THE DEVELOPMENT OF YES-NO QUESTION INTONATION IN PUERTO RICAN SPANISH

DISSERTATION

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By

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Abstract

Intonational development has been an area of interest during the past four decades, from the perspectives of both production and perception. But relatively few conclusions have been made about how children acquire the intonational component of their grammar. To date, prior studies of intonational development have not included a fine-grained pragmatic analysis of the types of intentions that may be encoded intonationally in a given language. This dissertation takes an integrated approach to the study of intonational development within the domain of yes-no questions. Very recent studies of intonational development have successfully used the Autosegmental-Metrical (AM) framework in order to capture the intonational categories acquired by children. From the phonological side, I use the AM model to assess how children acquire the target intonational categories available for yes-no questions in Puerto Rican Spanish (PRS). In addition to discussing the phonological aspect of this learning problem, I argue that an understanding of the fine-grained pragmatic nuances in the child’s ambient language are essential if we are to predict which intonational forms will or will not emerge at specific stages in child speech. In this dissertation, I consider three types of speech: adult-directed, child-directed (CDS) and child speech. This is done from a speaker perspective (production), as well as a hearer perspective (perception).

Results from a production study for adult speech revealed that within the yes-no question domain, PRS has a default yes-no question contour ([H% L in the Sp_ToBI system for prosodic transcription], as well as two additional contours ([H+L% L and L% HL%]). H+L% L% shows a
positive belief value with respect to propositional content ([+belief]), while L* HL% shows a \textit{disbelief} value with respect to propositional content ([−belief]). The latter two contours are chosen when the speaker wishes to convey information about his/her belief state with respect to propositional content, and I therefore refer to them as \textbf{epistemic contours}. A perception experiment confirmed that in neutral contexts, H+L* L% and L* HL% are perceived as carrying epistemic bias. The \textbf{default contour} (¡H* L%) carries no bias in neutral contexts, but takes on contextual bias. The perception experiment also demonstrated that there were differences in the ways the default versus epistemic contours were perceived when they were heard in biased (rather than neutral) contexts. Discourse context was found to have a strong effect on the belief state that participants inferred for the default contour. For epistemic contours, the presence of the linguistically encoded epistemic information sometimes weakened the effect of the discourse context. It was also shown that hearers may integrate discourse context and epistemic information in the contour for specialized meanings when they are available.

The child production data examined in this dissertation are from a longitudinal database of speech from two female PRS-acquiring children between the ages of 19 and 42 months, and their caretakers. Analysis of all yes-no questions produced during this time period for both children and caretakers showed that the default contour (¡H* L%) is heavily favored in both child-directed speech (CDS) and child speech. The default contour was by far the most frequently used contour in CDS, and was used almost categorically in child speech. On the other hand, epistemic contours were found to be relatively low frequency in CDS. The frequency relationship for contour types for CDS was ¡H* L%>L* HL%>H+L* L%. The relationship in frequency between L* HL% and H+L* L% was perhaps due to the fact the [-belief] contour (L*}
HL%) has very specific CDS functions that weren’t found for H+L* L%. Such CDS-specific functions include use of the contour to encourage a child to reformulate a mistaken answer, or to convey to the child that the information they have contributed to the common ground is very interesting or novel. However, it was found that for epistemic contours, frequency does not predict the order of emergence of epistemic contours in child speech. Only the [+belief] contour emerges in child speech, with very few tokens. I argue that the [-belief] contour’s meaning is more complex and pragmatically restricted than the [+belief] contour, accounting for the non-appearance of the [-belief] contour. Additionally, the two children in the study do show evidence that they recognize the interrogativity component of all three contours, demonstrating partial comprehension of the functions of the epistemic contours. This is taken as evidence that children may learn about the information encoded through intonation incrementally, that is, they may acquire some but not all components of the contour’s meaning. Therefore, in addition to frequency, I consider both the notions of complexity and incrementality as relevant aspects to consider in a child’s intonational development. Lastly, a perception study investigating how 4- to 6-year-olds comprehend the most complex contour, the [-belief] contour, demonstrated that 4- and 5- year olds are above chance at comprehending the contour’s meaning. 6-year-olds perform in an even more adult-like way than 4- and 5-year-olds. Linguistic comprehension of the [-belief] contour is present at the same ages for which earlier studies have shown evidence for linguistic comprehension of epistemic modal verbs.

Taken together, the results presented in this dissertation highlight how important it is to clearly define the form-meaning relationships in the adult system if we are to fully understand
how intonation will be developed in child speech. The function of the intonational form is key in understanding when it will be produced and comprehended.
For Kira - you are missed.
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CHAPTER 1: INTRODUCTION

Acquiring one’s first language involves acquiring all components of the grammar: phonological, morphological, syntactic and semantic. The acquisition of intonational grammar is interesting because what intonation does varies cross-linguistically. For example, Levinson (2010) has recently argued that in Yéli Dnye, a Papuan language spoken Rossel Island, no intonational differences (nor any other kind of grammatical differences) are found between questions and declaratives. He claims that questions are “detected by virtue of the informational mismatch between speaker and addressee” (2742). He also observes that while responses to questions may differ kinesically based on the polarity of the question (eyebrow flashes versus blinks), there were no kinesic differences identified to differentiate yes-no questions versus declaratives, for example. However, many languages do rely on intonation for subtle distinctions in meaning. European Portuguese has been shown to differentiate intonationally between two types of confirmation questions: confirmation questions of understanding (whether the hearer perceived the meaning of a question) versus confirmation questions of perception (whether the hearer perceived what was actually pronounced) (Mata & Santos, 2010). Declaratives in English may take on some properties of questions when they are produced with a rise, and this will depend on information in the common ground (Lai, 2012). Therefore, context may do all the work as in the Yéli Dnye case, lots of the work like in the European Portuguese case, or a part of the work like in the English case (though little is known about the kinesic cues to interrogativity for the European Portuguese and English cases). Therefore, we expect languages that use post-lexical tone, or intonation, to use the tones available in their repertoire in different ways and to different degrees. As Crystal (1986) notes, there are fewer pitch patterns available in a language
than there are situations to be differentiated. Part of learning to become a speaker of an intonation language like English, Spanish or Catalan involves learning the intonational forms available in that language, the meanings associated with them and also how much/little one can rely on the discourse context in order to convey the desired message. How is this learned?

Crystal warns against certain assumptions that researchers have tended to make in the past. For example, since there are fewer pitch patterns than situations/intentions, one-to-one mapping between prosodic form and prosodic function does not seem likely. Additionally, with respect to the acquisition of intonation, Crystal also warns against assuming that just because a child produces a rising tone, s/he is automatically asking a question. “Everything depends on the careful analysis of the accompanying behavior and situation before one can be justified in ascribing such an interpretation to the utterance” (p. 36). Dore (1975) sees prosody as a means by which primitive speech acts can be performed – the child produces a rudimentary (lexical) expression in addition to a ‘primitive force-indicating device’ (p. 31). This is perhaps not surprising since Esteve-Gibert & Prieto (in press) showed that Central Catalan-acquiring children between 9 and 11 months of age children make prosodic distinctions (duration, pitch range) between very rudimentary intentions. Their data showed that intentions that require some sort of response are characterized by longer duration and wider pitch range than those that do not. Whether this is a universal phenomenon remains to be shown, but at the very least we can say that there is evidence that children begin to distinguish intentions prosodically at a very young age. Halliday (1975) describes his son Nigel as going through a phase during which he uses rising tones for all “pragmatic” utterances (utterances that require a response) and falling tones for “mathetic” utterances (those that do not require a response). Children, then, are shown to be
sensitive to intentionality from early on, and prosodic differences seem to be tightly associated with this intentionality. But Crystal points out the need for a better notion of “intentions” in work on prosodic development, i.e. the “meaning” part of intonation in terms of intonational form-meaning pairs. He also took issue, though, with how the “form” part had been analyzed. Crystal (1978) observes the problematic tendencies in the studies on intonational development at the time – they were either too specific and based on acoustic specification of events, or were not specific enough. Researchers, who tended to study their own children, would often make reference to vaguely-defined intonational contrasts.

1.1. The Autosegmental Metrical framework

Crystal’s criticism came just before Pierrehumbert’s (1980) seminal dissertation, which provided a framework for intonation that kept the phonological representation of intonational categories separate from the phonetic implementation of these categories. A revised model of this framework was proposed by Beckman and Pierrehumbert (1986). As Gussenhoven (2004) notes, the term ‘Autosegmental-Metrical model’ was later coined by Ladd (1996/2008). This model is now perhaps the most widely accepted phonological framework for intonational analysis. The framework assumes that the fundamental frequency (F0) contour is a sequence of high (H) and low (L) tones throughout an utterance. Some languages (including varieties of Spanish) also show evidence for mid (M) level tones as well as extra-high (¡H*) tones. There are two types of tones. The first type is the *pitch accent*. Pitch accents are tonal events associated with metrically prominent syllables within the utterance. They are monotonal (e.g. H*, L*) or bitonal (e.g. L+H*, L*+H, H+L*, H*+L). The asterisk symbol (*) is used just after the tone that is associated with the metrically strong syllable. In bitonal pitch accents, if there is a tone preceding this
starred tone, the preceding tone is referred to as the leading tone. For example, in a H+L* pitch accent the leading tone is a high (H) tone. If the starred tone is followed by a tone, it is referred to as the trailing tone. For example, in the H*+ L pitch accent, the trailing tone is a low (L) tone.

Tonal events associated with the edges of prosodic phrases are known as boundary tones. These can be of varying pitch heights as well, but in more general terms will be high (H) or low (L). Boundary tones are associated with right edges of intermediate phrases (ip) or intonational phrases (IP). At ip edges boundary tones are marked by the ‘-‘ sign and at IP edges they are marked by the ‘%‘ sign. Within one IP it is possible to find more than one pitch accent. The final pitch accent, which is quite often the most prominent pitch accent, is referred to as the nuclear pitch accent. Pitch accents preceding the nuclear pitch accent are known as prenuclear pitch accents. The combination of a nuclear pitch accent and the subsequent boundary tone is commonly referred to as a nuclear configuration in many transcription systems. Just as contrasts in segmental phonology are discovered based on differences in meaning in a given language (e.g. in English [b]it is different than [p]it) meaningful semantic or pragmatic contrasts motivate proposing distinct intonational categories (e.g. L+H* vs. L*+H).

1.2 The Sp_ToBI system

The Sp_ToBI system is the application of the AM framework to the Spanish language. The first transcription conventions for Spanish come from the 1\textsuperscript{st} Sp_ToBI workshop held at The Ohio State University in October 1999. The result was a preliminary proposal for of transcription conventions for Spanish, or Sp_ToBI (Beckman et al., 2002). Modifications for these transcription conventions were later proposed by Hualde (2003), Face and Prieto (2007) and Estebas-Vilaplana and Prieto (2008). Three more Sp_ToBI workshops have been held since the
initial workshop in Columbus, Ohio. The most recent, the 4th Sp_ToBI workshop held in Las Palmas de Gran Canaria, Spain, looked to find ways to make the Sp_ToBI transcription system applicable to all varieties of Spanish. In order to do so, researchers applied the transcription system to many dialects of Spanish to test its possible limitations. Researchers elicited very comparable speech corpora using the same methodology for each variety of Spanish, and in this way were able to compare the intonational systems of the various dialects being investigated. The result was that there was considerable agreement in transcribing these cross-dialectal data sets. The findings for the various dialects have now been published in the volume *Transcription of Intonation of the Spanish Language* (Prieto & Roseano 2010). Each chapter presents the inventory of pitch accents and boundary tones discovered for the specific variety, and common meanings associated with different nuclear configurations. A summary of the system can be found online in the Sp_ToBI Training Materials: [http://prosodia.upf.edu/sp_tobi/en/](http://prosodia.upf.edu/sp_tobi/en/) (Aguilar, de-la-Mota and Prieto 2009). Throughout this dissertation, I will use the Sp_ToBI system for the intonational transcription of yes-no questions produced and perceived in adult speech (Chapters 2 and 3), as well as child-directed speech (Chapter 4) and child speech and perception (Chapters 4 and 5). The specific labels used in this dissertation come from the chapter on Puerto Rican Spanish intonational phonology (Armstrong 2010) from this same volume, and the labels assumed are available in Appendix A.

### 1.3 Applying the AM framework to intonational development

The AM framework has been shown to be a useful system in studying intonational development since it allows us to consider the target categories we assume to be available to children in the input. In Crystal’s (1978) discussion on intonational development that I referenced above, he
cites two opposing theoretical positions on this topic. The first position says that the use of intonation is in itself evidence of the acquisition of grammatical structure (Brown 1973; Menyuk, 1971), and the other is that intonation comes after the development of syntax, especially word order (Bloom, 1973). While some recent work suggests that the latter is the case (Snow 2006), other work applying the AM framework shows counterevidence. Studies looking at intonational development for toddlers in Dutch (Chen and Fikkert 2007), European Portuguese (Frota and Vigário 2008) Peninsular Spanish and Central Catalan (Prieto et al. 2012) have all shown evidence not for correlations with syntactic development, but with vocabulary size. This finding is not surprising since intonation contours are related to various meanings in a given language, and the ability to do form-meaning mapping would be necessary to make the association between a given form and its (various) meaning(s), a task similar to what children must do when they are learning new words. Mata & Santos (2010) have recently applied the AM model in their work on the intonation of children’s affirmative responses to different question types in European Portuguese. They found that children use different pitch accent types for their responses based on whether they are responding to understanding questions (H*, L+H*) versus perception questions (L*+H). After the age of 24 months, children tended to produce falling contours as affirmative answers with non-neutral acceptance. The pitch accent found for children’s answers before and after the second birthday differed based on the intonational meaning of the confirmation question. Caretakers were also found to use more “strongly” marked phonetic contrasts between neutral and non-neutral understanding questions once children were older.

Within the domain of yes-no questions, the AM framework has also been applied to analyze both child-directed speech (CDS) and child speech. Prieto et al. (2011) found that at 19
months old, children are already producing three different nuclear configurations that are frequent in CDS for Peninsular Spanish. Thorson et al. (submitted) found evidence that for Pensinsular Spanish and Central Catalan-acquiring children produce almost all of the same form-meaning pairs present for yes-no questions found in CDS speech (as well as what has been claimed for adult speech in these varieties), though the authors did find some non-typical form-meaning pairs produced in for both CDS and child speech. Thorson et al. call attention to the need for fine-grained semantic and pragmatic analyses of intonation contours for a more precise understanding of intonational development.

