodic-feature system is similar to that of the adult's system.[51]

There are two points of view about the role of prosodic features in the grammar of the child: 1) syntax guides a child to the use of intonation; and 2) intonation guides a child to the use of syntax. In support of the former, Bresnan developed the hypothesis, "...intonation depends systematically upon underlying syntactic structure."[52] In contrast, Menyuk and Bernholtz recorded the single-word (plus babbling) utterances of a child from his 18th to his 20th month and asked two adult listeners to classify the utterances as 1) declarative, 2) questioning, or 3) emphatic. The listeners were in 81-per cent agreement. The authors concluded, "...the child uses prosodic features generatively to create sentence types rather than merely imitating prosodic features of a particular word."[53] However, Bolinger and Crystal state that both positions imply incorrectly that intonation is a single feature.[54] Crystal further asserts that prosodic features comprise a complex system, the function of which is also complex, serving gramatical, attitudinal, and social ends.[55]

After the 21st month, Carlson and Anisfeld noted a distinction in the speech of their subject between speech meant to communicate and mere

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[51] Ibid., 82-83.

[52] Joan Bresnan, "Stress and Syntax: A Reply," Language, 48 (1972), 326.

[53] Paula Menyuk and Nancy Bernholtz, "Prosodic Features and Children's Language Production," MIT Research Laboratory of Electronics, Quarterly Progress Reports, 93 (1969), 219.

[54] Dwight Bolinger, "Accent is Predictable (If You're a Mind-Reader)," Language, 48 (1972), 644.

[55] Crystal, "Prosodic Systems and Language Acquisition," 86.

soundmaking. The former was loud, accompanied by eye contact, and frequently by physical contact; the utterances were repeated until the addressee responded or the speaker became frustrated or bored. Non-communicative speech or soundmaking, on the other hand, showed greater variability in repetitions, a lack of focus, extreme loudness, and deviant pitch patterns. They reported that a joking tone of voice, lower in pitch, more forced, and with a half-smiling countenance became apparent by the 27th month.[56]

Describing a 28-month old child's use of prosodic features in solo and peer play, Tull, stated that:

> Anne uses pitch inflections, primary and secondary stress, adult question and statement inflections, and loudness or softness variations as a constant expressive complement to her grammar. In private play, play with a thirty-seven month old neighbor, and in story telling, she seems to invent her own prosodic features and plays with sounds in a repetitive semantic context. In solo play Anne frequently uses a play telephone, inventing conversations and using several voice tones to represent different speakers.[57]

Although little has been written about the child's development of prosodic features beyond two years of age, it is generally accepted that by three years of age the child's prosodic features indicate his knowledge of syntax and semantics. However, many children continue to use expressive sounds in a communicative way apart from syntax and morphological semantics.[58]

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[56] Patricia Carlson and Moshe Anisfeld, "Some Observations on the Linguistic Competence of a 2-year-old Child," Child Development, 40 (1969), 573.

[57] Barbara Tull, "Descriptive Linguistic Case Study of the Speech of Anne Tull During Her Twenty Eighth and Thirtieth Months," (unpublished paper, Ohio State University, 1970), 14.

[58] Gertrud Wyatt, Language Learning and Communication Disorders in Children, New York: The Free Press (1969), 261.

Summary of the Review of Literature

Researchers have measured prosodic features by auditory judgments and mechanical and electronic analyses of fundamental frequency or "contours" of frequency, and duration, and intensity. Listeners tend to agree with each other and with the intention of the speaker about the meaning conveyed and the emotion that is conveyed. Also, judgments indicate an ability to differentiate between ethnic speech samples and a tendency to make social judgments from these. In instrumental analyses, fundamental frequency and "contours" of fundamental frequency appear to be distinctive acoustic features, along with ones of duration.

All infants engage in soundmaking from birth. The first feature of discernible communication is a "contour" of intonation. The child continues exploring and using prosodic features as complements to his phonemes, semantics, and grammar until his system of prosodic features is similar to that of the adult, presumably by age two and one-half.

The preceding review provided the base for three assumptions to be tested further in the study under consideration: a) listeners can make absolute judgments of the race of a speaker from his voice, b) measurable differences of fundamental frequency, contours of frequency and/or duration should differentiate the speech of black and white children, and c) children's prosodic features change developmentally from 19 to 27 months.

CHAPTER III

PROCEDURES

The material for the study under discussion consisted of samples of speech obtained from four black speakers and four white speakers. In order to determine if listeners can identify the race of a speaker from his speech, a listening task, based on these samples, was designed and administered to 38 black and 64 white listeners. Instrumental analyses were used to quantify and compare measures of fundamental frequency, duration, and contours of fundamental frequency of the speech from the two groups and from the individual sources.

Selection of the Speakers

The black speakers were from 16 to 19 months of age when the study began, lived in black homes, and in black neighborhoods. The white speakers were 19 or 27 months of age, lived in white homes, and in white neighborhoods. All speakers[1] were unknown to the experimenter and except for Don and Bob, to each other.[2]

Aaron and Cathy lived in a black neighborhood of Delaware (Ohio), a city of 14,000 inhabitants; Bob and Don, in the geographical center of

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[1]The selected speakers are designated with alphabetically ordered pseudonyms. The black speakers are Aaron, Bob, Cathy, and Don; the 27 month old white speakers, Eric and Fay; the 19 month old white speakers, Gay and Hank.

[2]Bob's mother is Don's older sister; Bob stays with Don's family nearby daily while his mother works.

a black housing development in Columbus (Ohio), a city of 540,000 inhabitants. Eric, Fay, and Gay lived in Delaware; Hank, in a small, rural enclave of duplex homes.

Identification of each child by selected social stratification and family-member indices is shown on Table 1.[3] During the study Aaron and Cathy changed environments. Aaron lived first with his mother and brother in the maternal grandmother's home, and later in an apartment. Cathy, her mother, brother, and sister lived first in the father's home, later in the maternal grandparents' home.

Recording of the Speech Samples

Twelve monthly tape recordings[4] of 60-90 minutes were made separately with Aaron, Bob, Cathy, and Don.[5] One such recording was made of Eric, Fay, Gay, and Hank. The recordings were made in the home and neighborhood play environments of each child. The experimenter arrived at the home with a play object to begin conversation with the subject and the siblings, peer, family, or whoever was present. Minimally structured play and conversation proceeded.

Each child's recording was edited to obtain a continuous recording of the subject's total utterances for the month.[6] The utterances which

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[3]W. Lloyd Warner, "The Study of Social Stratification," in Readings on Social Stratification, ed. by Melvin M. Tumin (Englewood Cliffs, New Jersey: Prentice-Hall, 1970), 230.

[4]The original recordings were made on a Realistic 505 tape recorder at a 3 3/4 ips speed. The recorder was carried in a canvas bag from the shoulder of the experimenter, with the microphone exposed.

[5]The nine months common to all black subjects during the 12 month period of the experiment--age 19-27 months--were chosen for analysis.

[6]This editing was done from a Magnecord 1024 recorder to a Sony TC 255 recorder at 3 3/4 ips.

TABLE 1

SPEAKER IDENTIFICATION BY SELECTED SOCIAL STRATIFICATION AND FAMILY-MEMBER INDICES.

Name	Race	Parent's Occupation (M=Mother F=Father)	Home Type	Home Location	Home Occupants		
					No.	Siblings Sex, Age (m=male f=female)	Other Relation, Race (b=black, w=white)
Aaron (I)	Black	Homemaker (M)	Home	Delaware	4	m, 7 mo.	Mother (b), Grandmother (w)
Aaron (II)			Apt.	Delaware	3	m, 7 mon.	Mother (b)
Bob	Black	Clerk (M)	Duplex	Columbus	2		Mother (b)
Cathy (I)	Black	Unskilled (F)	Home	Delaware	5	m, 2½;f,3½	Mother (b), Father (b)
Cathy (II)		Homemaker (M)	Home	Delaware	7	m,2½; f,3½	Mother (b), Uncle (b, blind) Grandfa. (b), Grandmo. (b)
Don	Black	Homemaker (M)	Duplex	Columbus	5	m,7,9,12	Mother (b)
Eric	White	Clerk (F)	Apt.	Delaware	3		Mother (w), Father (w)
Fay	White	Professional (F)	Home	Delaware	5	f,4,6	Mother (w), Father (w)
Gay	White	Skilled (F)	Duplex	Delaware	4	f,5	Mother (w), Father (w)
Hank	White	Skilled (F)	Duplex	Rural	3		Mother (w), Father (w)

were most free of noise (signal-to-noise ratio of 18 dB or more)[7] and free of overlapping voices, excluding questions, echoic repetitions, and extremely emotional utterances (i.e. crying, whining, shrieking, etc.) were considered for the final speech sample. With these limitations the selections were as random and as representative as possible.

A sample was 12 seconds, the duration preferred by three listeners who were asked to select from samples of 6, 9, 12, and 15 seconds, the one which was of comfortable length and which permitted the judging of the race of the speaker. Each 12-second sample, representative of a child's speech for a designated month, contained from three to nine utterances (mean, six).

Speech samples of Aaron, Bob, Cathy, and Don at 19 months, and at 27 months, and of Eric, Fay, Gay, and Hank were mixed and selected randomly for order of presentation to the listeners.[8] The recorded samples were spliced with intervening pauses of 30-seconds.

Listeners and the Listening Task

The listeners were 38 black and 64 white high-school and college students, who volunteered to participate. Of the 102 listeners, 33 black

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[7] A peak signal-to-noise reading was made each second on a print-out from a Bruel and Kjaer Level Recorder 2304 with a writing speed of 1000 mm/second and a paper speed of 10 mm/second. The mean of these readings for each utterance was then obtained. A minimum 18-dB signal-to-noise ratio gave a signal whose frequency and duration could be reliably measured in the judgment of Claude Lambert (engineer-technician) and the experimenter.

[8] The speech samples of Gay and Hank were added to the tape for more white-speaker balance after the high school students listened to the tape. However, after an initial separate analysis of all data for each hypothesis, it was apparent that there were no significant differences between high school judgments from the 10 speech-sample tape and college judgments from the 12 speech-sample tape. Therefore, the experimenter pooled the data for analysis.

high-school listeners were in the Upward Bound Program of Ohio Wesleyan University, Summer, 1972. They listened in two groups, 14 sophomores and 19 seniors. The 33 white high-school listeners were in summer school at Hayes High School, Delaware, 1972; they listened as one group. The 5 black and 31 white college listeners were in a speech colloquium and an upperclass course in Sociology at Ohio Wesleyan University, Fall, 1972. They listened as two groups.

The listening task of 10 minutes, including instructions, was performed in the students' classrooms at the beginning or end of a class period. The Realistic 505 recorder used in making the tapes was also used as a playback. The loudness level was judged to be comfortable.

The listeners followed the instructions visually as the experimenter read them aloud. The questions were answered:

I am Black_____White_____(check one).
I am_____years old.

Then the listeners were requested:

Turn together to response page Number 1 and we will read the questions together:

1. Is this child black_____or white_____?
2. Are you certain_____or uncertain_____of your choice?
3. What influenced your choice? Grammar_____
   Inflections_____
   Loudness_____
   Pitch_____
   Sounds_____
   Stress_____
   Timing_____
   Voice Quality_____
   Words_____

Answer questions 1 and 2 for all speech samples. Answer question 3 whenever possible.

Terminology in Question 3 was not defined.

Treatment of the Data of Judgments

From the responses to Question 1, "Is this child black or white?", for each of the 12 speech samples on the master tape, the following five hypotheses were tested:

1) Judgments of the race of the speakers are independent of the race of the listeners. (white vs. black)

2) Judgments of the race of the speakers are independent of the age of the listeners. (high school vs. college)

3) Judgments of the race of the speakers are independent of the age of the speaker. (19 vs. 27 months)

4) Judgments of the race of the 19-month old speakers occur by chance. (50 percent vs. 50 percent)

5) Judgments of the race of the 28-month old speakers occur by chance. (50 percent vs. 50 percent)

From the responses of the listeners to Question 2, "Are you certain or uncertain of your choice?", for each of the 12 speech samples on the master tape, the following two hypotheses were tested:

6) Certainty of judgments is independent of the judgments of the race of the speaker. (white vs. black)

7) Certainty of judgments is independent of the age of the speaker. (19 vs. 27 months)

The responses were analyzed by chi-square tests of a) independence (Hypotheses 1, 2, 3, 6, 7) or b) goodness of fit (Hypotheses 4, 5).[9] In the event of a significant chi-square value, a phi-coefficient was calculated

[9] Don Lewis and C.J. Burke, "The Use and Misuse of the Chi-Square Test," Psychological Bulletin, 46 (1949), 433-489.

to determine the strength of the relationship between the two variables.[10]

For statistical testing of Hypothesis 1 for each speech sample, that racial judgments are independent of the listeners' race, the data were grouped in a 4-cell contingency table. The judged race of the speaker was entered in a cell horizontally; the race of a listener in a cell vertically.

Sample Contingency Table for Hypothesis 1.

	Listeners' Race		
Judgments	Black	White	Total
"Black"	17	28	45
"White"	21	36	57
	38	64	102

This table shows that 17 black listeners judged the speaker to be "black"; 21 judged the speaker to be "white"; 28 white listeners judged the speaker to be "black" and 36 judged the speaker to be "white".

For statistical testing of Hypothesis 2 for each speech sample, that racial judgments are independent of the age of the listeners, high school or college, the data were grouped in a 4-cell contingency table. The age of the listener was entered in a cell horizontally; the judged race of the speaker, in a cell vertically.

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[10]The guidelines of Herbert Sorenson, Statistics for Students of Psychology and Education, New York: McGraw-Hill Book Co. (1936), 276-277. were used to interpret the meaning of the phi-coefficient in this study:

0	= complete absence of correlational tendency	
0 - .25	= very slight correlational tendency	(slight)
.25 - .50	= definite correlational tendency	(moderate)
.50 - .80	= marked relational trend	(high)
.80 - 1	= quite clear cut relationships	(very high)
1	= linear relationship	

Sample Contingency Table for Hypothesis 2.

	Listeners' Judgments		
Listeners' Age	"Black"	"White"	Total
High School	32	34	66
College	13	23	36
	45	57	102

This table shows that the speaker was judged "black" by 32 high-school listeners and 13 college listeners. The speaker was judged "white" by 34 high-school listeners and 23 college listeners.

For statistical testing of Hypothesis 3 for each speech sample, that racial judgments are independent of the age of the speaker, the data were grouped in 4-cell contingency tables and analyzed for the four black speakers whose speech samples for both 19 and 27 months were judged by the listeners. The judged race of the speaker was entered in a cell horizontally; the age of the speaker in a cell vertically.

Sample Contingency Table for Hypothesis 3.

Judged Race	Age of the Speaker		
	19 mo.	27 mo.	Total
"Black"	45	15	60
"White"	57	87	144
	102	102	204

This table shows that the speaker was judged "white" at both ages more often than he was judged "black". He was judged "black" at 19 months by 45 listeners and at 27 months by 15 listeners. He was judged "white" at 19 months by 57 listeners and at 27 months by 87 listeners.

For statistical testing of Hypothesis 4, that the racial judgments occurred by chance at 19 months, the data were grouped as follows for a goodness of fit test.

Sample Goodness of Fit Table for Hypothesis 4.

Judged Race	Observed	Expected	f_o-f_e	$\frac{(f_o-f_e)^2}{f_e}$
"Black"	45	51	-6	.76
"White"	57	51	+6	.76
			X^2 =	1.52

This table shows that 45 listeners judged the speaker to be "black"; while 57 listeners judged the speaker to be "white". The expected distribution of equally divided judgments would have been 51 "black" and 51 "white" judgments. A similar statistical test was made of Hypothesis 5, that racial judgments occurred by chance at 27 months.

For statistical testing of Hypothesis 6, that certainty of judgment is independent of the racial judgments, data were grouped in a 4-cell contingency table. "Certain" judgments were entered in the first row of cells horizontally; "uncertain" judgments were entered in the second row of cells horizontally; the judgments of the race of the speaker were entered in the vertical cells.

Sample Contingency Table for Hypothesis 6.

Judgment	Judged Race "Black"	"White"	Total
Certain	11	22	33
Uncertain	34	35	69
	45	57	102

This table shows that the listeners made more "uncertain" than "certain" judgments. Eleven of the listeners who judged the speaker "black" were "certain" of their choice, 34 were "uncertain". Of those who made "white" judgments, 22 were "certain" and 35 were "uncertain".

For statistical testing of Hypothesis 7, that the "certainty" of judgments is independent of the age of the speaker, the samples of the four black speakers judged at both 19 and 27 months were analyzed. "Certain" and "uncertain" judgments were entered in the 4-cell contingency table vertically; judgments at 19 months were entered in the first row horizontally; judgments at 27 months were entered in the second row horizontally.