With respect to linguistic comprehension of intonational forms, the verdict is still out in terms of the age at which children are able to comprehend intonational meaning. While it seems that the development of the ability to comprehend focus through intonation is something that comes rather late (see Ito et al. 2012 for an overview). Wells et al. (2004) showed that 5-year-olds can easily discriminate speech act types, and often times discriminate affect types using intonation. But as Ito et al. point out, one of the issues with work on intonational comprehension is that the experimenters do not provide children with discourse context - children are often times been presented with decontextualized examples, which is not how we expect them to be exposed to intonation in real speech, or how we expect them to learn to use intonation. There is therefore a need to continue to develop methods for testing intonational comprehension in context for children.

By applying the Sp_ToBI system, the “form” issues that Crystal brought up in the late 1970s may be less of an issue. But where do we stand with respect to the issue of intentions? As I discussed earlier in this chapter, different languages use intonation in different ways. It is
therefore necessary to understand just how the language divvies up form-meaning pairings when the “form” is an intonation contour. Relatively little work (with the exception of the studies mentioned above) have applied the AM framework in linguistic comprehension work with children. Therefore, while the form side of linguistic inquiry into intonational development is in much better shape than it was when Crystal identified the problematic areas I mentioned above, it seems that there is much work to do with respect to the meanings and intentions conveyed by these forms.

1.4 Dissertation goals and overview

The aim of this dissertation is to learn more about intonational development by looking at just a small piece of the grammar of Puerto Rican Spanish (PRS): yes-no questions. This language variety is particularly interesting with respect to yes-no question intonation since it has been shown to predominantly use falls to signal questions (Quilis 1987; 1993). Therefore, the initial rise/fall contrast found in child production for languages like English (Halliday 1975/2004) and even Japanese (Yoshida 1977) would possibly not be relevant for this variety of Spanish because both yes-no questions and declaratives are intonationally encoded by a final fall.

The first goal of this study is to provide a clear picture of the role of intonation in the yes-no question domain. Chapter 2 presents production data from two experiments using Discourse Completion Test (DCT) methodology (Billmyer & Varghese, 2000; Kasper and Dahl 1991; Cohen 1996; Beebe and Cummings 1996; Prieto 2001; Nurani 2009). The first DCT used in the dissertation is an adaptation from Prieto (2001), and is part of the materials used for the Atlas interactivo de la entonación del español (http://prosodia.upf.edu/atlasentonacion/index.html, coordinated by Pilar Prieto and Paolo Roseano). The second DCT includes additional materials
specific to the investigation of the pragmatic nuances of yes-no questions. All materials were used with the goal of uncovering the possible intonational contours found within the yes-no question domain, and to begin to conceptualize the factors that govern speaker choice of intonation contours. In Chapter 2, I present an overview of how intonational meaning of questions has been handled from a more semantico-pragmatic point of view, and how these analyses can be applied to the case of PRS. The results from the production experiment in Chapter 2 suggest that PRS divides the yes-no question system up through intonation based on whether or not the speaker decides to convey their epistemic belief with respect to propositional content. Of course, whether or not they have a specific belief at all about the propositional content will restrict contour choice. This has potential implications for theories of bias in yes-no, or polar questions in general. The results from the production experiment in Chapter 2 present the system for using intonation in the yes-no question domain from a speaker-oriented perspective for adult-directed speech.

It was next necessary to test the proposed meanings that were uncovered in the production experiments. In Chapter 3, I use novel methodology in a perception experiment that looks at the interaction between contour choice and discourse context in order to understand how different discourse contexts might possibly change the meaning of the different contours found for yes-no questions in Chapter 2. The results clearly indicate that speakers rely on both linguistic forms (intonation) and discourse context when inferring a speaker’s belief state. However, they also show that when epistemic bias is directly encoded through a linguistic form, the effect of the linguistic form may weaken the effect of discourse context when perceiving the speaker’s belief state. The study provides useful methodology for work on understanding the
pragmatics of different intonation contours, as well as how the contours interact with discourse context. The perception experiment was also a necessary step to understand how intonation works from a hearer-based perspective. I assume that not only do children learn to become speakers of the language they are acquiring, but also hearers. It was necessary, then, to evaluate the adult system from both speaker and hearer perspectives. The results of both the production and perception experiments verified that PRS has a default yes-no question contour, and two additional yes-no question contours that convey information about the speaker’s belief state, i.e. epistemic information. To my knowledge, existing accounts of question intonation have not specifically considered epistemic components. The acquisition of epistemic intonation contours (for questions or other sentence types) also appears to be lacking from the intonational development literature.

Chapters 2 and 3 allowed for a clearer picture of the adult system. These chapters allowed for a better understanding of what kind of meaning is conventionally conveyed through the three contours, but also how these meanings may or may not be affected by context. This was important to establish prior to analyzing child speech or child-directed speech (CDS). With this information available, in Chapter 4 I analyze the use of the three yes-no question contours using longitudinal data from two PRS-acquiring toddlers and their caretakers. The longitudinal data come from two separate corpora: the CLESS database (the University of Connecticut’s Cross-Linguistic Early Syntax Study project) and the PAELMA corpus (Proyecto de la adquisición del español como lengua maternal from the Universidad de Puerto Rico – Río Piedras).

The results reported on here show that epistemic contours are not frequent in CDS, nor are they common in child speech. This suggests that children learn to use the default contour
early on, making no intonational distinctions based on intention type, as Prieto et al. (2011) found for Peninsular Spanish-acquiring children. This difference shows clearly that even within a small part of the grammar (yes-no questions) we find cross-dialectal differences in intonational development. The results also suggest that the contour’s epistemic value in addition to its pragmatic restrictions play a role in how it is acquired.

Finally, in order to examine whether or not children are able to extract the “disbelief” component of the contour when it is presented in context, I evaluated child comprehension of the L* HL% contour. This was done using a linguistic comprehension task testing children aged 4, 5 and 6 in their ability to distinguish between the non-epistemic question contour ¡H* L% and the incredulous/doubt question contour L* HL%. In this task, the child had to point to which of two twin sisters “did not believe” a third character after hearing each twin produce either the ¡H* L% or L* HL% contour. The results show that at the same ages at which children have been shown to begin to make distinctions between epistemic modal verbs and mental state verbs (4-6 years old), PRS-speaking 4-, 5- and 6-year-olds were all above chance in determining which of two speakers was expressing disbelief in the task. The contour L* HL% was also shown to be a reliable cue to disbelief in the perception experiment in Chapter 3, and the child perception results suggest that by the pre-school stage, children are aware that L* HL% conveys disbelief on the part of the speaker. To my knowledge, this is the first study to investigate child comprehension of intonation as an epistemic marker, and therefore makes a needed contribution to the body of research on linguistic comprehension. It is also one of the few studies on child prosodic comprehension that provides the children with a discourse context, a detail I showed to be important in previous chapters.
1.5 Contributions

This dissertation provides a comprehensive way of studying intonational development, starting with a full view of the adult (target) system from both speaker and hearer perspectives. It provides two types of novel methodology for perception work (Chapters 3 and 5) that can be applied to studies of the pragmatics of intonation for both adult and child speech. In Chapter 3, I present a perception paradigm useful for assessing contrasts in perceived belief states for intonational forms. In addition, I showed how the type of information conveyed through a contour will affect its interaction with discourse context in terms of inferred meaning, i.e. hearer-oriented meaning. This method could be applied to other conventionally conveyed intonational meanings as well. Chapter 5 shows new methods for assessing children’s ability to make epistemic distinctions through intonation in context. This is an area that, to date (to my knowledge) has not been directly tested in linguistic comprehension tasks. Beckman and Venditti (2010) point out that languages using intonation in the way that English does use tones as “pragmatic morphemes chosen from a small and relatively closed set” (p. 531). The specific tonal sequences that convey a specific pragmatic meaning, then, can be referred to as intonational morphemes in languages like English and Spanish. The type of information conventionally conveyed by the intonational morphemes studied here is epistemic, and therefore their acquisition is quite probably related to a child’s developing Theory of Mind. Therefore the understanding how these forms developed would be relevant to clinical work on autism and language development. For instance, it has been claimed that autistics lack epistemic resources to access the mental states of others (Born, 2011). Including linguistic comprehension tests that probe a child’s comprehension intonational morphemes marking epistemic information could be
included as a component of the detection of autism. This research also makes clear that reliable descriptions of intonational meaning are essential to the study of intonational development.
2.1 Introduction

Given the principal goal of this dissertation - to understand how children acquire the intonation contours associated with yes-no questions in Puerto Rican Spanish (PRS) - it is first necessary to present the architecture of the adult system used within the yes-no question domain. In this chapter, I consider the relationships between form (specifically, the intonation contour) and meaning (the meaning of the question in context) used by PRS-speaking adults in two production experiments. In this way I establish the phonological categories and their corresponding meanings that will be available for acquisition by the PRS-acquiring child.

Estigarribia (2007) studied the acquisition of yes-no questions in English child speech and child-directed speech using the label ‘yes-no questions’. This label, he observes, is common in acquisition studies. There are many ways of talking about this particular question type – polar interrogatives (Ginzberg and Sag, 2000), closed interrogatives (Huddleston & Pullum, 2002), and polar questions (Ladd 1981; Büring & Gunlogson 2000; Sudo to appear). Within the Hispanic Linguistics tradition they are often referred to as absolute interrogatives (Sosa 1999). In the intonation literature, we often find the terms information-seeking and confirmation-seeking questions (Prieto and Roseano 2010; Vanrell 2011; Crespo-Sendra 2011). Given that the overarching goal of this dissertation is to understand how children acquire question intonation, I follow Estigarribia, using the term yes-no questions. When necessary, however, I use the exact terms of the various authors cited here.
2.1 Previous work on yes-no question intonation

The type and amount of information that can be linguistically encoded through intonation/prosody has been shown to be specific to the language variety. Payà & Vanrell (2005), for instance, showed that Majorcan and Minorcan Catalan use the same pitch accent for unbiased yes-no questions, but with different boundary tones depending on dialect. This study found that for tag and echo questions, there was an effect of information status, speaker attitude and degree of certainty on both nuclear pitch accent and boundary tone choice. For European Portuguese, Santos & Mata (2008) showed that speakers distinguish between two types of confirmation questions through nuclear pitch accent choice: those that confirm understanding versus those that confirm perception. The authors also found effects of question type on F0 height such that boundary tones for confirmation questions of understanding are lower than they are for confirmation questions of perception, though they also found that the latter have lower boundary tones than ‘contact’ confirmation questions. Vanrell’s (2011) perception data revealed a categorical distinction based on tonal scaling in Majorcan Catalan: unbiased questions show ¡H+L* L% (with an upstepped high tone) while a plain H leading tone is found for biased questions in the variety (H+L* L%). Thus there is cross-linguistic evidence that speakers mark utterances for interrogativity in addition to other information (i.e. perception, understanding, different levels of information structure, etc.). Peninsular Spanish also makes sub-divisions in question types through the use of intonation (Prieto et al. 2011).

Crosslinguistic differences in what are often referred to as incredulous questions are found as well. Some language varieties show gradient relationships between unbiased yes-no questions and incredulity questions. Two language varieties that show this relationship are
Central Catalan and Buenos Aires Spanish (Crespo-Sendra 2011; Ar Lee et al. 2008), with increased pitch expansion being used either globally or locally for an incredulity interpretation. Ward & Hirschberg (1992), for American English, show that the incredulity interpretation of L*+H LH% was inferred mainly based on pitch range modifications, but other spectral features were found to play a role as well. Some languages like Brazilian Portuguese use categorical contrasts to distinguish between the two question types (Truckenbrodt et al. 2009).

There is also evidence that intonation contributes to question meaning in the semantico-pragmatic literature. Bartels (1997) and Merin and Bartels (1997) both showed that there are meaning distinctions between rising and falling interrogatives in American English. Gunlogson (2003) as well as Nilsenova (2002) have observed distinctions in meaning when comparing falling versus rising declaratives. Hara (2006) shows how certain intonation contours for questions may even be ungrammatical when they combine with some interrogative particles. For instance, the Japanese interrogative sentence-final particle darou, which has a modal flavor, is ungrammatical with rising intonation but with falling intonation has the function of a self-addressing question (i.e. ‘I wonder’).

For Romance languages there are few detailed accounts of intonational meaning from a detailed pragmatic perspective. One important contribution, however, is Escandell-Vidal’s (1998) pragmatic account of question intonation in Peninsular Spanish. She discusses interrogatives and procedural meaning in her Relevance Theory account of interrogatives. Escandell-Vidal argues that within the category of interrogatives, intonation allows for different levels of interpretiveness to be encoded linguistically. She highlights the important role of discourse context, claiming that "the particular illocutionary force of an utterance depends on the
combination of its encoded meaning (including procedural information) and contextual assumptions” (199). She argues for a markedness distinction between the fall-rise contour, which she classifies as the default, unmarked case, the most basic example of interrogative intonation. The rising-falling intonation contour, on the other hand, is used to mark “attributed interrogatives”, which have two degrees of interpretiveness: 1.) they encode instructions to process the utterance as an interrogative and 2.) they encode a representation of a thought of a speaker that is the interpretation of the thought of another individual.

2.2 Questions, context and bias

In the last decade, the literature has begun to consider the importance of the role of discourse context, as well as how intonation works within a given sentence type like interrogatives. Gunlogson (2003) pointed out that while Bartels' (1997) dissertation examines "pragmatic" questions and how they interact with tune and sentence type, contextual restrictions are not addressed. In Gunlogson’s own dissertation she investigates the contextual restrictions on declarative questions in American English. Her analysis is a compositional approach that crucially assumes that both sentence type and intonation have their own contributions to meaning.

Most often, yes-no questions may carry some sort of bias on the part of the speaker. A great deal of the literature has been dedicated to proposals for the types of bias that speakers express when a yes-no question is uttered. Safarova proposes two bias types within the decision-theoretic approach: 1.) desire-state bias – the speaker wishes the proposition of the same polarity

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1 This is Escandell-Vidal’s term within Relevance Theory.
2 The term evidential here is not based on source marking (i.e. the traditional notion of evidentiality marking), but just the fact that there is evidence in the context.
3 PQ=polar question
4 The audio files for the various versions for the other varieties of Spanish investigated in Prieto & Roseano 2010 are
to be true and 2.) information bias – based on speaker beliefs, the speaker expects the opposite polarity to hold. She also found relationships between contour type and the speaker’s expectation of the polarity of answers in a perceptual categorization task designed to uncover the relationships between tune types and bias type in American English. She found that expectations of a negative answer (information bias) tended to be perceived with L*L-L% (in the Mainstream American English ToBI system), while expectations of a positive answer (desired-state bias) tended to be perceived with L*H-H% and H*H-H%. H*L-L% tended to be perceived as the speaker having no specific expectation with respect to the polarity of the answer.

The notions of bias and speaker belief states are an area of constant debate in accounts of the pragmatics and semantics of yes-no questions in general (independently from accounts that directly address the use of intonation). One classic account of biased questions is Ladd's (1981) account of inner and outer negation polar questions (henceforth inner and outer negation questions), where he showed how negation can operate either inside or outside the proposition under question. That is, when negation is used in questions the speaker can either confirm a negated proposition the s/he has inferred (inner negation) or confirm a proposition that s/he believes to be true, in which case the negation operates outside of the proposition in question (outer negation). Inner and outer negation questions are analysed in Büring & Gunlogson's (2000) discussion of bias and neutrality in polar questions, for which they introduce the terms Contextual Evidence, defined in (1), and Compelling Contextual Evidence, defined in (2):

(1) Contextual Evidence
Evidence that has just become available to the participants in the current discourse situation" (7).

(2) Compelling Contextual Evidence
a. Evidence for p is compelling if, considered in isolation, it would allow the participant to assume p (i.e. the evidence could reasonably be considered to justify the inference that p).

b. Evidence against p is compelling if it is compelling evidence that the opposite of p, W-p. (7)

Thus, in their account, different types of questions (“positive polar questions”, “inner negation polar questions”, etc.) have differing contextual evidence conditions.

Sudo’s (to appear) account builds off of Büring & Gunlogson’s proposal that biased questions have Evidential Bias\(^2\), and adds an additional bias type that he refers to as Epistemic Bias. Sudo’s main claim is that two types of bias are necessary to characterize the inferences that PQs (yes-no questions) hold. Sudo's proposed definition of Epistemic Bias is shown in (3):

\[\text{(3) Epistemic Bias}\]

Epistemic Bias: If a PQ\(^3\) carries an implication compatible with the positive (resp. negative) answer based on what the speaker believes, the PQ is said to carry positive (resp. negative) epistemic bias.

The simple distinction between these two bias types, according to Sudo, is that evidential bias is related to evidence in the discourse context, while epistemic bias comes directly from a speaker’s private belief or expectation. For Sudo, the ‘modal flavor’ of epistemic bias does not necessarily have to be related to the speaker’s belief. When there is outer negation, there may be expectations based on norms or rules (deontic epistemicity), as in (4) or the speaker’s desires (bouletic) as in (5):

\[\text{(4) Speaker A knows that B just ran 10 miles in 107 degree weather.}\]

\(^2\) The term evidential here is not based on source marking (i.e. the traditional notion of evidentiality marking), but just the fact that there is evidence in the context.

\(^3\) PQ=polar question
A: Aren’t you thirsty?

(5) A spent all day baking a cake for B. B hasn’t eaten cake yet, and is about to leave

A: Don’t you want a piece of cake?

In (4), the modal flavor is based on a norm about what happens when one runs in hot weather, and would be considered deontic. In (5), the expectation is based on what A wants: for B to eat the cake that A has worked so hard on all day.

In addition to motivating the two bias types for inner and outer negation questions, Sudo also provides evidence in favor of the two bias types from Japanese question particles. For instance, the particle desho carries with it a strong positive bias, but no evidential bias. Positive polar questions with desho will be felicitous no matter what the contextual evidence – they merely imply that the speaker expects a positive answer. However, the particle conveys a strong negative epistemic bias in outer negation contexts. In his analysis, Sudo also argues that the two question particles he discusses, no and desho, do not add any truth-conditional meaning to the utterance, but rather they contribute non-truth-conditional meaning. Sudo argues that his data show that “…at least part of the bias is grammatically encoded in the meanings of the particles, rather than derived from pragmatic principles” (15). This proposal differs from Safarova’s in that the two types of bias she discusses are conflated into one. Safarova’s bias categories are based on the polarity of the expected answer, but both would belong to the epistemic bias category in Sudo’s proposal. This notion of epistemic bias is also embraced by Romero & Han (2002) in their work on preposed negation in yes-no questions as contributing the “implicature that the
speaker believed or at least expected that the positive answer is correct” (8). When this is the case, they claim that a given question would have a positive epistemic implicature. The notions of both belief and expectedness, are also built into Romero & Han’s proposal.

Asher & Reese (2005) have argued for biased questions as complex speech acts, “illocutionary acts comprised of both an assertion and a question” (29). A good example of such a complex speech act for Asher & Reese is the incredulity question. Asher & Reese propose that an assertion of incredulity or uncertainty can be made through a complex intonation contour, though slightly different implementations may be used to distinguish between meanings such as incredulity versus uncertainty. Cohen (2007) also argues for a “multidimensional” treatment of incredulity questions, proposing that they have a dual aspect. They are questions, but they also function as an assertion of incredulity or indignation. Cohen exemplifies the multidimensional meaning of incredulity questions with the example in (6), an excerpt from Sointula, by Bill Gaston:

(6) Gore: I . . . want to be rid of this whiskey before I tackle the West Coast Trail.”

Bob: YOU’RE doing the trail?”

Gore sees Bob scan his body while asking this and he hears incredulity in the question.

Gore: Yes. (He pauses.) Why? (92)

Cohen points out that when Gore says “yes”, he answers the “question” element of Bob’s utterance, but when he asks “why?” this is a response to Bob’s assertion of incredulity. This multidimensional function is what Asher & Reese refer to with the term *question•assertion*, an
illocutionary act comprised of both a question and an assertion (i.e. a complex speech act).

2.3 Yes-no question intonation in Puerto Rican Spanish


Sosa (1999) found two types of contours for PRS yes-no questions, both falling. For Sosa, the neutral yes-no question contour shows an utterance-initial rise, maintained in suspension until a final fall. Just before the final fall, according to Sosa, an additional rise is found. Sosa describes a second contour used for PRS yes-no questions, when the negative particle no is found in the question and a specific answer is expected. In this case, there would be no additional rise found prior to the final fall. Therefore, Sosa’s distinction for final falls for questions in PRS is based on the presence versus absence of an additional rise prior to the final fall. Contour choice would then depend on the presence of negation, as well as speaker expectations about the answer to the
question (bias). Sosa’s account implied that the polarity of the response is not relevant when the “negation” contour is chosen.

The F0 curves in Quilis’ (1987; 1993) examples look similar to the neutral yes-no question contour described by Sosa, and Quilis also argues that PRS has a special contour for questions with negation. However, his description of the contour differs from Sosa’s. Quilis (1993) describes the negation contour as having a rising F0 after the negative particle that stays suspended until the end of the utterance where there is a light fall. Sosa notes that there is nothing “light” about the final fall he found for questions with negation – the contour does not stay in suspension like the negation question contour described by Quilis. In the same account, Quilis also gives an example of a question with a matiz de extrañeza ‘nuance of surprise’ in PRS. Looking at the pitch track of the example he provides (485) it seems that this contour is characterized by a high prenuclear tone followed by a fall throughout the stressed nuclear syllable in the question ¿Es maestra? ‘Is she a teacher?’, similar to the contour Sosa’s ‘negation’ contour.

While these earlier descriptions are not in complete agreement, it is clear that within the yes-no question domain there are at least two different contours, whose uses are likely based on some type of bias. In order to determine whether there are indeed categorical differences between the different question contours, precise divisions among semantico-pragmatic restrictions must be identified. Escandell-Vidal's work (1996; 1998) in Relevance Theory has been the only work taking a comprehensive look at the interaction between intonation and pragmatic meaning in Spanish. To my knowledge, there are no existing accounts for other varieties. Given prior descriptions, it seems that the restrictions governing contour choice and the
actual contour choices available for PRS speakers differ from those of Peninsular Spanish. In fact, the dialects of Spanish studied in Prieto and Roseano (2010) show that even for very general categories like “information-seeking” and “confirmation-seeking”, there is a substantial amount of variation in terms of the contours that different dialects of Spanish use for these functions. The work presented here will be the first comprehensive account of the phonological and semantico-pragmatic characteristics of yes-no questions in any variety of American Spanish (to my knowledge). Having a clear picture of these characteristics will allow me to define the specific acquisition problem of the PRS-acquiring child with respect to intonational development within the yes-no question domain. After presenting the results from two perception experiments, I will speak to the nature of these contours with respect to the different notions of bias found in the semantico-pragmatic literature.

2.3. Methods

The analysis put forth here is based on results from two production experiments. The method used for both studies was a widely used elicitation procedure (Billmyer & Varghese, 2000; Kasper and Dahl 1991; Cohen 1996; Beebe and Cummings 1996; Prieto 2001; Nurani 2009) called the Discourse Completion Test (DCT). One advantage of this methodology is that it allows for the collection of large amounts of data in a relatively short amount of time. Additionally, as Billmyer & Varghese note, the method can help us to gain a better understanding of natural communication through constructed contexts. To elicit the data analyzed in this chapter, I used constructed contexts that served as situational prompts to elicit various sentence and speech act types in PRS, as well as specific types of unbiased and biased
yes-no questions. The data analyzed here were collected from two DCTs – I will refer to them as DCT1 and DCT2.

2.3.1 Participants

2.3.1.1. DCT1 participants

Five female participants between the ages of 20-25 participated in the first task. Three of the speakers were from the Greater San Juan metropolitan area, and two were from cities on the West Coast of the island (Utuado and Aguadilla). While it was assumed that there might be regional variation, the motivation was to find tendencies that were common across speakers.

2.3.1.2. DCT2 participants

The same five females from DCT1 were included as participants in DCT2, which was administered 7 months after DCT1. 9 additional speakers were included in DCT2 for a total of 11 females and 4 males, aged 20-45. This time 9 speakers were from the Greater San Juan metropolitan area, 1 from Utuado, 1 from Aguadilla, 1 from Mayagüez, 1 from Lares and 1 from Ponce. All four male speakers were from the Greater San Juan metropolitan area. As in DCT1, I looked for tendencies across speakers in an effort to evaluate which contours were characteristic of yes-no questions in PRS as a general variety.

2.3.2. Materials

2.3.2.1. Discourse Completion Test 1 (DCT1)

DCT1 is a subset of the situations used in Prieto (2001), but focuses on questions only. It consisted of a set of 22 non-wh questions (yes-no questions?) with a variety of pragmatic nuances, designed to find tendencies in the variety. The specific items can be seen in Appendix A. DCT1 was adapted linguistically and culturally for PRS from the Peninsular Spanish version.
The specific situations from this task were also the ones used for all dialects of Spanish included in Prieto & Roseano (2010). They note that the task is based on everyday situations that we would expect the participants to be familiar with. (7) shows a typical situational prompt and suggested response for PRS. In this particular example, the target was a polite request.

(7) Pídele la hora a una persona mayor.

¿Usted me podría decir la hora?

Ask an elderly person what time it is.

Could you tell me what time it is?

The DCT1 corpus was comprised of 25 questions per participant, yielding a total of 125 utterances.

2.3.2.2 Discourse Completion Test 2 (DCT2)

While DCT1 elicited a wide array of question types with different intentions and nuances, DCT2 was more restricted. The first part of DCT2 elicited neutral yes-no questions, yes-no questions with negative evidence with respect to p, yes-no questions with positive evidence for p and counter-expectation questions (see Table 1). This was done to test the possible effect of contextual evidence on contour choice. An additional motivation for including yes-no questions with negative evidence with respect to p was to test Sosa (1998) and Quilis' (1987; 1993) claims for a special negation contour PRS. The second part of DCT2 (Table 2) was designed based on prior work on “polar questions” and “negative polar questions” (Büring & Gunlogson, 2000;
Ladd 1981). Büring & Gunlogsen, for example, discuss the notion of *compelling contextual evidence* in the felicity conditions for polar questions in English and German. Additionally, Ladd's notions of polar questions showing inner negation and outer negation was relevant since the two authors describing PRS intonation in the past have claimed that a specific intonation contour is used for negative questions in PRS.

DCT2 consisted of two parts. The first part included the typical situational prompts that were meant to elicit the following:

<table>
<thead>
<tr>
<th>Context</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neutral</td>
<td>No specific answer expected, speaker expects neither p nor ( \neg p )</td>
</tr>
<tr>
<td>Negative evidence (evidence for ( \neg p ))</td>
<td>Compelling evidence that ( \neg p ) has just become available to the speaker</td>
</tr>
<tr>
<td>Positive evidence (evidence for p)</td>
<td>Compelling evidence that p has just become available to the speaker</td>
</tr>
<tr>
<td>Counter-expectation</td>
<td>Contextual evidence that p, p was unexpected by speaker</td>
</tr>
</tbody>
</table>

Table 1. Contexts and descriptions for DCT2, Part 1

Part 2 of DCT2 focused on polar questions with negation, namely Ladd's (1981) notions of inner and outer negation, and Büring & Gunlogson's descriptions of them based on evidence. Because I wanted to mirror Ladd’s examples exactly, I included a neutral context that was a near minimal pair to inner and outer negation versions in Part 2 as well.
Table 2. Contextual characterizations for situational prompts in DCT2, Part 2.

### Contextual characterizations for situational prompts in DCT2, Part 2.

<table>
<thead>
<tr>
<th>Context</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neutral</td>
<td>No specific answer expected, speaker expects neither p nor ¬p</td>
</tr>
<tr>
<td>Inner negation yes-no question</td>
<td>At the time of utterance, speaker had previously assumed the truth of p, but due to contextual evidence has inferred that p is actually false, and is using negative question to check the new inference (compelling evidence that ¬p)</td>
</tr>
<tr>
<td>Outer negation yes-no question</td>
<td>Speaker must not just expect that p’ on general grounds, but have particular (and possible private) evidence for the very fact that p’ (Büring &amp; Gunlogson: p. 11).</td>
</tr>
</tbody>
</table>

#### 2.3.3. Procedure

The recordings were done with a Samson Zoom H2 Handy Recorder at a sampling rate of 44100Hz. The participants were told to read the context and respond how they would in a natural situation.

Part 1: speakers were presented with each context type five times, for a total of twenty targets. The targets were always minimal/near minimal pairs in the sense that the segmental string was identical (or almost identical – e.g. a negative particle was added for the "negative answer expected" condition in order to test prior claims about the relationship between contour choice and negation). As in DCT1, the speakers read the contexts and responded accordingly using the suggested targets. A total of 20 utterances were produced for DCT2 Part 1. (DCT2 stimuli are found in Appendix C).
Part 2: Participants read contexts and produced utterances for two instances of a neutral polar question, two instances of Ladd's inner negation and two instances of outer negation for a total of 6 utterances. A total of 26 utterances were produced by each of the 14 participants who participated in DCT2 (26 x 14 = 364).

2.3.4. Analysis

The 489 utterances from DCT1 (125 utterances) and DCT2 (364 utterances) were analyzed using Praat software for phonetic analysis (Boersma & Weenink, 2010).