Sample Contingency Table for Hypothesis 7

Age of Speaker	Listeners' Judgments		
	Certain	Uncertain	Total
19 mo.	33	69	102
27 mo.	69	33	102
	102	102	204

This table shows that 33 listeners were "certain" of their choice of the race of the speaker at 19 months and 69 were "uncertain". At 27 months 69 listeners were "certain" and 33 were "uncertain".

On the listeners' response form, listeners were asked a third question, "What influenced your choice? Grammar_____, Inflections_____, Loudness_____,...", and were asked to check any factor(s) which appeared to affect their racial judgments. High school listeners added "words", "sounds", and "grammar" as additional influencing factors in the blanks provided. Answer forms were revised to include these listener-suggested terms for the college listeners.

The responses of black, white, high-school, college, and total listeners were tallied for each factor. Each listener checked from zero to three factors influencing his judgment on a single speech sample. Each factor was listed in rank order from most frequently selected to least frequently selected. The number of "voice quality" tallies for

all 12 speakers, for example was divided by the total number of tallies for all nine items in that column to obtain a percent of judgments for "voice quality" compared with the percent for each other factor.

Instrumental Analyses of Selected Frequency and Duration Features

Each 12-second speech sample was slowed by a factor of eight as it was re-recorded from a Magnecord 1022 to an Ampex 350 recorder. The visual print-out of fundamental frequencies was made on a Mingograf 34 with a paper speed of 100 mm per second. The experimenter counted sound waves on the print-out to determine average fundamental frequency and length of pauses in 50-msec. segments of each utterance. These readings were collated on a PL 1 Computer program written by Takefuta. This yielded a visual print-out of a melody curve for each utterance; also the mean fundamental frequency, standard deviation of the mean, median fundamental frequency, average rate of change of fundamental frequency, up and down, in Hertz and semitones; and total time in milliseconds for each utterance. The results for each utterance were pooled, month-by-month and child-by-child. The means of each set of measurements for each month were determined.

From the melody curves the experimenter calculated the total voiced time, total unvoiced time, average voiced segment, and average unvoiced segment in milliseconds for each utterance and each month. The experimenter transcribed each sample phonetically from the tape recordings to identify the number of utterances and syllables per month. The average length of each syllable was determined by dividing the total voiced time of a sample by the number of syllables uttered within that sample.

Each voiced segment within an utterance was identified as monophasic,

biphasic, or polyphasic.[11] For quantizing the complexity of each voiced segment, a monophasic segment was designated, 1; a biphasic segment, 2; and a polyphasic segment, 3. (Figure 1)

To test the conclusions cited in the literature that the directions of the initial and final inflections are distinctive[12], and may be culturally altered[13], the experimenter analyzed the initial and final inflections in each utterance. The contour of frequency of each initial and final inflection was quantized by assigning a number 1, 2, or 3 to rising, level, and falling inflections, respectively.[14] Rising inflections of a semitone or more were designated 1, pitch constancy for 150 msec. or longer was designated 2, and falling inflections of a semitone or more were designated 3. (Figure 1)

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[11] Witting, "A Method of Evaluating...Intonation," 141.

[12] Lieberman, Intonation, Perception and Language, 39.

[13] Pike, "Controlled Infant Intonation," 24.

[14] Takefuta, "A Study...Intonation Signal," 70.

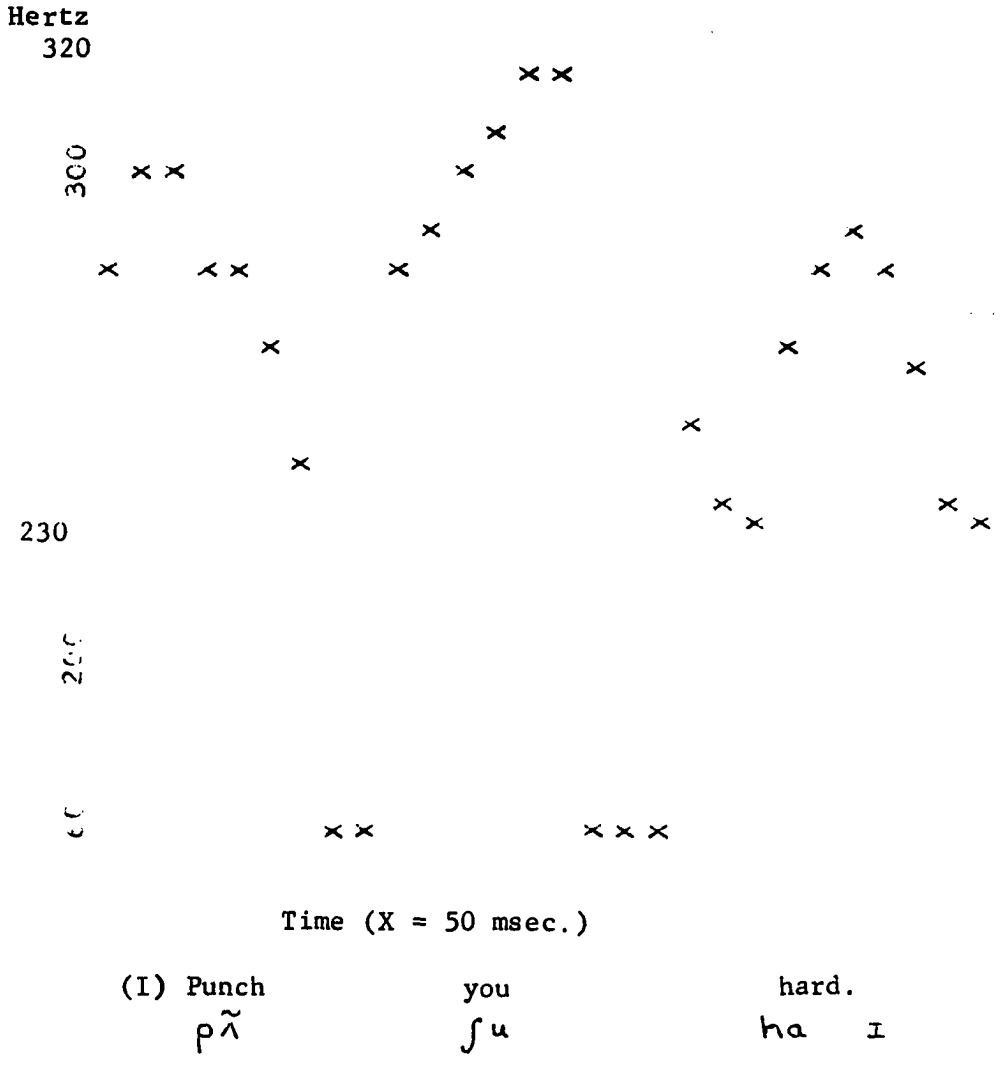

Fig. 1--Sample computer printed melody curve of fundamental frequency readings each 50 msec. for one utterance. (The utterance is printed from left to right, beginning to end.)

Frequency is designated on the ordinate in Hertz (Hz). The frequency range is 230 Hz to 320 Hz. A computer frequency reading of 60 Hz, the lower limit of the computer program, is read as cessation of voice (either a voiceless consonant or a pause).

Time is represented on the abscissa with each "X" representing the average frequency reading for a 50-msec. interval. The total time of this utterance is 1400 msec. There are three vocalized units (350 msec., 300 msec., 500 msec.) with two internal pauses (100 msec., 150 msec.) in the illustration, "punch you hard."

The frequency contour in the initial unit is two directional or biphasic and is designated 2; the medial unit is single directional, monophasic, 1; the final unit is three directional, polyphasic, 3. The direction of the initial inflection in the utterance is upward and is designated 1; the final inflection is downward and is designated 3.

Analyses of "White" and "Black" Speech Samples

With no regard for the apparent race or age of the speaker, speech samples judged "white" with a moderate or high phi-coefficient value were grouped for analysis, as were those judged "black". Mean measurements for each feature of the "black" speakers, frequency, duration, and contours of frequency, were compared with mean measurements of the same features for the "white" speakers. Differences are also noted, as are the ratios of each difference between "black" and "white" speakers on each measure. Ratios were determined by dividing each "black" measurement by the corresponding "white" measurement. A plus (+) is entered if the ratio is greater than 1.0, and a minus (-), if the ratio is less than 1.0.

Analyses of Nine Monthly Speech Samples of Four Black Speakers

Mean values for a) the six measurements of fundamental frequency, b) seven measurements of duration, and c) four of contours of frequency, month-by-month, were subjected to testing for linear regression.[15] Each feature was tested separately. A mean representing the arithmetic mean for the 9 months was determined; also, a coefficient of the correlation of the dependent variable (frequency, duration, and contours of frequency) and the independent variable (time). These were obtained for each feature, child-by-child. The hypothesis tested in each instance was that no linear regression function could be drawn. A significant result would indicate that the data over the nine months were not randomly distributed. A

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[15] This statistical testing was done on a subroutine program of an IBM Computer based on the method of Bernard Ostle, Statistics in Research (1954), 159-221.

comparison is made of the results of the tests of regression of each feature for Aaron with results on these same features for the other three children, Bob, Cathy, and Don.

Summary of Experimental Procedures

Thirty-eight black and 64 white high-school or college students listened to 12 speech samples of 19- or 27-month old children. They made a judgment for each sample of: a) the race of the speaker, b) the certainty of their judgments, and c) aspects of speech that possibly influenced them. These judgments were used to test seven hypotheses by chi-square analyses.

Selected physical measurements were made of samples of speech of two white speakers at 19 months, two white speakers at 27 months, and nine monthly samples for four black speakers. The following measurements were obtained for each utterance, each month, for each child.

Frequency
- Range (Hz and semitone)
- Median (Hz)
- Mean (Hz)
- Standard deviation (Hz)
- Average rate of change up (Hz per 50 msec.)
- Average rate of change down (Hz per 50 msec.)

Duration
- Total utterance length (msec.)
- Total voiced length (msec.)
- Percentage of voiced length
- Mean voiced segment (msec.)
- Total unvoiced length (msec.)
- Mean unvoiced segment (msec.)
- Mean voiced length of a syllable (msec.)

Frequency contour
- Complexity
  - Initial voiced segment (1, 2, or 3)
  - Final voiced segment (1, 2, or 3)

Direction of inflection
Initial voiced inflection (1, 2, or 3)
Final voiced inflection (1, 2, or 3)

The measurements were used to obtain comparisons between "black" and "white" samples of speech and to identify measures which showed possible linearity over nine months with one or more black children.

CHAPTER IV

RESULTS AND DISCUSSION

Judgments of the Race of the Speaker

This portion of Chapter IV contains the results of the chi-square tests of the seven hypotheses introduced in Chapter III. These hypotheses were used to analyze the responses of the listeners to the 12 speech samples of black and white children representative of their speech at 19 or 27 months.

The hypothesis, Judgments of the race of the speakers are indepentent of the race of the listeners, was not rejected for 10 of the 12 speech samples. (Table 2) It was rejected for Bob at 19 months and at 28 months. He was judged "white" by more white listeners at 19 months, and "black" by more black listeners at 27 months (ϕ , slight). With this apparent agreement, 10 of 12 samples, black and white judgments were not considered separately in later testing.

The hypothesis, Judgments of the race of the speakers are independent of the age of the listeners, was not rejected for 9 of the 10 speech samples.[1] (Table 3) It was rejected for Cathy at 19 months (ϕ , moderate). All of the college students judged Cathy to be "black", while 54 of 66 high-school students judged her "black".

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[1]For testing Hypothesis 2, 10 speech samples were used instead of 12 as the high-school listeners did not hear the samples of Gay and Hank.

TABLE 2

CHI-SQUARE AND PHI-COEFFICIENT VALUES RESULTING FROM A TEST OF THE HYPOTHESIS: JUDGMENTS OF THE RACE OF THE SPEAKERS ARE INDEPENDENT OF THE RACE OF THE LISTENERS.

Speakers	Judged Race of Speaker "Black"		Judged Race of Speaker "White"		X^2	ϕ
	Race of Listener Black	White	Black	White		
Aaron (19)	17	28	21	36	.01	
Aaron (27)	6	10	32	54	.07	
Bob (19)	20	17	16 a	47	7.11	.26
Bob (28)	34	46	2 b	18	5.99	.24
Cathy (19)	31	59	7	5	1.66	
Cathy (27)	18	39	20	25	1.27	
Don (19)	11	25	26 a	36	.81	
Don (27)	33	57	5	7	0	
Eric	7 a	15	29	49	.04	
Fay	9	13	29	42	.06	
Gay	3	9	2	22	.73	
Hank	1 a	11	4	19	.05	

(Significant X^2 at .05 level of confidence with 1 df = 3.84)

a = 1 listener failed to make a judgment
b = 2 listeners failed to make a judgment

TABLE 3

CHI-SQUARE AND PHI-COEFFICIENT VALUES RESULTING FROM A TEST OF THE HYPOTHESIS: JUDGMENTS OF THE RACE OF THE SPEAKER ARE INDEPENDENT OF THE AGE OF THE LISTENERS.

Speakers	Age of Listeners: High-School			College			X^2	ϕ
	Judged Race of Speaker: "Black"		"White"	"Black"		"White"		
Aaron (19)	32		34	13		23	.99	
Aaron (27)	11		55	4		32	.22	
Bob (19)	23	b	41	14		22	.01	
Bob (27)	49	b	15	31		5	.78	
Cathy (19)	54		12	36		0	5.77	.24
Cathy (27)	40		26	17		19	1.19	
Don (19)	22		44	14	a	21	.20	
Don (27)	56		10	35		1	2.53	
Eric	17	a	48	5	a	30	1.24	
Fay	18		48	5		31	1.68	

(Significant X^2 at .05 level of confidence with 1 df = 3.84)

a = 1 listener failed to make a judgment
b = 2 listener failed to make a judgment

With this apparent agreement, 9 of 10 samples, high-school and college judgments were not considered separately in later hypothesis testing.

The hypothesis, Judgments of the race of the speaker are independent of the age of the speaker, was rejected with moderate or high phi-coefficient values for the four subjects whose speech was judged at both 19 and 27 months. (Table 4 and Figure 2) Listeners made significantly different judgments of race of Aaron, Bob, Cathy, and Don at 19 months from those they made at 27 months. Aaron was judged "white" at 19 and 27 months. However, there was a significant increase in "white" judgments from 19 to 27 months. Although a majority of listeners judged Bob and Don to be "white" at 19 months, the majority judged them "black" at 27 months. Listeners judged Cathy "black" at both ages; however, more judged her "black" at 19 months than at 27 months. These results suggest that the age of the speaker affects the judgments of the listeners. The hypothesis was tentatively rejected.

TABLE 4

CHI-SQUARE AND PHI-COEFFICIENT VALUES RESULTING FROM A TEST OF THE HYPOTHESIS: JUDGMENTS OF THE RACE OF THE SPEAKERS ARE INDEPENDENT OF THE AGE OF THE SPEAKER.

Speakers	Judged Race of the Speaker "Black"		"White"		X^2	ϕ
	Age of Speaker 19 mo.	27 mo.	19 mo.	27 mo.		
Aaron	45	15	57	87	19.86	.32
Bob a	37	80	63	20	36.33	.42
Cathy	90	57	12	45	24.93	.35
Don b	36	91	65	11	59.92	.54

(Significant X^2 at .05 level of confidence with 1 df = 3.84)

a = 4 listeners failed to make a judgment
b = 1 listener failed to make a judgment