2.3.4.1 Intonational labeling

The data were analyzed assuming the Autosegmental Metrical (AM) framework (Pierrehumbert 1980; Beckman and Pierrehumbert 1986; Venditti 1995; Jun and Fougeron 1995, inter alia). In this model two types of tones are used, high (H) and low (L), though this is not the case for all languages. For languages like Spanish or English, like other “intonation languages” (i.e. those that use tones at the post-lexical level) there are two types of tonal events: pitch accents and boundary tones. Pitch accents are associated with metrically prominent syllables in an utterance. Ladd (1996) refers to them as the “location of prominence-related intonational events”. They may be monotonal (e.g. H* or L*) or bitonal (e.g. H+L*, L+H*, etc.). The “starred tone” (the one that has the asterisk) is the tone that is aligned (relatively) with a metrically strong syllable. Thus for the case of a bitonal pitch accent like H+L*, the high (H) tone is considered a leading tone (a dependent tone which precedes the starred tone) while in the bitonal pitch accent L*+H the H tone is considered a trailing tone (a dependent tone follows the starred tone). Schemas of these pitch accents in Spanish are shown in Figures 1 and 2:
More than one pitch accent can occur within a given Intonational Phrase (IP), but just like in segmental phonology, pitch accents have language-specific distributions (see Sosa (1999), Face (2001) and Hualde (2003) for discussion on distributions in Spanish). Within the present system, L*+H is not known to appear IP-finally, and is therefore considered a strictly *prenuclear* pitch accent. L+H* on the other hand, is known to occur IP-finally and therefore occurs in *nuclear* position (i.e. on the metrically-strong syllable of the most prominent word in the utterance, very often the utterance-final word).

Tonal events associated with the edges of prosodic domains are referred to as *boundary tones*. Like pitch accents, boundary tones may be high (H) or low (L) and for the case of Spanish as mid (M) (Beckman et al. 2002; Estebas-Vilaplana & Prieto, 2009). While Ladd states that “boundary tones are in this strict sense single tones – either H or L”, the most recent revision of the Sp_ToBI labelling system in fact allows for complex boundary tones based on evidence

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5 Pierrehumbert’s (1980) proposal for English includes *phrase accents* as well.
for clear complex tonal movements after the nuclear stressed syllable (i.e. HL% or LH%). This most recent revision of the Sp_ToBI system (Estebas-Vilaplana & Prieto 2009) builds on the initial Sp_ToBI proposal (Beckman et al. 2002), as well as an earlier revision by Face & Prieto (2007). The version can be found on the Sp_ToBI Training Materials website⁶ (Aguilar et al., 2009). The descriptions of various dialects of Spanish in Prieto & Roseano (2010) shows cross-dialectal variation in the phonological inventory of pitch accents and boundary tones across varieties of Spanish, though the work also confirms that the Sp_ToBI system was adequate for cross-dialectal description. Appendix A shows the inventory of pitch accents and boundary tones proposed for PRS in Armstrong (2010). These were the categories used for labelling the data presented in this chapter. Figure 3 shows an example of the intonational labelling carried out in Praat. The words tier shows orthographic words, while the tones tier shows the Sp_ToBI labels.

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Figure 3. Example of intonational labelling in Praat for the question ¿Pueden venir a la comida? 'Can you (pl.) come to the meal?' Two prenuclear pitch accents are found: L*+H on pueden and H* on venir. The final pitch movement is comprised of a ¡H* pitch accent on comida followed by a fall to a low boundary tone in the post-tonic syllable.

2.3.4.2. Pragmatic analysis

Because it has been shown that choice in linguistic form (whether it be intonational or through some other strategy) within the domain of yes-no questions varies across languages and may be triggered by many factors, the following were considered in the pragmatic analysis:

- Presence/absence of negation (Sosa 1998; Quilis 1987; 1993)
- Attribution of procedural information (Escandell-Vidal 1998)
- Expected answer (as in Safarova 2006)
- Contextual evidence (Büring & Gunlogson 2000; Gunlogson 2003)
- Epistemic bias (Sudo, to appear)
2.4. Results

2.4.1. Phonological/phonetic descriptions of the contours

There were three contours that appeared most frequently for the three tasks I report on here. ü%H* L% was the most frequent contour in each of the tasks, as demonstrated in Figure 3 (DCT1: 94% ü%H* L%>4% L* HL%; 2% H+L* L%; DCT2 – Part 1: 65% ü%H* L%>29% L* HL%>6% H+L* L%; DCT3 – Part 2: 79% ü%H* L%>14% H+L* L%>7% L* HL%). Combining all contexts, ü%H* L% was the most frequent contour (75% ü%H* L%>18% L* HL%). 7% H+L* L%). Before speaking to what the three tasks reveal about the meaning of the contours, I will now describe their phonetic implementations in the order of their overall frequency.

![Figure 4. Distributions (%) of contour by task, and overall](image)

Figure 4. Distributions (%) of contour by task, and overall
2.4.1.1 – Phonetic and phonological observations - ¡H* L%

The most frequent contour in the corpus, ¡H* L%, is in fact the crucial piece of evidence motivating the pitch accent ¡H* in PRS. Armstrong (2010) showed that this extra-high tone contrasts with narrow focus statements in the variety, for example, where the H* L% nuclear configuration (i.e. the combination of a nuclear pitch accent + boundary tone) is found. The scaling, or height, of the high tone determines whether the utterance is to be processed as a question or a statement. Thus I use the upstepped diacritic (¡) to mark the tone as extra-high. This extra-high tone has been proposed for other varieties of Spanish as well. The category ¡H* is also proposed for Canary Islands Spanish (Cabrera Abreu & Vizcaíno Ortega, 2010) based on the question/declarative distinction, while in Peninsular Spanish the L+¡H* L% label has also been proposed by Estebas Vilaplana & Prieto (2010) for echo questions. An example of a typical ¡H* L% production is shown in Figure 5. This example comes from DCT2, Part 2.
Figure 5. Waveform, spectrogram and F0 trace for the unbiased yes-no question ¿No hay por aquí un lugar que venda piononos? ‘Is there a place that sells piononos around here?’ produced with two prenuclear pitch accents: L*+H and H*, followed by a ¡H* nuclear pitch accent and boundary tone L%.

The phonetic implementation of ¡H* L% may also depend on whether or not there is segmental material following the IP-final stressed syllable. (8a) and (9a) show examples of segmental material following IP-final stressed syllables, while (8b) and (9b) show the lack of segmental material after the IP-final stressed syllable.

(8a) ¿Me dejarías pasarlo? 'Would you let me pass it?'
(8b) ¿Me dejarías pasar? 'Would you let me by?'

(9a) ¿Visitaste las universidades? 'Did you visit the universities?'
(9b) ¿Visitaste la universidad? 'Did you visit the university?'
When there is no segmental material following the nuclear syllable, languages varieties are known to cope in one of two ways: *compression* or *truncation*. Grabe et al. (2000) define the distinction between the two:

Compression involves a speeding up of the realization, so that the complete accent shape is produced on the small amount of voiced segmental material available. When speakers truncate, on the other hand, they start to produce the accent as if there was plenty of voiced material to come, but then they simply stop when the voiced material has run out, and the falling accent shape is never completed (p. 162).

While Ladd (1996) claims that languages will either be truncating or compressing, Grabe et al. find that different varieties of a given language may compress or truncate. For instance, they find that Southern British English speakers compress H* L 0%, while Leeds speakers truncate it. However, the DCT data reveal that PRS speakers show variation in compression versus or truncation of the L boundary tone in ¡H* L% when there is no segmental material following the IP-final accented syllable. Figures 6 and 7 show the same utterance, ¿Se quieren callar? produced by two different speakers for the same context. In Figure 6, the speaker truncates the L% boundary tone. The phonetic realization shows that the F0 remains in suspension after the peak is reached for the ¡H* target. However, in Figure 7 the speaker produces both tonal targets in the ¡H* L% nuclear configuration, an example of compression.
Figure 6. Waveform, spectrogram and F0 trace for the biased (imperative) yes-no question ¿Se quieren callar? ‘Can you guys be quiet?’ produced with the prenuclear pitch accents: L*+H followed a ¡H* nuclear pitch accent and a truncated L% boundary tone. The ¡H* tone remains in suspension.
Figure 7. Waveform, spectrogram and F0 trace for the biased (imperative) yes-no question ¿Se quieren callar? ‘Can you guys be quiet?’ produced with the prenuclear pitch accents: L*+H followed a ¡H* nuclear pitch accent and a L% boundary tone. Both the ¡H* pitch accent and L% boundary tone are realized in IP-final stressed syllable in callar.

The data from DCT1 show that PRS speakers do in fact show a tendency with respect to truncation for a specific construction, the tag question. Most tag questions in PRS are candidates for truncation or compression simply because they tend to be either oxytones or monosyllabic (e.g. ¿OK?, ¿verdad?, ¿si?, ¿no?). Speakers tend to truncate the L% boundary tone in tag constructions. Figure 8 shows a tag question that a trained Sp_ToBI labeller might assign the nuclear configuration L* HH% or L+H* HH%, but this pitch shape is simply due to truncation. All speakers except the speaker from Ponce truncated categorically for tag questions. The Ponce
speaker realized 50% of her four tag questions as compressed\textsuperscript{7}. Figure 8 shows an example of the phonetic implementation of a tag question typical of those found in DCT1.

![Figure 8](image-url)

Figure 8. Waveform, spectogram and F0 trace for the tag question *Vienes a comer, ¿verdad?* ‘You’re coming to eat, right?’ produced with two intonational units: in the first unit we find the prenuclear pitch accent L*+H followed by a L+H* nuclear pitch accent and H- intermediate phrase (ip) boundary. The low boundary is truncated and the F0 maximum of the \( \hat{H}^* \) target is realized towards the offset of the IP-final stressed syllable in \( \hat{v}er\)dad? Were this a separate category the nuclear configuration might be described as L* HH\% in Sp_ToBI. It is labelled phonologically here, even though the L\% tone is truncated.

The phonetic implementations of the \( \hat{H}^* \) L\% nuclear configuration as a result of truncation merit further investigation.

\textsuperscript{7} Further evidence for the truncation rule in this variety was found in the child speech/child-directed speech corpus described in Chapter 4, coming from the fact that the perceptual tag question *¿ves?* (‘You see?’) is typically realized with L+H* HH\%, while the past tense version of this tag *¿viste?* never shows truncation. This supports the analysis that tag questions are underlyingly \( \hat{H}^* \) L\%, rather than one that proposes a rise specifically tied to the tag construction.
An additional type of phonetic variation was also observed in the data. Based on the data set, this phonetic variation seems to be regional: speakers from Lares and Mayagüez produced realizations of \( \text{\textipa{H}}^* \text{L} \% \) for which the L boundary tone was realized as a mid (M) tone. That is, the speaker does not realize the L tone at the baseline of her register as we might expect for a prototypical \( \text{\textipa{H}}^* \text{L} \% \) token. Native speakers of PRS, however, when asked about \( \text{\textipa{H}}^* \text{M} \% \), interpreted it as a good token of \( \text{\textipa{H}}^* \text{L} \% \), and described it as “just a question”. This phenomenon should not be confused with truncation – it occurs regardless of whether there is post-nuclear segmental material in IP-final position.

2.4.1.2. – Phonetic and phonological observations – \( \text{\textipa{L}}^* \text{HL} \% \)

The second most frequent contour identified in the data was labeled \( \text{\textipa{L}}^* \text{HL} \% \). This contour is characterized by a flat, low tone in the nuclear stressed syllable, with a subsequent rise-fall occurring in the post-nuclear material. This contour was not found to be subject to any sort of boundary tone truncation as was found for \( \text{\textipa{H}}^* \text{L} \% \).

Figure 9 shows a prototypical \( \text{\textipa{L}}^* \text{HL} \% \) example, taken from DCT2 – Part 1. This nuclear configuration is characterized as a flat, low tone in the nuclear stressed syllable followed by complex boundary tone: a rise and subsequent fall.

---

8 Examples from the child speech/CDS corpus show that all three tones of the contour are consistently realized even for monosyllabic utterances. There were no monosyllabic utterances with \( \text{\textipa{L}}^* \text{HL} \% \) in the adult corpus collected here.
Figure 9. Waveform, spectrogram and F0 trace for the biased incredulous question ¡¿Hay reunión mañana?! ‘There’s a meeting tomorrow?!’ produced with the initial prenuclear pitch accent L*+H followed by a L* nuclear pitch accent and HL% boundary tone.

The peak of the high target of the complex boundary tone HL% does tend to be relatively lower when compared to pre-nuclear H tones.

2.4.1.3. – Phonetic and phonological observations – H+L* L%

The least frequent contour in the corpus, labeled H+L* L%, is also characterized by an IP-final fall. However, this fall is different in terms of both height and alignment from ¡H* L%. Questions with H+L* L% may show a hat pattern, like that shown in Figure 9. In Figure 10, the F0 has already begun to fall in the pre-tonic syllable in the word piononos in the question ¿No hay por aquí un lugar que vende piononos?
Figure 10. Waveform, spectrogram and F0 trace for the biased question ¿No hay por aquí un lugar que vende piononos? ‘Isn’t there a piononos place around here?’ produced with the initial prenuclear pitch accent L*+H and following H* prenuclear pitch accent, followed by a L+H* nuclear pitch accent and H- intermediate phrase (ip) boundary. The nuclear pitch accent is realized as a fall throughout the nuclear stressed syllable two low target, H+L* and followed by a low boundary tone L%. 