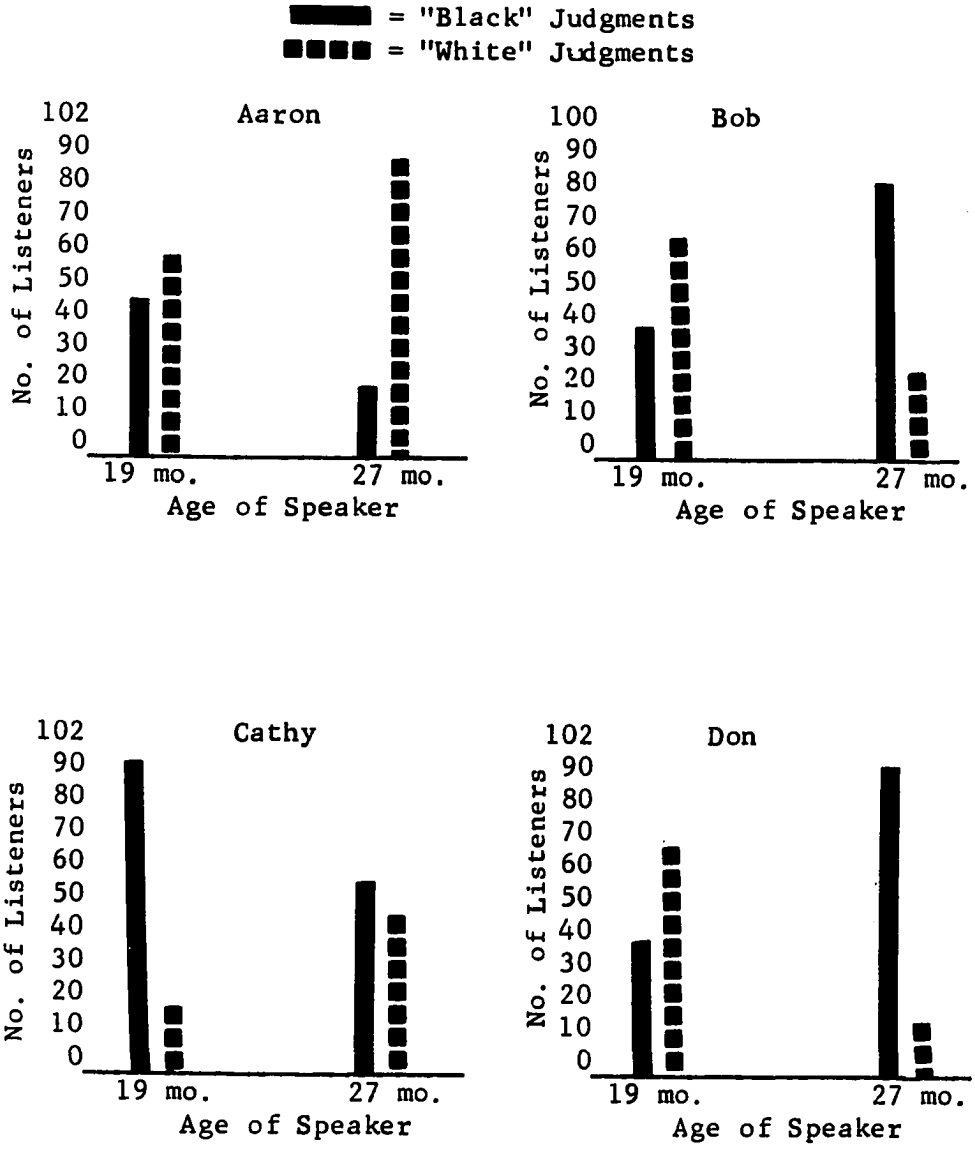

Fig. 2.--Numbers of judgments of the race of the black speakers at 19 months and at 27 months.

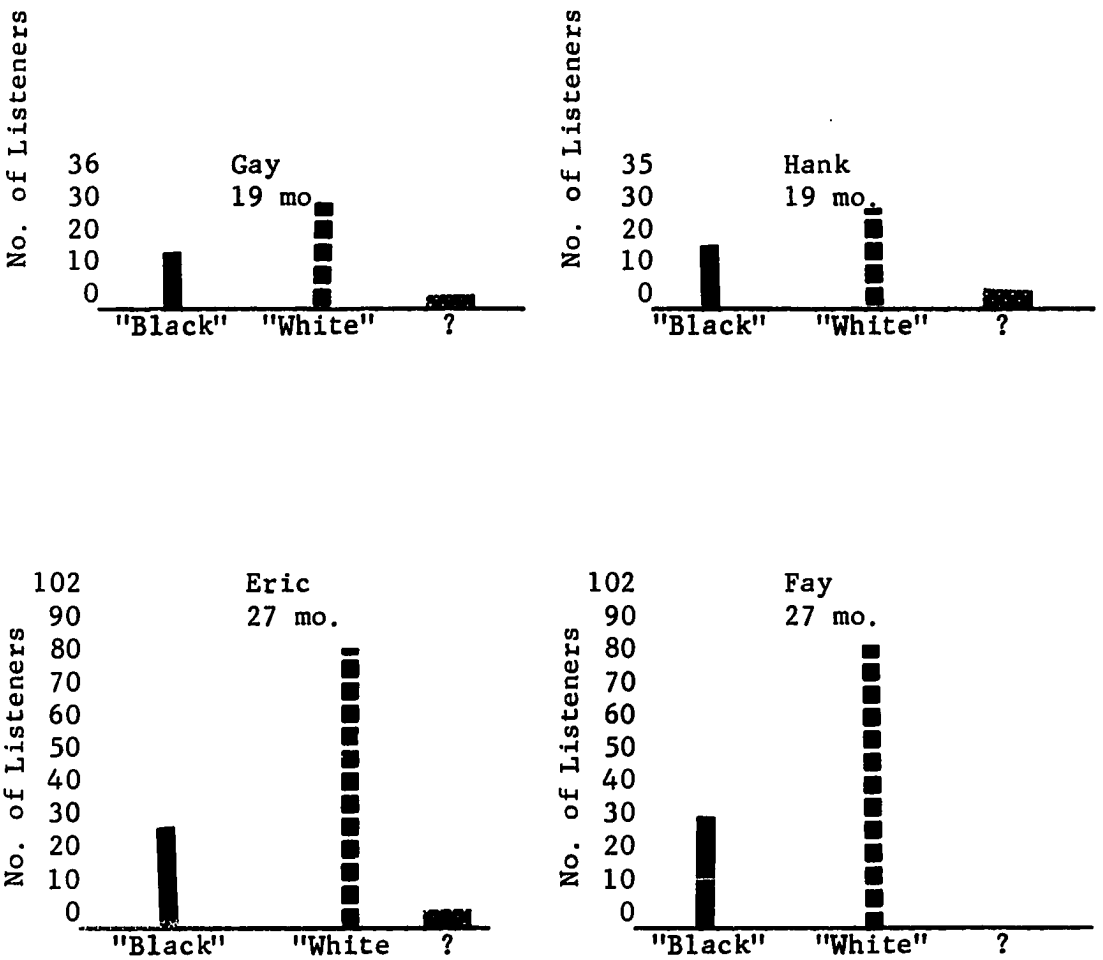

Fig. 3--Numbers of judgments of the race of the white listeners.

The hypothesis, Judgments of the race of the 19-month old speakers occur by chance, was not rejected for 2 of the six 19-month old speakers. (Table 5, Figure 2) It was rejected for Cathy, (ϕ , high). Listeners judged her to be "black". Listeners judged Bob, Don, and Gay to be "white", (φ , slight). These results suggest that the judgments at 19 months may not have occurred by chance.

TABLE 5

CHI-SQUARE AND PHI-COEFFICIENT VALUES RESULTING FROM A TEST OF THE HYPOTHESIS: JUDGMENTS OF THE RACE OF THE 19-MONTH OLD SPEAKERS OCCUR BY CHANCE.

Speaker		Race of the Speaker: Black — Judgments of the Listeners: Observed	Black — Expected	White — Observed	White — Expected	X^2	ϕ
Aaron		45	51	57	51	1.52	
Bob	b	37	50	63	50	6.76	.17
Cathy		90	51	12	51	59.64	.55
Don	a	36	50.5	65	50.5	8.32	.22
Gay	a	12	18	24	18	4.00	.14
Hank	b	12	17.5	23	17.5	3.46	

(Significant X^2 at .05 level of confidence with 1 df = 3.84)

a = 1 listener failed to make a judgment
b = 2 listeners failed to make a judgment

The hypothesis, Judgments of the race of the 27-month old speakers occur by chance, was rejected (ϕ , moderate or high for 5 of the 6 speech samples) . (Table 6) It was not rejected for Cathy. Listeners tended to agree in their judgments of Bob and Don as "black", and Aaron,

Eric, and Fay as "white". Listeners agreed, beyond chance, in 5 of 6 of the 27-month old speakers. Thus the hypothesis was tentatively rejected.

TABLE 6

CHI-SQUARE AND PHI-COEFFICIENT VALUES RESULTING FROM A TEST OF THE HYPOTHESIS: JUDGMENTS OF THE RACE OF THE 27-MONTH OLD SPEAKERS OCCUR BY CHANCE.

Speaker	Race of the Speaker: Black		White		X^2	ϕ
	Judgments of the Listeners: Observed	Expected	Observed	Expected		
Aaron	15	51	87	51	50.82	.50
Bob a	80	50	20	50	36.	.42
Cathy	57	51	45	51	1.42	
Don	91	51	11	51	62.74	.56
Eric a	22	50	78	50	31.36	.40
Fay	23	51	79	51	30.74	.39

(Significant X^2 at .05 level of confidence with 1 df = 3.84)

a = 2 listeners failed to make a judgment

The hypothesis, Certainty of judgments is independent of the judgments of the race of the speaker was not rejected for 7 of the 12 samples. (Table 7) However, listeners were more "certain" of their "white" judgments than they were of their "black" judgments for Eric, Fay, and Hank (ϕ , slight or moderate). Listeners were more "certain" of their "black" judgments for Cathy at both 19 and 27 months of age (ϕ , slight). However, with fewer than half of the speech samples receiving significant chi-square values, the hypothesis was not rejected.

TABLE 7

CHI-SQUARE AND PHI-COEFFICIENT VALUES RESULTING FROM A TEST OF THE HYPOTHESIS: CERTAINTY OF JUDGMENTS IS INDEPENDENT OF THE JUDGMENTS OF THE RACE OF THE SPEAKER.

Speakers		Judgments of the Listeners: Certain		Uncertain		X^2	ϕ
		Black	White	Black	White		
Aaron (19)		11	22	34	35	1.70	
Aaron (27)		10	59	5	28	.04	
Bob (19)	b	17	25	20	38	.16	
Bob (27)	b	45	6	35	14	3.42	
Cathy (19)		53	2	42	10	5.06	.22
Cathy (27)		38	17	19	28	7.32	.26
Don (19)	a	13	15	23	50	1.37	
Don (27)		57	4	34	7	1.83	
Eric	b	3	35	19	43	5.84	.24
Fay		5	41	18	38	5.38	.24
Gay	a	1	8	11	16	1.5	
Hank	b	1	12	11	11	4.75	.37

(Significant X^2 at .05 level of confidence with 1 df = 3.84)

a = 1 listener failed to make a judgment
b = 2 listeners failed to make a judgment

The hypothesis, Certainty of judgments is independent of the age of the speaker, was rejected for two speakers (ϕ moderate), and was not rejected for two speakers. (Table 8) A majority of the listeners were "uncertain" of their judgments of Aaron and Don at 19 months, and "certain" of their judgments at 28 months. Listeners tended to make the same number of "certain" responses for Bob and Cathy at 19 and at 28 months of age. The hypothesis was tentatively rejected for two speech samples, and not for two.

TABLE 8

CHI-SQUARE AND PHI-COEFFICIENT VALUES RESULTING FROM A TEST OF THE HYPOTHESIS: CERTAINTY OF JUDGMENTS IS INDEPENDENT OF THE AGE OF THE SPEAKER.

Speakers		Age of the Speaker: 19 mo.		27 mo.		X^2	ϕ
		Judgments of the Listeners: Certain	Uncertain	Certain	Uncertain		
Aaron		33	69	69	33	24.02	.48
Bob	b	42	58	51	49	1.29	
Cathy		50	52	55	47	.31	
Don	a	28	73	61	41	19.93	.44

(Significant X^2 at .05 level of confidence with 1 df = 3.84)

a = 1 listener failed to make a judgment
b = 4 listeners failed to make a judgment

Beyond judgments of race and ones of certainty, the listeners were asked:

What influenced your choice?

Grammar_____
Inflections_____
Loudness_____
Pitch_____
Sounds_____
Stress_____
Timing_____
Voice Quality_____
Words_____

The rank order in proportions of occurrence of these nine items as tallied from the responses of the listeners is presented on Table 9. College listeners were most influenced in their judgments by "inflections", "voice quality", "sounds", and "stress". High-school listeners were most influenced by "voice quality", "stress", "pitch", and "inflections".

TABLE 9

PERCENTAGE OF EACH AVAILABLE CUE INDICATED AS INFLUENCING THE JUDGMENTS BY THE LISTENERS OF THE RACE OF A SPEAKER.

Oral Cues	Listeners				
	High School		College		Total
	Judgments of the Listeners				
	"Black"	"White"	"Black"	"White"	
	%	%	%	%	%
Voice Quality	32	31	19	19	25
Inflections	14	13	22	19	17
Stress	20	15	15	9	15
Pitch	15	21	6	11	13
Sounds			16	19	10
Timing	9	10	8	5	8
Loudness	10	10	5	4	7
Grammar			5	7	3
Words			4	7	2
	100	100	100	100	100

In summary, high-school and college listeners selected "voice quality", "inflections", "sounds", "stress", and "pitch" as the cues which most frequently influenced their racial judgments, and "timing", "loudness", "grammar", and "words" as seldom influencing their judgments.

Instrumental Analyses of Selected Features of Frequency and Duration

Analyses of "Black" and "White" Speech Samples

This portion of Chapter IV presents the statistical results of instrumental measurements of "white" and "black" samples of speech. From the racial-judgment results, three speakers were identified, with statistically significant agreement among the listeners with moderate

or high phi-coefficient values, as "white" and three as "black". With no consideration of the apparent race or age of the speaker, these three "white" samples and three "black" samples were analyzed for possible dissimilarities in measurements of fundamental frequency, duration, and contours of frequency.

Analyses of fundamental frequency are summarized in two tables (Tables 10, 11), of duration (Tables 12, 13), and of contours of frequency (Tables 14, 15). Tables 10, 12, and 14 include the mean measurements of each feature in Hertz, semitones, milliseconds, and a quantized scale of 1, 2, or 3 for each sample. Tables 11, 13, and 15 include the mean measurements of each feature for the three "white" speakers and for the three "black" speakers, as groups. Tables 11, 13, and 15 also include a measure of the difference between the "black" and "white" speakers for each feature, a ratio of that difference, and a notation that the mean measurement for the "black" speakers was greater (+) or less (-) than the mean measurement for the "white" speakers.

It may be noted in Table 10 that the highest value with each of the seven features was obtained from a "white" sample, the lowest from a "black" sample. The same difference appeared in the pooled means of Table 11.

TABLE 10

MEANS OF MEASUREMENTS OF FREQUENCY OF INDIVIDUAL SPEECH SAMPLES JUDGED "BLACK" AND "WHITE".

Measures of Frequency	"Black" Speakers 1	2	3	"White" Speakers 1	2	3
Range (Hertz)	133	112	177	135	204	204
Range (Semitones)	31	32	41	38	43	43
Median (Hertz)	304	267	312	294	309	336
Mean (Hertz)	303	274	312	301	315	352
Stand.Deviation (Hertz)	38	29	46	38	51	59
Rate of Change Up *	14	14	14	14	22	18
Rate of Change Down *	15	12	16	17	18	16

* = Hertz per 50 msec.

TABLE 11

POOLED MEANS OF MEASUREMENTS OF FREQUENCY AND DIFFERENCES OF THE SPEECH SAMPLES JUDGED "BLACK" AND THOSE JUDGED "WHITE".

Measures of Frequency	Speakers "Black"	"White"	Difference Measure	B/W Ratio	"Black"
Range (Hertz)	141	187	46 Hz	.75	-
Range (Semitones)	35	41	6 S-tones	.85	-
Median (Hertz)	294	313	19 Hz	.92	-
Mean (Hertz)	296	323	27 Hz	.92	-
Stand. Deviation (Hertz)	38	49	11 Hz	.78	-
Rate of Change Up *	14	18	4 Hz	.78	-
Rate of Change Down *	14	17	3 Hz	.82	-

* = Hertz per 50 msec.

For the four measurements of duration, a) length of an utterance, b) length of voicing within an utterance, c) length of unvoicing within an utterance, and d) average length of unvoicing within an utterance, the statistical measurements of each "white" speaker were greater than for any "black" speaker. (Table 12) In other words, the "white" speakers' utterances

were longer, their voiced segments were longer, and their internal pauses were longer than those of the "black" speakers.

In contrast, 2) the percentage of each utterance which was voiced, b) the mean length of each voiced segment, and c) the mean length of each syllable were greater for the "black" speakers than for the "white". Subjectively the "white" samples seemed to the experimenter to be short, choppy utterances with longer internal pauses than the "black" samples which contained longer voiced segments with minimal internal pauses.

TABLE 12

MEANS OF MEASUREMENTS OF DURATION OF INDIVIDUAL SPEECH SAMPLES JUDGED "BLACK" AND "WHITE".