Figure 11 shows an example of a H+L* L% question without a hat pattern. In this case, there is an initial rise in the L*+H prenuclear accent, and the F0 maximum of the utterance occurs on the stressed syllable on aquí. The F0 starts its decline once the maximum is reached, and continues to fall throughout the utterance until its end. This pattern is never found for ¡H* L% questions for example, they either continue to rise throughout the utterance until the extra-high tone is reached, or they show the same hat pattern.
2.4.2. Task-specific differences

2.4.2.1. DCT 1
As shown in Figure 4, there were differences in the frequencies of the contours depending on the task. In DCT1, ¡H* L% was by far the most frequent contour. The frequencies of H+L* L% and L* HL% combined make up just 6% of the data for DCT1. Table 3 shows the frequencies and raw data for DCT1:

Figure 11. Waveform, spectrogram and F0 trace for the biased question ¿No hay por aquí un lugar que vende piononos? ‘Isn’t there a piononos place around here?’ produced with the initial prenuclear pitch accent L*+H. The initial H tone is followed by two phonetically downstepped ¡H* prenuclear pitch accents, and finally the H+L* nuclear pitch accent. There is a low boundary tone, L%. 
<table>
<thead>
<tr>
<th></th>
<th>¡H* L%</th>
<th>H+L* L%</th>
<th>L* HL%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neutral (6)</td>
<td>93 (28/30)</td>
<td>6 (2/30)</td>
<td>0 (0/60)</td>
</tr>
<tr>
<td>Bias – focus (3)</td>
<td>100 (15/15)</td>
<td>0 (0/15)</td>
<td>0 (0/15)</td>
</tr>
<tr>
<td>Bias - Echos (4)</td>
<td>100 (20/20)</td>
<td>0 (0/20)</td>
<td>0 (0/20)</td>
</tr>
<tr>
<td>Bias – Echos (counter-expectation) (2)</td>
<td>50 (5/10)</td>
<td>0 (0/10)</td>
<td>50 (5/10)</td>
</tr>
<tr>
<td>Bias – tag (4)</td>
<td>100 (20/20)</td>
<td>0 (0/20)</td>
<td>0 (0/20)</td>
</tr>
<tr>
<td>Imperative questions (2)</td>
<td>100 (10/10)</td>
<td>0 (0/10)</td>
<td>0 (0/10)</td>
</tr>
<tr>
<td>Offers and invitations (3)</td>
<td>100 (15/15)</td>
<td>0 (0/15)</td>
<td>0 (0/15)</td>
</tr>
<tr>
<td>Rhetorical (1)</td>
<td>100 (5/5)</td>
<td>0 (0/15)</td>
<td>0 (0/15)</td>
</tr>
</tbody>
</table>

Table 3. Frequencies and raw data for DCT1, by question type

The first important observation that can be made from Table 3 is that ¡H* L% can be used across a variety of contexts. This is similar to Escandell-Vidal’s findings for the low-rise in Peninsular Spanish. It is used for both neutral and biased questions, and therefore it seems that Gunlogson’s (2003) claim about neutral interrogatives taking on the bias of the context would apply in the case of this contour. As Escandell-Vidal (1998) noted that even for Peninsular Spanish, yes-no questions in Spanish quite often do not show interrogative syntax (subject-verb inversion). This means that to make the declarative in (10a) a question, speakers often opt for the non-inverted (10c) rather than inverted (10b).

(10a) Ud. tiene sed. You (formal) have.3S.PRS thirst ‘You are thirsty.’

(10b) ¿Tiene Ud. sed? Have.3S.PRS you (formal) thirst Are you thirsty?
The fact that Spanish is a pro-drop language perhaps reduces the odds of finding surface preforms in yes-no questions, and therefore less inversion is found on the surface. But Caribbean Spanish and PRS in particular are known to prefer overt subjects (Villa-García et al. 2010). Word order has been shown to be less flexible than in Caribbean Spanish than in non-Caribbean Spanish, and preverbal subjects tend to be preferred (Villa-García et al. 2010, Navarro Tomás 1948; Cameron 1992; Toribio 1994, 2000; Ticio 2002, 2004; Martínez- Sanz 2008). This is not to say that null subjects and postverbal subjects cannot be found in PRS (Pérez-Leroux 1999, Ticio 2004). More rigid word order could lead to PRS speakers disfavoring inversion in yes-no questions. None of the questions in this experiment showed subject verb inversion, so intonation would have been the main cue to sentence type.

It was found that ¡H* L% can be used in both unbiased and biased situations, and for more specific intention types such as imperative questions, offers and requests. L* HL%, on the other hand, only appeared for one specific context type – counter-expectation questions. H+L* L% occurred in neutral contexts, but much less frequently than ¡H* L%. The results from DCT1 do not provide any clear tendencies for H+L* L%.

2.4.2.1. DCT2 – Part 1

There were four context types in DCT2, Part 1: neutral contexts, contexts containing evidence that ~p, contexts containing evidence that p and counter-expectation contexts. Table 4 presents the distribution of the three contours for DCT2 – Part 1.
Table 4. Frequency distribution (%) and raw data for DCT2 - Part 1, by question type

<table>
<thead>
<tr>
<th></th>
<th>¡H* L%</th>
<th>H+L* L%</th>
<th>L* HL%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neutral</td>
<td>84 (59/70)</td>
<td>16 (11/70)</td>
<td>0 (0/70)</td>
</tr>
<tr>
<td>Evidence for ~p</td>
<td>74 (52/70)</td>
<td>0 (0/70)</td>
<td>26 (18/70)</td>
</tr>
<tr>
<td>Evidence for p</td>
<td>71 (50/70)</td>
<td>6 (4/70)</td>
<td>23 (16/70)</td>
</tr>
<tr>
<td>Counter-</td>
<td>32 (22/70)</td>
<td>1 (1/70)</td>
<td>67 (47/70)</td>
</tr>
<tr>
<td>expectation</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The data are presented visually in Figure 12.

Figure 12. Visual distribution of contexts and contour types for DCT2 – Part 1.

¡H* L% was favored in all but one context type – counter-expectation. H+L* L% continued to show lower frequency, but like in DCT1, we find its main appearance in the neutral contexts. L* HL% is most used in the counter-expectation context, and in this task it was used even more frequently than ¡H* L% for that context. It does, however, appear relatively frequently in the evidence for ~p and the evidence for p contexts, but I will address this observation later in the chapter. DCT2 - Part 1, then, confirms the following findings from

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DCT1: ¡H* L% was the most commonly chosen contour, and was found for all discourse contexts, and L* HL% is most frequently found in counter-expectation contexts, though it is found in other contexts where the speaker has just acquired evidence for p or ~p.

2.4.1.1. DCT2 – Part 2

The results from the final task, DCT2, Part 2, are presented in Table 5, and visually represented in Figure 13.

<table>
<thead>
<tr>
<th></th>
<th>¡H* L%</th>
<th>H+L* L%</th>
<th>L* HL%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neutral</td>
<td>100 (28/28)</td>
<td>0 (0/28)</td>
<td>0 (0/28)</td>
</tr>
<tr>
<td>Inner negation</td>
<td>79 (22/28)</td>
<td>0 (0/28)</td>
<td>21 (6/28)</td>
</tr>
<tr>
<td>Outer negation</td>
<td>57 (16/28)</td>
<td>43 (12/28)</td>
<td>0 (0/28)</td>
</tr>
</tbody>
</table>

Table 5. Frequency distribution (%) and raw data for DCT2 - Part 2, by question type
Again, the most commonly chosen contour was \( \text{iH}^* \text{ L}\% \), appearing in all contexts. What was especially telling in this task was that while \( \text{H} + \text{L}^* \text{ L}\% \) did not appear for the neutral or inner negation contexts, it did appear in the outer negation context, where the speaker had a prior belief that \( \text{p} \). \( \text{L}^* \text{ HL}\% \) never appeared in this context, though it did appear in the inner negation contexts much like in DCT2 – Part 1, where it appeared in contexts with evidence for \( \neg \text{p} \). When \( \text{iH}^* \text{ L}\% \) appeared for the inner negation context, it was often phonetically modified such that the \( \text{iH}^* \text{ L}\% \) was produced in a very high level in the tonal space. Native speakers who listened to these phonetically modified utterances felt that this modification indicated surprise on the part of the speaker.

This task again confirms the malleability of \( \text{iH}^* \text{ L}\% \) in terms of where it appears. It also provides new evidence for a meaning of \( \text{H} + \text{L}^* \text{ L}\% \). The data suggest that while the \( \text{iH}^* \text{ L}\% \)
contour can be used for both inner and outer negation, the same is not true for H+L* L%. It can only be used for outer negation. That indicates that the meaning of H+L* L% is somehow related to a positive belief state on the part of the speaker, i.e. that at the time of the utterance the speaker is able to convey a belief that p. A working hypothesis is that H+L* L% works as an intonational morpheme conveying the feature [+belief], and this guides the speaker in terms of the scope of negation in outer negation contexts.

What can be determined overall from the quantitative analysis is that: 1.) ¡H* L% is produced in all discourse contexts in this production study, 2.) L* HL% is used in counter-expectation situations as well as situations where the speaker has just come to know some information (that were not necessarily designed to elicit counter-expectation) and 3.) H+L* L% appears in contexts designed to be neutral, but the context where H+L* L% was most reliably found was in the outer negation context.

2.5. Discussion

The data elicited from three tasks in this production study show that the three most common contours within the yes-no question domain in PRS are ¡H* L%, H+L* L% and L* HL%, the most common contour being ¡H* L%. This contour is the most common across almost all discourse contexts. In her analysis on Peninsular Spanish, Escandell-Vidal (1998) claims that the fall-rise contour is the "more basic example of an interrogative", which represents the "default" contour for yes-no questions. This "unmarked contour," notes Escandell-Vidal, is felicitous for all possible interpretations for interrogative utterances. In Peninsular Spanish (or at least the variety being described by Escandell-Vidal), the unmarked contour is a fall-rise (L* HH% according to Estebas-Vilaplana & Prieto 2010). PRS also has a contour that appears to be
the default tune for interrogativity, and it corresponds to a rise-fall that is labeled \( \text{¡H}^* \text{ L}\% \). This contour was found for all of the contexts investigated in the corpora and occurred most frequently in the corpus, it and is the contour that shows the most phonetic variation (i.e. it has many allotonic variants). The variety in phonetic realizations found for \( \text{¡H}^* \text{ L}\% \) due to truncation confirms Grabe et al.’s conclusion that as a direct result of truncation, very different F0 patterns need to be analyzed as realizations of a single phonological category. At the same time, such cases need to be distinguished from others that reflect a genuine difference in phonological representation. Information about whether a particular variety is truncating or compressing can be vital when decisions about phonological category membership are made (p. 162). Grabe et al.’s conclusion holds for PRS, since the surface forms show cases of F0 suspension (as in Figure 6) as well as high rises (as in Figure 8). Quilis’ negation contour, in fact, appears to simply be a case of truncation. All examples provided by Quilis for the contour are truncation candidates, since all show IP-final stressed syllables. D’Imperio (2002) has also categorized Southern dialects of Italian as either “truncating” or “compressing”. But PRS shows that within one variety, the same speaker may either compress or truncate. Cabrera Abreu & Vizcaíno Ortega (2010) also show evidence that Canary Islands speakers have the choice to compress or truncate in yes-no questions. These findings are in line with the findings of Prieto & Ortega-Llebaria (2009) for both speakers of Peninsular Spanish and Central Catalan, who observed that some speakers within the same dialect simply truncated more than others. The constraints on these choices are still unknown, however. It is possible that very subtle nuances, attitude or register may drive this choice, given that PRS speakers judged truncated examples as "more inviting" or
"innocuous". This rule, which is based on prosodic environment, was not identified for L* HL% or H+L* L%.

Additional phonetic variants of ¡H* L% (unrelated to truncation) were found for biased contexts when a speaker is surprised about the propositional content s/he is questioning. Pitch scaling may be manipulated so that the ¡H* is realized at an even higher F0 value. Additionally, there was regional variation identified showing undershoot of the L% boundary tone for speakers from Lares and Mayagüez.

Turning to the non-default contours, there seems to be a relatively consistent relationship between L* HL% and counter-expectation, though ¡H* L% seems to also be an option in counter-expectation contexts. When ¡H* L% is found in counter-expection contexts, pitch expansion was often found for the ¡H* pitch accent. L* HL% is also found in other contexts where the speaker has just learned information. Even though some of those contexts were not designed to look specifically at counter-expectation, the fact that the contexts included information that would have been “newsworthy” to the speaker means that speakers may have simply put themselves in the situation, and decided that the new information was not expected. For example, in situation D4 in Appendix C, the speaker has been talking with a friend about a couple, Carlos and Marina. The speaker is informed that Carlos wants to break up with Marina due to the fact that she lives so far away, in Aguada. The speaker then confirms ¿Marina vive en Aguada? Some speakers produced this with L* HL%. If we accept that L* HL% is indeed associated with counter-expectation in this variety of Spanish, then it would simply be the case that when the the participants imagined the context, they imagined the fact that Marina lived so far away was incongruent with a prior belief about when she lived, and therefore produced L*
Because this was a production study, a certain amount of variation was expected. Native speaker feedback on the use of either of these tunes helped to identify the difference in contour choice in the following context:

(9) Contexto: Siempre vas a la misma tienda para desayunar, y en esa tienda siempre hay dos tipos de empanadilla: de queso y de carne. Un día entras y ves que hay una nueva etiqueta que dice 'empanadilla de guayaba'. Miras a la mujer que te atiende y le preguntas:

¿Hay empanadilla de guayaba? (L* HL%)

Context: You always go to the same place for breakfast, and they always have two types of turnovers: cheese and meat. One day you enter and see that there is a new label that says "guayaba turnovers". You look at the woman waiting on you and ask:

There are guayaba turnovers? (L* HL%)

Five native speakers of PRS were consulted during the analysis. Many commented that using a ¡H* L% with expanded pitch rather than L* HL% would be less rude (i.e. indicating surprise but not "doubt"). One way of interpreting this observation is that in surprise questions, the speaker simply conveys that the propositional content is not expected, an example of bouletic epistemicity. As Sudo (to appear) points out, epistemic bias does not have to be based on belief state. The use of ¡H* L% with expanded pitch range is thus probably not related to belief state, but to expectations. The native speaker comments get at a “doubt” interpretation of L* HL%, referencing a speaker’s disbelief about propositional content. This would explain why the contour might be considered rude, since the speaker would then be implying that she did not believe the woman at the store. Through L* HL% the speaker is able to call attention to her disbelief that p at the time of the utterance. Both surprise and disbelief require the speaker to juxtapose previous epistemic attitudes towards the proposition (expectations, beliefs, etc.) to some recently acquired knowledge (e.g. surprise – p does not belong to my set of prior expectations; disbelief – p does not belong to my prior set of beliefs, and it is incongruent with
my prior set of beliefs). In addition to the disbelief element, I would also like to suggest that a deontic interpretation of \( L^* \) \( HL% \) based on the example in (9). The doubt interpretation may also convey the speaker’s evaluation of propositional content based on rules or norms. The norm is that the empanadillas are meat or cheese, and finding that there are guayaba turnovers violates this norm, and the speaker can call attention to this through \( L^* \) \( HL% \). Importantly, phonetically modified \( \overset{!}{H^*} \) \( L\% \) (pitch expansion) and \( L^* \) \( HL\% \) in general have in common that contextual evidence is necessary for their licensing. That is to say, surprise/counter-expectation/doubt/disbelief/norm-violating questions can only be uttered when their propositional content has just been activated (whether it be linguistically or extra-linguistically) in the discourse context.

The meaning of \( H+L^* \) \( L\% \) was more difficult to pin down, but using many discourse contexts proved to be telling. In DCT1, there was no clear indication of \( H+L^* \) \( L\% \)’s meaning, or even if it was simply a less-used option to \( \overset{!}{H^*} \) \( L\% \) in neutral contexts. For example, the latter seemed to be the case based on DCT2 – Part 1 as well (it was used for 16% of the questions that were supposed to be neutral contexts). DCT2 – Part 2, however, showed that \( H+L^* \) \( L\% \) was much more predictable in contexts where the speaker had an epistemic bias, to use Sudo’s (to appear) term, for p. There were also differences in terms of verbal morphology and negative vs. positive polarity items in DCT2 – Part 2. The examples in (11a)-(11c) show these differences:
(11a) Tu amigo: Te quiero llevar a comer comida típica de Puerto Rico. ¿Qué quieres comer?
Your friend: I want to take you out to eat traditional Puerto Rican food. What do you want to eat?