Measures of Duration	"Black" Speakers 1	2	3	"White" Speakers 1	2	3
Total (seconds)	1.4	1.7	1.8	2.3	2.8	2.6
Total voiced (seconds)	1.1	1.4	1.5	1.7	1.7	1.6
Total unvoiced (seconds)	.3	.2	.5	.6	1.1	1.
Percentage voiced	75	83	83	72	60	60
Av. voiced seg. (msec.)	372	596	784	465	499	398
Av. unvoiced seg.(msec.)	169	174	192	185	395	300
Av.syllable length(msec.)	260	407	351	237	399	131

TABLE 13

POOLED MEANS OF MEASUREMENTS OF DURATION AND DIFFERENCE OF SPEECH SAMPLES JUDGED "BLACK" AND THOSE JUDGED "WHITE".

Measures of Duration	Speakers "Black"	"White"	Difference Measure	B/W Ratio	"Black"
Total (seconds)	1.6	2.6	1 sec.	.62	-
Total voiced (seconds)	1.6	1.7	.4 sec.	.94	-
Total unvoiced (seconds)	.3	.9	.6 sec.	.33	-
Percentage voiced	80	64	16	1.25	+
Av. voiced seg. (msec.)	584	454	130 msec.	1.22	+
Av. unvoiced seg.(msec.)	178	293	115 msec.	.62	-
Av.syllable length(msec.)	339	256	83 msec.	1.32	+

In measurements of the contours of frequency the final inflection of the "white" speakers tended to lower their frequency more often than the "black" speakers, who raised their pitch as often as they lowered it. (Tables 14 and 15) Initial voiced segments of the "white" speakers involved more polyphasic segments, and began more frequently with an upward inflection than did those of "black" speakers. The complexity of the final utterances of "black" and "white" speakers did not differ.

TABLE 14

MEANS OF MEASUREMENTS OF CONTOURS OF FREQUENCY OF INDIVIDUAL SPEECH SAMPLES JUDGED "BLACK" AND "WHITE".

Measures of Contours of Frequency	"Black" Speakers 1	2	3	"White" Speakers 1	2	3
Initial unit complexity	2.	2.2	2.2	2.6	3.	1.5
Final unit complexity	2.	2.5	1.7	1.4	2.	2.5
Initial inflection	2.6	1.5	1.7	1.2	1.5	2.
Final inflection	2.1	1.7	2.3	3.	2.5	2.5

TABLE 15

POOLED MEANS OF CONTOURS OF FREQUENCY AND DIFFERENCE MEASUREMENTS OF THE SPEECH SAMPLES JUDGED "BLACK" AND THOSE JUDGED "WHITE".

Measures of Contours of Frequency	Speakers "Black"	"White"	Difference Measure	B/W Ratio	"Black"
Initial unit complexity	2.1	2.4	.3	.88	-
Final unit complexity	2.1	2.	.1	1.05	+
Initial inflection	1.9	1.6	.3	1.19	+
Final inflection	2.	2.7	.7	.74	-

Analyses of Nine Monthly Speech Samples of Four Black Speakers

This section of Chapter IV includes the results of the tests for a trend in the fundamental frequency, duration, and contours of frequency of the four black children from their 19th through their 27th months. The hypothesis under test was, The function is not linear for the feature under test. The comparative statistical test results for each feature and for each child are presented in Tables 16, 17, and 18 in mean values, correlations, and t-values.

Analysis of each measurement of frequency showed no significant change over the nine months for any of the four children. (Table 16) The values of frequency for Aaron, a "white" speaker at 27 months, were no higher than those of the other black speakers in all instances.

Five of the seven measurements of duration showed no significant changes from 19 to 27 months for any child. (Table 17) However, all four black speakers tended to decrease the length of their pauses within an utterance, one speaker, significantly. Aaron, a "white" speaker at 28 months, decreased the duration of his pauses less than any other black speaker, had the shortest mean duration of syllables and significantly decreased this length.

Two of the four measurements of contours of frequency, those of final-segment complexity and direction of initial inflections, showed no significant change. (Table 18) In the instance of the complexity of the segments there was a decrease in complexity in 6 of the 8 pooled initial and final segments. However, only one of these, the initial voiced segment of Cathy, was statistically significant. Aaron, a "white" subject increased the complexity of his initial voiced segment; however, this was below the

TABLE 16

MEASURES OF REGRESSION FOR A NINE-MONTH PERIOD WITH FOUR BLACK SPEAKERS: MEAN OF MEASUREMENTS OF FREQUENCY, CORRELATIONS WITH MONTHS, *t*-VALUES FOR REGRESSIONS.

Frequency Measures	Mean	*r*	*t*	Significance
Range-Hertz				
Aaron	173	.14	.39	-
Bob	146	.04	-.10	-
Cathy	177	.12	.32	-
Don	140	.44	1.31	-
Range-Semitones				
Aaron	39	.13	.36	-
Bob	35	.20	-.53	-
Cathy	40	.22	.59	-
Don	35	.32	.90	-
Median-Hertz				
Aaron	283	.04	.10	-
Bob	295	.11	-.30	-
Cathy	290	.31	-.88	-
Don	299	.28	.77	-
Mean-Hertz				
Aaron	285	.04	.10	-
Bob	299	.18	-.49	-
Cathy	296	.17	-.46	-
Don	315	.03	.09	-
Stan Deviation-Hertz				
Aaron	43	.21	.58	-
Bob	40	.19	-.52	-
Cathy	46	.11	.30	-
Don	38	.20	.54	-
Rate of Change Up-Hertz				
Aaron	21	.05	.14	-
Bob	17	.12	.33	-
Cathy	21	.07	-.18	-
Don	18	.17	.46	-
Rate of Change Down-Hertz				
Aaron	22	.04	-.10	-
Bob	16	.34	.97	-
Cathy	20	.02	.05	-
Don	16	.35	-1.	-

Significance at .05 level of confidence with 8 df, *t* = 2.31,
Significance at .05 level of confidence with 7 df, *r* = .67

Mean represents the arithemic mean of the sample observations.

r is a coefficient of the correlation of the dependent (frequency) and the independent (time) variables.

t is a statistic for the null hypothesis that the regression slope equals zero. A plus or minus sign indicates the direction of the regression line.

TABLE 17

MEASURES OF REGRESSION FOR A NINE-MONTH PERIOD WITH FOUR BLACK SPEAKERS: MEAN OF MEASUREMENTS OF DURATION, CORRELATIONS WITH MONTHS, *t*-VALUES FOR REGRESSIONS.

Duration Measures (msec.)	Mean	*r*	*t*	Significance
Total Utterance Length				
Aaron	1857	.31	.88	-
Bob	1682	.35	.98	-
Cathy	1716	.16	.42	-
Don	1914	.14	-.36	-
Total Voiced Length				
Aaron	1430	.37	1.06	-
Bob	1351	.30	-.84	-
Cathy	1401	.12	.32	-
Don	1475	.11	-.30	-
% Voiced				
Aaron	77	.06	.17	-
Bob	80	.16	.42	-
Cathy	82	.06	-.16	-
Don	80	.34	.97	-
Mean Voice Unit				
Aaron	552	.23	.63	-
Bob	716	.36	1.03	-
Cathy	542	.50	-1.51	-
Don	699	.30	.84	-
Total Unvoiced Length				
Aaron	468	.18	.48	-
Bob	341	.24	.65	-
Cathy	365	.27	.75	-
Don	494	.08	.21	-
Mean Unvoiced Unit				
Aaron	194	.18	-.48	-
Bob	226	.55	-1.73	-
Cathy	168	.55	-1.75	-
Don	251	.78	-3.31	+
Mean Length of Syllable				
Aaron	264	.70	-2.59	+
Bob	422	.58	-1.89	-
Cathy	323	.52	-1.63	-
Don	384	.50	-1.52	-

Significance at .05 level of confidence with 8 df, *t* = 2.31,
Significance at .05 level of confidence with 7 df, *r* = .67

Mean represents the arithmetic mean of the sample observations.

r is a coefficient of the correlation of the dependent (duration) and the independent (time) variables.

t is a statistic for the null hypothesis that the regression slope equals zero. A plus or minus sign indicates the direction of the regression line.

level of significance. On the final inflections Aaron, the "white" speaker, showed a significant trend toward a consistent downward inflection by his 27th month. All of Aaron's utterances in three of the last five months ended with a downward inflection. None of the other three speakers ended all of his utterances of any month with a downward inflection.

TABLE 18

MEASURES OF REGRESSION FOR A NINE-MONTH PERIOD WITH FOUR BLACK SPEAKERS: MEAN MEASUREMENTS OF CONTOURS OF FREQUENCY, CORRELATIONS WITH MONTHS, *t*-VALUES FOR REGRESSIONS.

Frequency Contour Measures	Mean	*r*	*t*	Significance
Initial unit complexity				
Aaron	2.4	.63	2.1	-
Bob	2.4	.13	-.35	-
Cathy	2.	.75	-3.01	+
Don	2.4	.08	.22	-
Final unit complexity				
Aaron	2.	.56	-1.79	-
Bob	2.3	.62	-2.1	-
Cathy	2.0	.15	-.40	-
Don	2.4	.42	-1.23	-
Initial inflection				
Aaron	1.59	.16	.42	-
Bob	1.9	.29	.79	-
Cathy	1.67	.58	1.87	-
Don	1.4	.10	.26	-
Final inflection				
Aaron	2.4	.72	2.77	+
Bob	2.3	.05	.13	-
Cathy	2.	.34	.96	-
Don	2.2	.19	.51	-

Significance at .05 level of confidence with 8 df, *t* = 2.31,
Significance at .05 level of confidence with 7 df, *r* = .67

Mean represents the arithemetic mean of the sample observations.

r is a coefficient of the correlation of the dependent (contours of frequency) and the independent (time) variables.

t is a statistic for the null hypothesis that the regression slope equals zero. A plus or minus sign indicates the direction of the regression line.

Summary of Results

In testing the hypotheses through analyses of the judgments of the listeners, three of the seven hypotheses were rejected for a majority of the speech samples. The judgments of the listeners were not independent of the age of the speaker. They made different judgments of the same speaker at 19 months from the ones at 27 months. Also, agreement among listeners in racial judgments of the 19- and 27-month old speakers was above the level of chance. This agreement was greater at 27 months. These results, based on chi-square treatments of the data, when extended to phi-coefficients, showed that at 19 months 4 out of 5 speakers yielded values of slight or no correlation; while at 27 months 4 out of 5 speakers yielded values of moderate or high correlation. For 2 of the 4 black speakers the listeners were "certain" of the 27-month judgments and "uncertain" of their 19-month judgments. Both high-school and college listeners selected "voice quality", "inflections", "sounds", "stress", and "pitch" respectively as the acoustic cues which most frequently influenced their judgments of the race of a speaker.

All measurements of the mean frequency of the fundamental for the "white" speakers were higher than those for the "black" speakers. In duration the "white" speakers used longer utterances and longer internal pauses than the "black" ones. The "black" speakers used higher percentages of voicing within an utterance and longer syllables than the "white" ones. With contours of frequency, the "white" speakers showed more complex initial voiced units and more rising initial inflections and falling final inflections than the "black" speakers.

A hypothesis, No linear regression line can be drawn, was not

rejected for any feature of the fundamental frequency for the four speakers "over time". Although there were statistically significant trends among the analyses of duration and contours of frequency, caution precludes interpreting them as "rejections". The trends were evident with individual children, not a group. In measures of duration, all of the black speakers tended to decrease the length of their pauses within an utterance, one speaker doing so significantly. Aaron, a "white" speaker, decreased the length of his syllables significantly. A majority of the measures of contours of fundamental frequency decreased in complexity "over time" in the initial and final units of an utterance treated together. One child showed a significant decrease in the complexity of her initial voiced segments. A significant change in the direction of the final inflection of an utterance "over time" occurred in the speech samples of Aaron, a "white" speaker. He showed an increasing tendency to lower his voice at the end of an utterance, as indicated by his contour of frequencies.

CHAPTER V

SUMMARY AND CONCLUSIONS

Summary

The purpose of the study under discussion was to expand the information available on selected prosodic features of speech which may differ among social dialects, specifically black and standard white English dialects of children in Central Ohio. One hundred two persons listened to 12 speech samples of black or white children at 19 or 27 months of age. The listeners judged whether each speech sample was that of a "black" speaker or of a "white" speaker. The results of these judgments were tested with chi-square tests of independence or goodness of fit.

Selected measures of fundamental frequency, duration, and contours of fundamental frequency were also obtained. Two analyses were made of the measures: a) "black" speech samples were compared with "white" samples, and b) monthly speech samples of the four black children were analyzed for linearity of regression over nine months.

Conclusions

The following conclusions were indicated from the judgments of the listeners:

1. The age of the speaker influenced the judgments of the listeners.

2. Judgments of the race of the 19- and the 27-month old speakers occurred with a degree of consensus above the level of chance. This agreement was greater at 27 months than at 19 months.

3. The listeners were more "certain" of their judgments of samples representing speakers of 27 months than ones representing speakers of 19 months.

Changes appeared to take place in the speech of the children between 19 and 27 months which affected the judgments, the agreement among listeners, and the certainty of the listeners in making their judgments. This is in keeping with prior reports that changes occur in children's speech at this age. Presumably at this age speech becomes more like the speech of the adult models than it was earlier. The concurring judgments of race at 19 and 27 months supports assumptions that listeners recognize a difference between black and white speakers in the United States.

In addition to the judgments of race, listeners selected, from a list of nine possible cues, "voice quality","inflections", "sounds", "stress", and "pitch" as those most frequently influencing their judgments of the race of a speaker. "Voice quality", selected most frequently, "sounds", and "stress"-- to the extent that the latter involves sound pressure--were not measured. The study of these topics should be a goal of the future. The investigation under consideration was focused on identifying distinctions attributable to fundamental frequency, duration, and contours of frequency.

Physical measurements were made of six features of fundamental frequency, seven of duration, and four of contours of fundamental frequency. When the data representing the "black" speakers were compared with those representing "white" speakers, the results indicated that:

1. "White" speech samples had higher mean fundamental frequencies than did "black" speech samples.

2. "White" utterances were longer and the length of voicing per utterance was longer than those of "black" utterances.

3. "White" utterances had longer pauses than "black" utterances.

4. "Black" voiced segments were longer and the percentage of voicing within an utterance was longer than in the case of "white" segments.

5. "Black" syllables were longer than "white" syllables.

6. "White" utterances showed a contour of fundamental frequency which became lower on the final inflection than did those of "black" utterances.

When physical measures of the nine monthly samples of the black speakers were analyzed, the results showed:

1. No significant outcome in the instance of any measure of fundamental frequency for any child.

2. Each black speaker decreased the length of his pauses "over time". One decreased this length significantly.

3. Each black speaker decreased the length of his syllables "over time". Aaron, judged to be "white", decreased this length significantly.

4. One subject significantly decreased the "complexity" of her initial voiced segments in an utterance.

5. Aaron, judged to be "white", showed a significant trend toward lowering the frequency of his final inflection in an utterance.

If Aaron's speech is considered similar to that of the standard white speakers, the results of the analyses of the black and of the "black" and "white" speech samples led to five conclusions:

1. White utterances are longer than black utterances.

2. Black speakers vocalize longer proportionately within an utterance

and have briefer pauses than white speakers.

3. White speakers utter shorter syllables than black speakers.

4. White speakers show greater complexity in the initial voiced segment of an utterance than black speakers.

5. White speakers lower their fundamental frequencies at the end of an utterance more often than black speakers.

These conclusions agree with the literature cited in Chapter II identifying duration and contours of fundamental frequency as primary parameters of prosodic features.

In the study under consideration several possible prosodic features were identified which may vary for social dialects. Although there were statistically significant trends among the analyses of duration and contours of frequency, these were evident in individual children and not in the total group of four. Therefore, these conclusions are suggested tentatively for further testing with larger samplings of black and white speakers of various ages and sociolinguistic distributions.

The limitations of this study arise from several factors: a) for reasons of practicality the number of speakers was small and any generalizations from these results must be tested further; b) prosodic features of amplitude and spectra were not measured, as the recording process in the natural environment of play prevented sufficiently controlled conditions; c) further analysis of the nine monthly speech samples of the four black children to determine if Aaron was more like himself from month 19 through 27 than he was like Bob, Cathy, or Don at any one month would be desirable; d) several incongruities in the data need to be identified and tested further. For example, Aaron, a black speaker, was judged "white" by the listeners at 28 months. Explanations for this may lie in his sociolinguistic home

environment. His grandmother, matriarch of the home and frequent baby sitter, was white; uncles, aunts, and cousins, who stayed at the grandmother's home for weeks at a time, were college students or professional persons. Adler and others have stated that social class differences, influenced by occupation, education, and income, have primary effects on linguistic patterns and thus may take precedence over ones of racial dialect.[1] The experimenter has no explanation for a second and a third incongruity, the fact that Bob and Don were erroneously identified as "white" at 19 months, nor that Cathy, judged "black" at 19 months, was not judged "black" by a significant margin at 27 months.

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[1] Adler, "Social Class Bases of Language," 6.

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