Tú: ¿Hay por aquí algún lugar que venda piononos? Es que me encantan los piononos.
You: Is there a place that sells piononos? It’s just that I love piononos!

(11b) Tu amigo: Vamos a tener que ir a Piñones para comprar piononos. En este barrio va a ser difícil.
Your friend: We're going to have to go to Piñones to buy piononos. It'll be difficult in this neighborhood.

Tú: ¿Por aquí no hay ningún lugar que venda piononos?
You: Isn't there a place that sells piononos around here?\(^9\)

(11c) Tu amigo: ¿Dónde quieres comer esta noche?
Your friend: Where do you want to eat tonight?

Tú: (Crees que hay cerca un lugar que vende piononos) ¿No hay por aquí un lugar que venda piononos?
You: (You think that there's a place nearby that sells piononos) Isn't there a place that sells piononos around here?

The unbiased context in (11a) shows the indefinite demonstrative algún ('some') as well as the use of subjunctive, indicating that the speaker does not know whether the piononos place exists. Thus this is a non-assertion of the proposition, \( p \). In (11b) the negative indefinite ningún (in this case, 'any') appears with the subjunctive. Here the speaker has inferred ~\( p \) from the context and wants the hearer to ratify that ~\( p \). Finally, in (11c) the speaker uses algún with the indicative, making evident that in the mind of the speaker, the piononos place exists. While the default question-marking ¡H* L% could be found for all three contexts, H+L* L% was very

\(^9\) Although this is the typical use of inner negation questions in Ladd (1981), this is not something I would say as a native speaker of American English. In my opinion, the declarative question 'There's no place that sells piononos around here?' would be much more natural. The outer negation interpretation is the only possible interpretation for me with this syntax.
obviously restricted to the outer negation context like that in (11c). Romero & Han (2002) referred to Ladd's outer negation questions as having a *positive epistemic implicature* while Sudo similarly describes outer negation questions as having positive epistemic bias. The fact that the H+L* L% contour was reliably elicited through the outer negation context is key in teasing out the linguistic information encoded H+L* L%. The example in (11c) also demonstrates that there need not be information in the context directly referencing the proposition. The crucial piece of information in (11c) was *crees que hay un lugar cerca que vende piononos* ‘you think there’s a place nearby that sells piononos’, and not anything in the context such as linguistic or visual cues. It seems then, that contour choice may be activated by the speaker’s prior beliefs about a proposition that are made public by means of the contour. The data show that when H+L* L% is used in a question with the particle *no*, it affects the scope of that particle – the proposition does not fall under its scope. It should also be pointed out that contexts for which participants received evidence that ~p in DCT2 – Part 1 were essentially inner negation contexts as well, and speakers never chose H+L* L% for those questions. It seems that the H+L* L% contour conventionally conveys epistemic information about the speaker belief state, i.e. the speaker believes that p, and when there is negation present this should give the speaker information about its scope.

H+L* L% is most likely the negation contour that Sosa (1999) describes in his data. His fundamental distinction between two yes-no question contours was based on an additional rise for neutral questions versus the lack of an additional rise for negative questions that expect a *sí* or *no* answer. As I showed in Figures 10 and 11, the fall for H+L* L% typically starts in the pre-tonic syllable (Figure 10), or earlier (Figure 11). Both Sosa’s and my analyses agree in that this tune conveys a biased question. But Sosa claims that the negation contour indicates a bias for
either a negative or positive answer. The outer negation examples suggest that \( H+L^* L^\% \) is restricted to expecting a positive answer, since it was never used in inner negation contexts, which expect a negative answer. Furthermore, even when negation is present, the propositional content does not fall under its scope, and therefore a positive answer is expected. The polarity of the expected answer is not open to \( \text{sí} \) or \( \text{no} \) as suggested by Sosa.

\( H+L^* L^\% \) was also identified for questions without a negative particle in DCT1 and DCT2 – Part 1. The question in (12) was intended to show the speaker’s desire for her guests to attend the dinner:

(12) Organizaste una comida y decides cambiar la fecha para que todos los invitados puedan ir. Pregúntales si van a poder venir si la comida es el primer domingo de mayo. 
\( \text{¿Pueden venir a la comida, si la hacemos el primer domingo de mayo?} \)

You organized a dinner and you want to change the date so that everyone can come. Ask them if they can come to the dinner if you do it the first Sunday in May. 
\( \text{Can you guys come to the dinner if we have it on the first Sunday in May?} \)

This could be considered a bouletic use of \( H+L^* L^\% \), i.e. the speaker really wants (desires) the hearer to come. As Sudo pointed out, his general category of epistemic bias can be used for both beliefs and desires. It seems that \( H+L^* L^\% \) can convey \(+belief\) or \(+desire\) (or both). This example also provides evidence for \( H+L^* L^\% \) use with no negative particle present, as claimed by Sosa.

Differently from \( L^* HL^\% \), the context for which \( H+L^* L^\% \) was most often found did not require contextual evidence, in the terms of Büring and Gunlogson (2000), but rather a prior belief that \( p \). If speakers were truly intending to convey a bias that \( p \) in the neutral contexts when \( H+L^* L^\% \) was found, then there is reason to assume that no contextual evidence is necessary for \( H+L^* L^\% \) to be licensed. This observation indicates that the terms "information-seeking" and
"confirmation-seeking" questions, that are commonly used in studies of intonational phonology, are not fine-grained enough to account for contour choice in the yes-no question domain in PRS. All three contours can be found in generally “confirmation-seeking” contexts. For instance, the questions shown in examples (11b) and (11c) are both confirmation-seeking, but H+L* L% is only elicited in (11c). The directionality of the belief in (11c) is positive, and not activated by discourse context. These facts are relevant for the speaker’s contour choice, but would be lost if we were to only consider the information-seeking vs. confirmation-seeking distinction. The driving factor in contour choice is not only whether or not the question confirms information, but also the speaker’s epistemic state with respect to the propositional content.

Büring & Gunlogson’s notion of Contextual Evidence (and in turn, evidential bias) is useful to describe contour choice within the PRS yes-no question domain. ¡H* L% itself does not encode any bias, but with contextual evidence, it will have evidential bias. However, while contextual evidence would contribute to biased interpretations of ¡H* L%, it is not a licensing condition for it. Epistemic bias is not encoded linguistically for ¡H* L%, unless it is phonetically modified (¡H* pitch accent produced higher in tonal space) in surprised contexts. In this case, contextual evidence would be part of the licensing conditions. The combination between the phonetic modification and the contextual evidence would lead to a surprised interpretation, a type of bouletic epistemic bias related to the speaker’s level of expectedness.

The production data, especially from DCT2 – Part 2, suggest that H+L* L% is possible when the speaker has a private belief that was formed prior to the discourse context. Contextual evidence is not necessary for H+L* L% licensing. Of course, some sort of contextual evidence must have been necessary for the speaker to form the belief, but that evidence can be discourse-
old (Prince 1981), and does not require contextual evidence. This was most clear in outer negation contexts, though the contour appeared in questions where there was no negation. Like the particle *desho* in “positive polar questions” described by Sudo, no contextual evidence is necessary to license H+L* L%. Based on the data here I propose that H+L* L% encodes interrogativity in addition to epistemic bias.

Finally, L* HL% encodes incredulity, rather than surprise. This contour differs from both \(\hat{H}^* L\%\) in that it is contextually activated, and therefore evidential bias is part of its licensing conditions. However, epistemic bias is also conventionally conveyed, since by choosing L* HL% the speaker conveys *disbelief* with respect to the propositional content. This disbelief holds at the time of the utterance. This conventional meaning differs from surprise questions for which the speaker only conveys information about the expectedness of the p, rather than disbelief.

Table 6 shows the licensing conditions and the type of information linguistically encoded in \(\hat{H}^* L\%, H+L^* L\%\) and L* HL%. The table shows the contour, whether it is licensed by something activated in the context, whether it marks interrogativity and its specifications with respect to bias.
Table 6. Proposed licensing conditions and information encoded for yes-no question contours

<table>
<thead>
<tr>
<th></th>
<th>Contextually Dependent?</th>
<th>Marks interrogativity</th>
<th>Bias</th>
</tr>
</thead>
<tbody>
<tr>
<td>¡H* L%</td>
<td>No</td>
<td>Yes</td>
<td>None in neutral contexts, takes on bias with context</td>
</tr>
<tr>
<td>H+L* L%</td>
<td>No</td>
<td>Yes</td>
<td>[+positive]</td>
</tr>
<tr>
<td>L* HL%</td>
<td>Yes</td>
<td>Yes</td>
<td>[-positive] belief</td>
</tr>
</tbody>
</table>

Table 7 summarizes the differences between surprise questions and incredulity questions:

<table>
<thead>
<tr>
<th></th>
<th>Contextually Dependent?</th>
<th>Marks interrogativity</th>
<th>Bias</th>
</tr>
</thead>
<tbody>
<tr>
<td>¡H* L% (+expanded pitch range)</td>
<td>Yes</td>
<td>Yes</td>
<td>[-positive] expectedness</td>
</tr>
<tr>
<td>L* HL%</td>
<td>Yes</td>
<td>Yes</td>
<td>[-positive] belief</td>
</tr>
</tbody>
</table>

Table 7. Licensing conditions and information encoded for surprise vs. incredulity questions

The three phonological contours differ in their licensing conditions as well as what sort of information is conveyed through the contour. PRS has a default contour ¡H* L%, which has been claimed for both American English (Gunlogson 2003) and Peninsular Spanish (Escandell-Vidal, 1998). The other two phonological contours encode more than just interrogativity since they both encode epistemic information. L* HL% is more restricted than H+L* L%, however, since if the
conventional meaning of L* HL% is incredulity/disbelief, it will always depend on contextual evidence. The contextual evidence must become available in the discourse context just prior to the utterance, imposing an additional temporal restriction. Incredulous questions share this licensing condition with surprise questions, but the specific epistemic value differs. The contours that linguistically encode information about epistemic evaluations are quite similar to Escendell-Vidal’s (1998) attributed interrogatives, which she describes as having two degrees of interpretiveness, encoding instructions to be processed not just as an interrogative but also as encoding a thought interpreted by the speaker as the thought of another individual. In PRS, however, the information encoded in addition to interrogativity is speaker-oriented for both the case of H+L* L% and L* HL%. This notion of “complexity” is discussed Asher & Reese’s (2005) account of complex speech acts, as well as Cohen’s (2007) claims about multidimensionality for incredulity questions. The production results indicate that H+L* L% and L* HL% are more complex than ¡H* L% in terms of the amount of information that is both conveyed and processed by the hearer in PRS. When speakers choose a contour that is not the default contour for yes-no questions, this seems to be motivated by epistemic bias. The type of epistemic bias is further restricted by belief state and at times, contextual evidence.

2.5.1 Implications for intonational dialectology

A clearer idea of the pragmatic division of labor for PRS questions also allows us to compare PRS with other varieties of Spanish that have been shown to use falling question contours. Sosa identifies utterance-final falls for questions as a unifying feature among Caribbean dialects, and as additional evidence for a Caribbean dialect zone. Tejera (1999) cites Cuba, Puerto Rico, the Dominican Republic, Veracruz (México), Panamá, Cartagena,
Barranquilla and the rest of the Colombian coast and most of Venezuela as being part of an area that shares many linguistic features - lexically, morpho-syntactically, phonetically and prosodically. Another geographical area that has been known to share features with these coastal or Caribbean varieties is the Canary Islands, both segmentally, (cf. Almeida 1989; Alvar 1969, Catalán 1960, 1964; Samper Padilla 1990) and suprasegmentally (Sosa 1999; Quilis 1987, 1993). Additionally, there were villages in Puerto Rico, that as a result of waves of immigration from the Canary Islands, were made up of relocated Canary Islanders alone (Alvarez Nazario 1972) and as Lipski (n.d.) notes, even speakers of some Caribbean speech communities may mistake a speaker of Canary Island Spanish for a Caribbean speaker. Therefore we might expect to find intonational similarities between Canary Islands Spanish and PRS as well.

The final rise-fall movement found in some phonetic realizations of .Encoding.h* L% in PRS is in line with the "characteristic Caribbean circumflex pattern" described by Sosa. The phonetic implementations Sosa shown for Caracas and La Habana Spanish would correspond to the  encoding.h* L% configuration I have described here. Mendez's (unpublished Ms) characterization of Caracas Spanish also confirms an extra-high nuclear pitch accent followed by a fall to a low boundary. The contour seems to be common for other costeño varieties as well: Armstrong (unpublished manuscript) found that unbiased yes-no questions in San José Costa Rican Spanish also show a phonetic realization that would pertain to the  encoding.h* L% category, and Hualde & Schwegler (2007) show a similar contour for questions for the Spanish creole, Palenquero, spoken in San Basilio del Palenque, Colombia. Cabrera Abreu and Vizcaïno Ortega (2010) claim that most yes-no questions in Canary Islands Spanish are produced with the prototypical Caribbean extra high nuclear pitch accent (¡H*, in their account) followed by a sharp fall to a low boundary tone
(L%), ¡H* L%. In their account, ¡H* L% was found for biased and unbiased yes-no questions and imperative questions. Canary Islands Spanish also behaves like PRS in terms of phonetic implementation. As noted above, Cabrera Abreu & Vizcaíno Ortega show evidence that Canary Islands Spanish speakers, like PRS speakers, have the option to truncate or compress the L% for ¡H* L% as well

While it seems that with the exception of truncated contours, PRS yes-no question intonation tends to be falling, this is not the case for all Caribbean varieties. For instance, Willis (2004) describes a rise from a low nuclear pitch accent that reached a post-tonic peak and then a high plateau or very slight fall for unbiased yes-no questions in Cibaeño Dominican Spanish. This yes-no question contour described for Cibaeño Dominican speakers differs from typical Caribbean contours in that it is: 1.) globally rising 2.) there is no presence of a sharp fall (fall is of "much lesser magnitude" than the tonal fall from a nuclear high tone to a low boundary) and 3.) there is no high tone in the nuclear pitch accent. In the same corpus, however, Willis does find examples of the typical Caribbean final fall from a High nuclear pitch accent, and suggests that there is a pragmatic difference between the two very different contours in his data. Figure 14 shows the contrast between Cibaeño yes-no questions and typical Caribbean questions as depicted by Willis (2004):

---

10 Quilis (1993) also references IP-final suspension in Canary Islands Spanish, calling it a third option of realizing unbiased yes-no questions in Canary Islands Spanish. However all examples provided by Quilis are truncation candidates.
However, in a later description of Cibaeño Dominican Spanish, Willis (2010) finds an overwhelming preference for the H+L* L% nuclear configuration for yes-no questions (both biased and unbiased). Willis describes the H+L* L% nuclear configuration for this variety as a fall through the tonic syllable that reaches a low target at or before the syllable boundary. He also notes a phonetic implementation for this nuclear configuration such that the valley could be reached at the tonic syllable midpoint\textsuperscript{11}. Willis shows evidence for final rises in Cibaeño Dominican Spanish yes-no questions as well just as he had found in the earlier 2004 study, showing evidence for the H+L* H% configuration for unbiased yes-no questions, echo questions and counter-expectational echo questions, as well as L+H* M% for invitation questions. In fact, for all question types except for invitations, it seems that Cibaeño speakers have the choice between H+L* L% and H+L* H%. What allows speakers to choose between a final fall versus a final rise is still unknown. It seems likely that boundary choice would depend on some pragmatic difference that was not clear in Willis' data. Like Cibaeño Spanish, Granadino Spanish too opts

\textsuperscript{11} Anecdotally, I have noticed that in San Juan, where immigration is mainly from the Dominican Republic, that Dominicans produce H+L* L% in contexts where PRS speakers would produce ¡H* L%, most notably echo and tag questions. One Puerto Rican informant reported that los dominicanos siempre dicen ¿Es verdad? (H+L* L%), showing that H+L* L% for non-belief-encoding yes-no questions may be an indexical feature that Puerto Ricans use to identify speakers as Dominican.
for the H+L* L% nuclear configuration to encode both unbiased and biased yes-no questions (Chapell, 2011).

Recent work by García Riverón et al. (2010) shows that La Habana Cuban Spanish is perhaps similar to PRS in how epistemic bias is or isn't encoded by nuclear configuration. Their data suggest that La Habana Cuban Spanish has the same ¡H* L% vs. H+L* L% distinction for questions as I have described for PRS, with strikingly similar pragmatic restrictions. The example of a "interrogación neutral sin pronombre o adverbio interrogativo" from Rivera and her colleagues shows a rise to an extra-high tone in the nuclear stressed syllable followed by a fall to a low boundary tone, while their "interrogación de comprobación" shows the rise in the pre-tonic syllable followed by a fall throughout the nuclear stressed syllable.

Within Caribbean and costeño dialects, varieties often times differ in terms of whether the low target is reached within the nuclear stress syllable, or as a boundary tone. Table 8 shows a comparison of the falls found for seven Caribbean/costeño dialects according to the accounts mentioned in this section. "Default" indicates that the contour marks questionhood and may take on other contextually activated meanings, "biased" indicates the contour has epistemic restrictions and "not reported" indicates that the contour has not yet been reported within the domain of yes-no questions in the variety.
Table 8 indicates shows that PRS and La Habana Cuban Spanish are the only two varieties that pragmatically distinguish between two falling questions, though I suspect there are other dialects that exploit such a contrast. It is also of interest that PRS is the only variety reported to use L* HL% to indicate incredulity. While Canary Islands Spanish marks incredulity using L* HH% and Granadino Spanish marks incredulity with L+H* L%, no other dialect has been reported to use L* HL% for this meaning. It is possible that this contour, when used within the yes-no question domain, could provide speakers of other Caribbean dialects with indexical information about Puerto Ricans.

12 Willis (p.c.) notes that two falls were actually found in his 2004 study which would probably correspond to H*+L L% and H+L* L%, suggesting that this variety of Dominican Spanish also exploits two fall types for marking pragmatic differences within the yes-no question domain.
2.6. Conclusions

In this chapter, I have described the three most common phonological nuclear configurations found within the yes-no question domain in PRS, as well as their pragmatic meanings based. The study adds to the existing body of evidence that language varieties use intonation in different ways based on intentions and context, but also belief states. The methodology used here allowed me to get at such fine-grained distinctions. The types of distinctions that show categorical phonological differences will differ by language variety, as we have seen for languages like European Portuguese (Santos & Mata, 2008) or Majorcan and Minorcan Catalan (Payà & Vanrell 2005). Therefore, while the materials used here were helpful for this particular variety of Spanish, researchers may need to continue to adapt their materials in order to truly pinpoint the distinctions that are encoded in the specific variety they are investigating. On the other hand, if the pragmatic division of labor is clear using the existing materials used in this dissertation, it certainly facilitates comparative work.

Through this production work, I have confirmed that PRS uses a default contour that marks interrogativity, and can be found across many contexts and intention types. Ñ H* L% has a default unbiased yes-no question meaning, but we would expect it to preserve contextual bias in biased contexts, taking on evidential bias. It is also the yes-no question contour that shows the most variation in phonetic implementation, possibly due to the fact that it is used more frequently\(^\text{13}\). I have also shown two other contours that encode more information than interrogativity alone. In this way the two contours that convey epistemic information would be

\(^\text{13}\) Though we cannot take the production study to be representative of spontaneous speech since it was designed to elicit specific contexts, it is still reasonable to assume that because Ñ H* L% can be used in more contexts and is the default contour, that it would be the most frequent contour found in spontaneous speech.
categorized as “attributed interrogatives” within Escandell-Vidal’s (1998) account, since they encode instructions for processing the utterance as an interrogative, but they also encode a representation of a thought of the speaker. In this case it is the speaker’s own belief that drives contour choice (rather than another individual’s belief or thought, as in the Peninsular Spanish case described by Escandell-Vidal). As will be shown later in the dissertation, these differences have implications for the acquisition of form and meaning in PRS. The data from this production study are sufficient to propose a blueprint of the yes-no question intonation system for PRS, but it is also necessary to test the proposed meanings from a hearer’s point of view, taking into consideration the presence/absence/type of contextual evidence (which in turn would or would not generate evidential bias), as well as speaker belief states. Understanding the sorts of factors that drive contour choice, but also how the contours are perceived in context by hearers, will give us a full picture of the underpinnings of this system in order to make more precise predictions for its acquisition.

Finally, I have provided an overview of how PRS compares to other dialectally similar varieties of Spanish. Caribbean dialects have always been seen as "radical" because they do not mark questions with the fall-rise we see in Castilian Spanish or Mexican Spanish (Sosa, 1999). Not only does Canary Island Spanish encode questions with a final rise-fall, but other costeño dialects do as well. I suspect that many more dialects apart from the ones described here show a default final rise-fall to encode questions. For instance Cantabrian, Buenos Aires and Venezuelan Andean Spanish (Prieto & Roseano, 2010) all show final falls to mark yes-no questions. As more descriptions of the intonational systems of different Spanish varieties emerge, the less radical Caribbean dialects seem. Interestingly, PRS seems to mark incredulity through an overt
intonational morpheme, something that is not typically found for varieties of Spanish. In this sense PRS is more like Brazilian Portuguese. The findings from this production study demonstrate well how different degrees of information may be linguistically encoded by means of intonation within one sentence type, yes-no questions. These differences were successfully elicited using the DCT methodology. The production data reported allowed me to put together a more detailed snapshot of the intonational system of yes-no questions in PRS. The meanings I identified in this chapter are tested from a hearer perspective in Chapter 3.
CHAPTER 3: THE EFFECT CONTEXT AND CONTOUR ON PERCEIVED BELIEF STATE IN PUERTO RICAN SPANISH YES-NO QUESTIONS

3.1 Introduction and goals

The overarching goal of this dissertation is to discover how children learning Puerto Rican Spanish (PRS) as their first language acquire the intonation patterns associated with yes-no questions in this variety. I assume that PRS-acquiring children are not only developing the ability to become adult-like speakers of PRS, but also that they are developing the ability to become adult-like hearers of PRS. Becoming an adult-like hearer involves developing the ability to attribute a state of belief to a speaker by drawing on both contextual and linguistic cues in that way that adults do. In order to understand the system the PRS-acquiring child is targeting as a hearer, it is necessary to understand how adults depend on intonation and discourse context in order to infer the belief state of their interlocutors. With this in mind, there are two main goals for this chapter: 1.) to test the epistemic values attributed to ¡H* L%, H+L* L% and L* HL% as discussed in Chapter 2 and 2.) to understand how these epistemic values (or lackthereof) interact with discourse context. Answering these questions will not only provide a better picture of the system architecture for yes-no question intonation that the PRS-acquirer would be targeting, but should also provide experimental evidence for how hearers use intonation and context when perceiving the belief state of the speaker.

In the Chapter 2 I focused on three contours: ¡H* L%, H+L* L% and L* HL%, and the pragmatic restrictions governing how speakers choose them based on production data. A general overview of the most commonly used contours for yes-no questions in PRS is shown in Table 9:
Table 9. Pragmatic restrictions for \(\hat{H}^* L\%\), \(H+L^* L\%\) and \(L^* HL\%\)

<table>
<thead>
<tr>
<th>Marks interrogativity</th>
<th>Contextually Dependent?</th>
<th>Bias</th>
</tr>
</thead>
<tbody>
<tr>
<td>(\hat{H}^* L%)</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>(H+L^* L%)</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>(L^* HL%)</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

There are three basic notions that were central to my analysis of PRS questions in Chapter 2: **CONTEXTUAL EVIDENCE**, **EVIDENTIAL BIAS** and **EPISTEMIC BIAS**. **CONTEXTUAL EVIDENCE** is defined as “evidence that has just become mutually available to the participants in the current discourse situation” (Büring & Gunlogson 2000:7). **EVIDENTIAL BIAS** is the bias that arises as a result of this contextual evidence. Sudo (to appear) argues for the need to distinguish between two categories of bias (evidential vs. epistemic), rather than just one as proposed in Büring & Gunlogson. This distinction is shown in Table 10:

Table 10. Sudo’s evidential vs. epistemic bias, with definitions

<table>
<thead>
<tr>
<th>Bias</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Evidential</td>
<td>About contextual information available to all conversational participants; inherently public</td>
</tr>
<tr>
<td>Epistemic</td>
<td>Rooted in private belief on the speaker’s part; need not be shared by other conversational participants</td>
</tr>
</tbody>
</table>
Having two categories of bias also helps us to understand the use of intonation within the yes-no question domain, especially if we consider Gunlogson’s (2003) claim that interrogatives are only neutral when produced in a neutral context, but preserve the bias of the context when they are produced in a biased context. The production data in Chapter 2 showed that the nuclear configuration ¡H* L% can be used for many discourse contexts, suggesting its use as a general marker of interrogativity in PRS, much like the fall-rise described by Escandell-Vidal (1998) for Peninsular Spanish. Escandell-Vidal claimed the fall-rise was the “default” marker for interrogativity in that variety. The other two contours I discussed in Chapter 2, H+L* L% and L* HL%, appeared to have more restricted uses, encoding more than just interrogativity (Table 10). The production results suggested that those contours encode epistemic information, while ¡H* L% does not. This situation is interesting in light of Gunlogson’s claim that neutral interrogatives take on contextual bias. We would expect Gunlogson’s claim to hold for the case of ¡H* L%. If ¡H* L% only codes interrogativity, it should be perceived as neutral in neutral contexts, but biased in the presence of contextual evidence. This differs from the epistemic contours. If bias is encoded in the contour, then they should always be perceived as biased regardless of the presence of contextual evidence (though contextual evidence must be present for L* HL% to be uttered). While on the one hand we would expect contextual evidence to affect perceived bias when ¡H* L% is heard in the presence of contextual evidence, how might context affect the interpretation of the two epistemic contours? If it could be shown that the effect of context is different for contours that already encode epistemic bias, this would support Sudo’s two categories of evidential and epistemic bias. Showing how all three contours are perceived in
neutral contexts would also confirm the type of information linguistically encoded, i.e. it would allow me to identify the default meanings of the contours.

3.1.1. Context and linguistic forms

It is well known that discourse context may modify how speakers use and interpret linguistic forms. During the process of anaphora resolution, for example, a hearer must be able to correctly assign a referent to a pronoun (McDonald & McWhinney, 1995) in a given discourse situation. This referent may be activated linguistically or extra-linguistically, as in (12a) and (12b):

(12a) John’s really having a good year. Four of his articles came out last month.
(12b) A and B looking at a sleeping baby.
A: He’s been sleeping through the night lately.

In both (12a) and (12b), the hearer is able to resolve the referents of “his” and “he” using information that has been activated linguistically in the case of (12a), since John is explicitly mentioned. In (12b) since both speakers are looking at the same baby (joint attention) they share the knowledge that the baby is the topic of discussion, is male, etc. The meanings of the linguistic forms are therefore accessible in the discourse context, whether the information is discourse old or discourse new (Prince 1981).

In the same vein, linguistic forms like epistemic modals encode information about a speaker’s assessment of how probable or predictable a proposition (p) is, giving us information about a speaker’s belief state with respect to that proposition. Papafragou (2006) points out the importance of “epistemic conversational background”, which may affect how speakers interpret
different modal expressions. Papafragou’s examples (p. 1689) show distinct interpretations of the modals “must” and “may” in English:

(13) The children must be leaving.

(14) a. In view of what is known, the children must be leaving.

   b. In view of what their obligations are, the children must be leaving.

(15) John may go.

(16) a. In view of what is known, John may go.

   b. In view of what the circumstances are, John may go.

Hearers then infer which of the meanings is most relevant (based on Papafragou’s claim). Rocci (2004) describes an epistemic use of future marking for yes-no questions in Italian. It is used when the speaker has made an inference about some propositional content, and the speaker is able to subsequently call attention to this inference through a question conveying an epistemic attitude about the propositional content. Rocci discusses the use of the epistemic future in questions in Italian that come about as the result of the speaker’s inference. The first is “requests of confirmation” which are hearer-oriented - the speaker presupposes that the hearer has some access to the truth-value of the proposition. The second use is for “conjectural problematic questions”, where evidence for the proposition is in the common ground, rather than being attributed to the hearer. An additional resource in Italian is the che + subjunctive forms, which only in some cases may be felicitously substituted for the epistemic future. However, they may not be substituted for the epistemic future in requests of confirmation, nor can they receive the intonation contour used for requests of confirmation. The behavior of these forms demonstrates how lexical and grammatical markers of epistemic modality rely on different types of evidence.
Rocci discusses how “minor sentence types” reference different aspects of the common ground that although very subtle, are linguistically marked within one speech act type.

3.1.2. Intonation belief states, and discourse context

Just as languages mark epistemic and evidential information lexically and morphosyntactically, intonation may also function as a linguistic resource recruited to encode the same kind of information. Other authors have focused on the forms (specific intonation contours, both globally and locally) chosen by speakers based on degree of certainty, i.e. epistemic bias. Recent work focusing on intonation in Romance languages has shown intonational differences to signal what are sometimes referred to as “information-seeking” versus confirmation-seeking” contrast, which ultimately refers to the difference between a neutral versus biased distinction within the yes-no question domain. For example, Ibizan and Formenteran Catalan speakers mark the information- versus confirmation-seeking distinction through boundary tone choice, while Central and Balearic varieties of Catalan do so by modifying pitch accent type (Vanrell et al. to appear in 2013). Grice and Savino’s (1997) account of Bari Italian showed that speakers chose different pitch accents based on whether or not information is part of the common ground or not (new versus given information). Kügler (2003) showed that in Leipzig German this distinction drives boundary tone choice (low versus high). For Spanish specifically, the ten dialects investigated in Prieto & Roseano (2010) showed that different varieties of Spanish had different strategies for encoding different types of bias for questions. Like PRS, it is common for dialects to use one contour that marks interrogativity for many contexts, with other contours reserved for more specific uses. For instance, Buenos Aires Spanish uses L+1H* HL% for neutral yes-no questions, confirmation-seeking questions and imperative questions, but counter-expectation
questions are produced with L+iH*+L L%. In Canary Islands Spanish iH* L% was used for all questions types with the exception of counter-expectation questions, where L* HH% was found to be used. Through perception work, Crespo-Sendra (2011) confirmed prior findings for Central versus Valencian Catalan, showing that Central Catalan relies more on the pitch scaling of the boundary tone, while Valencian Catalan relies on the pitch scaling of the prenuclear tone. Thus perception experiments are valuable for developing a better understanding of how hearers depend on and rank the various intonational cues available in their respective varieties.

Earlier work has also investigated the relationship between intonation and discourse context. In their seminal paper, Pierrehumbert & Hirschberg (1990:308) state that “together, pitch accents, phrase accents and boundary tones convey how H(earer) should interpret the current utterance structurally – with respect to previous and subsequent utterances – and with respect to what H believes to be mutually believed in the discourse”. Hirschberg (2000) later argued that intonational meaning should be viewed as conversational implicature, i.e. what is implicated (in Gricean terms), since in her opinion intonation is non-truth functional and context-dependent. Hirschberg exemplifies this with the case of American English, a variety that relies heavily on rising intonation at the end of an utterance for signaling uncertainty. She argues that the rise in American English does not always mark uncertainty. Rather, a speaker may exploit common ground or shared knowledge with the interlocutor and use a rise, for instance, in an ironic or rhetorical way. The discourse context would in turn lead the hearer to the “correct” interpretation of the rise, showing the context-dependent nature of intonation. Tomlinson and Fox Tree (2011) recently tested the importance of situational context as well as the belief states of conversational participants experimentally. In their study on the uptalk rise in American
English, the authors found an interaction between prolongation and the uptalk rise, which depended on listener beliefs about speaker mental states. They argue that this finding supports the idea that both temporal and situational context are critical for calculating intentional meaning.

Escandell-Vidal’s (1998) Relevance Theory account of Peninsular Spanish question intonation shows how critical discourse context is for the interpretation of fall-rise intonation in this variety of Spanish. She cites the use of this contour not only for a “genuine question” but also for rhetorical questions, indirect requests, offers, exam questions, etc. She points out that her list is not exhaustive and could not be since “the interpretation of intentions crucially depends on contextual assumptions and their possible combinations are virtually unlimited” (p. 179). Escandell-Vidal claims that the fall-rise contour is the “default” contour in Peninsular Spanish. In addition to the default contour, she describes another possible contour used for questions in Peninsular Spanish, the rise-fall. According to Escandell-Vidal, the rise-fall question has more restrictions with respect to the inferential process that the hearer undergoes. Not only does the rise-fall encode the instruction to process the utterance as an interrogative, but it also encodes an instruction to process the utterance as an attributed representation (in this case hearer-attributed, but Escandell-Vidal points out that this does not have to necessarily be the case, it can be speaker-attributed). She argues that this characterization is grammatical, rather than discursive or syntactic. Therefore the function of an intonation contour within a sentence type may vary, depending on what sort of information can possibly be encoded through the contour, reminiscent of what Rocci showed for questions with *che* + subjunctive and epistemic future questions in Italian. Production studies and work based on native speaker intuitions do show evidence that
intonation may have these grammatical functions within a given sentence type, and that these functions interact in different ways with discourse context. Yet the body of experimental work testing this from a perception standpoint is rather lean.

Gravano et al. (2008) looked at the effect of intonation and epistemic modality on the assessment of speaker certainty. They investigated the presence or absence of the modal verb “would” versus the main verb “is” (That would be me vs. That’s me) with downstepped, declarative and yes-no question intonation. This was done through a perception experiment in which participants had to read short dialogues, and listened to an audio stimulus for the target utterance. The target utterance was always the last line of the dialogue. Participants heard each target with and without the epistemic modal would. Participants then heard each utterance type (with or without modal) with all three intonation contours: downstepped, declarative and yes-no question. Participants made certainty judgments using a 5-degree Likert scale measuring degree of perceived speaker certainty: Very uncertain, Somewhat uncertain, Neither certain nor uncertain, Somewhat certain, Very certain). The authors found both significant and independent contributions of the downstepped intonation contour as well as the epistemic modal verb: downstepped utterances were rated as more certain, followed by declaratives while finally yes-no questions were rated as uncertain. Utterances with epistemic would were also rated as significantly more certain.

While we know intonation to interact with discourse context, very little experimental work has been done to test this interaction, with the exception of Gravano et al.’s work. To my knowledge, no experimental work has been done to explore how intonation within one sentence type may interact with various discourse contexts differing in types of bias. As mentioned above,
this chapter’s aim is to test the epistemic values attributed to ¡H* L%, H+L* L% and L* HL% laid out in Chapter 2 and also to understand how these epistemic values, or the absence of them, interact with discourse context. To accomplish this, a perception experiment that measured degree of perceived belief was carried out. I define \textit{degree of perceived belief} as the degree to which the hearer thinks the speaker believes the propositional content of the yes-no question, ranging from [-belief] to [+belief] and including no belief (neutral).

\textbf{3.2. Methods}

\textbf{3.2.1. Participants}  
25 speakers of Puerto Rican Spanish between the ages of 18 and 65 participated in the study. In order to be included in the analysis, the participants had to have grown up in Puerto Rico and not lived in any other country for a period of more than 3 months. All of the speakers, with the exception of one, were from the San Juan Metropolitan Area (within a 25 mile radius of San Juan). The other speaker was from Orocovis, which is located in the Central Mountain Range area of Puerto Rico.

\textbf{3.2.2. Materials}  
\textbf{3.2.2.1. Pragmatic contexts}  
Six distinct pragmatic contexts were included in the materials, each of which was controlled for different types of epistemic bias and contextual evidence. The reader is referred to Appendix D for a complete version of the materials. The contexts were the following, where $p$ refers to the propositional content of the question:

\textbf{Context 1}: Neutral – no epistemic bias nor contextual evidence

\textbf{Context 2}: $p$ is inferred by the speaker based on linguistic evidence
Context 3: p is inferred by the speaker based on visual evidence

Context 4: private belief that p

Context 5: private belief that p; p is also inferred by visual evidence (congruence between epistemic state and contextual evidence)

Context 6: private belief that ~p, direct linguistic evidence for p (incongruence between epistemic state and contextual evidence)

(17) shows an example of one of the pragmatic contexts (context 5).

(17) Contexto: Carlos y Jorge son compañeros de casa. Carlos sabe que Jorge normalmente duerme hasta la 1 o las dos todos los domingos. Un domingo a la 1:30, Jorge sale de su cuarto y empieza a hablar con Carlos
Jorge: Hola Carlos, ¿qué hay?
Carlos: Na, aquí,cogiéndolo suave….
Jorge: ¿Qué has hecho hoy?
Carlos: Fui al gimnasio, hice compra, y tú… (mirando la cara de sueño de Jorge): ¿Acabas de despertarte?

Context: Carlos and Jorge are roommates. Carlos knows that Jorge normally sleeps until one or two on Sundays. One Sunday, at 1:30, Jorge comes out of his room and starts talking to Carlos
Jorge: Hi Carlos, what’s up?
Carlos: Nothing, just taking it easy…
Jorge: What have you done today?
Carlos: I went to the gym, went to the store and you… (looking at Jorge’s sleepy face): Did you just wake up?

3.2.2.2. Audio materials
The stimuli were produced by two male speakers of PRS. There were six unique segmental strings that corresponded to each of the pragmatic contexts. Each speaker produced the six segmental strings with each of the three different contours: ¡H* L%, H+L* L%, and L*
HL% (6x3=18 utterances per speaker). After the stimuli were recorded, the phonetic implementations of the utterances were confirmed based on the criteria in Table 11:

Table 11. Phonetic implementations for ¡H* L%, H+L* L% and L* HL%

Figures 15-17 show representative realizations of each of the three contours. The nuclear configuration in Figure 15 shows an extra-high tone, ¡H* in nuclear position, followed by a fall to a low boundary tone.
Figure 16 shows a common realization of H+L* L% that participants heard in the experiment. There are two types of early falls pertaining to the category H+L* L% that are possible in PRS: one with an initial rise and IP-medial plateau. The latter was used for this experiment, as shown in Figure 16.

Figure 15. Waveform, spectrogram and F0 trace for the yes-no question ¿Tú vas a comprar helado? ‘Are you going to buy ice cream?’ produced with a L*+H prenuclear accent on vas, a H* on comprar and a ¡H* nuclear pitch accent followed by a L% boundary tone.
The final question intonation included in the experiment is shown in Figure 17, and labeled as the nuclear configuration L* HL%. It is phonetically realized as a flat low tone in the nuclear stressed syllable with a subsequent rise and fall in the post-tonic segmental material.

Figure 16. Waveform, spectrogram and F0 trace for the yes-no question ¿Tú vas a comprar helado? ‘You’re going to buy ice cream?’ produced with a L+<H* prenuclear accent on vas, and a H+L* nuclear accent followed by a L% boundary tone.
Figure 17. Waveform, spectrogram and F0 trace for the yes-no question ¿Tú vas a comprar helado? ‘You’re going to by ice cream?’ produced with a L+>H* prenuclear accent on vas, and a L* HL% nuclear accent followed by a L% boundary tone

3.2.3. Procedure

Participants were sent a hyperlink to access the survey on the website surveygizmo.com. After consenting to participate, participants were brought to a page of training where each of the elements of the experiment was explained. They were told that this was a study about the intonation of Puerto Rican Spanish, and that the word “intonation” refers to the melody of human voice. They were given an example of how intonation changes speech act type for Es alto. ‘S/he is tall.’ versus ¿Es alto? ‘Is s/he tall?’. They were then told that in the experiment they would
hear utterances with different types of question intonation and that it was very important to have a way (speakers, headphones) to listen to the soundfiles in the experiment well. They were also told it was important to read each of the contexts well. The rest of the instructions are included in Appendix E. After the participants completed the training page, they moved on to the test trials. There were a total of 36 test trials.

Participants had to read the context/dialogue and clicked on the soundfile in order to hear the target question, as shown in Figure 18:

![Figure 18. Screenshot of presentation of context/dialogue and target question](image)

Next, the speakers had to judge the certainty of the speaker they heard using a 7-pt Likert scale. Rietveld & Chen (2006:294) note the advantages of a 7-pt Likert scale for obtaining perceptual judgments for intonational meaning.

- Gradations in judgments are possible.
- The resulting scale is claimed to be at the interval level.
- A yardstick is given, which enables the researcher to assess pairwise whether objects differ significantly.
The speakers were presented with seven statements that they were told to pick from. They were told to pick the one best describing the attitude of the speaker with respect to the propositional content. The participants were always given in the instructions in the format in (18):

(18) Choose the option that best describes the attitude of (Speaker name from dialogue) with respect to this phrase: (the proposition).

Participants then picked a number corresponding to the following scale:

1. S/he knows it is true.
2. S/he is convinced it is true.
3. S/he believes it is true.
4. S/he doesn’t know whether it is true or not.
5. S/he doubts that it is true.
6. S/he is convinced it is not true.
7. S/he knows it is not true.

Figure 19 shows a screenshot from the Likert-rating portion of the experiment:

Figure 19. Likert scale choices for speaker attitude about propositional content
Once the participant completed the Likert (perceived belief) rating, they were told to click the box if they thought the intonation did not make sense in the context, as shown in Figure 20. This was done to give the participants the opportunity to mark the utterance for pragmatic infelicity. I will refer to this as the “(in)felicity rating”. The participants were instructed to click the box if the intonation did NOT make sense given the context.

Finally, the participants had the option to leave comments, in order to collect qualitative data about the contour-context pairings. For instance, if an utterance was judged as not making sense in a given context, participants would then have the opportunity to explain why, thus allowing for both a qualitative and quantitative analysis.

### 3.3. Results

Figures 21-23 show error bars with the means and standard errors for each contour.
Figure 21. Mean perceived belief scores for ¡H* L%

Figure 22. Mean perceived belief scores for H+L* L%
It was first important to understand the perceived belief ratings when the contours were heard in a neutral context. To do this, the data were analyzed under a mixed-model logistic regression, fit to the data using the R statistical too (R Development Core Team, 2009). The data used for this first model came only from the participants’ responses for context 1, the neutral context (n=150). For the model presented here, the dependent variable was perceived belief score and the independent variable was Contour (three levels: ¡H* L%, H+L* and L* HL%). Table 12 includes the coefficients for the effect of contour on the neutral context, context 1. Contour was coded as a discrete variable, and both Participant and Item were included as random effects, using the lmer function in the lme4 package of the R statistical package (Bates, Maechler & Bolker, 2011). The model’s fixed effects are shown in Table 12, alongside the factors’ estimated coefficients and their predictive significance:

Figure 23. Mean perceived belief scores for L* HL%
Table 12. Coefficients for the effect of Contour on Context 1

Negative coefficients, listed in the ‘Estimate’ column, indicate that participants thought the speaker sounded like he had a higher degree of belief that p, while positive coefficients indicate that the speaker tended to be perceived as sounding like he had a lower degree of belief that p (i.e. disbelief that p). The default (intercept) contour type in the model was the non-belief encoding contour, ¡H* L%. The results show that when ¡H* L% was heard in a neutral context, the mean perceived belief score was 4 (the speaker does not know whether p or not p). The mean perceived belief score for H+L* L% in a neutral context, on the other hand, was significantly lower than it was for ¡H* L% (t = -2.88, p<0.01). Finally, L* HL% in a neutral context had significantly higher degrees of disbelief, with a positive coefficient in the ‘Estimate’ column (t=6.73, p<0.01). I next investigated the relationship between contour and context on perceived belief for each contour separately.

3.3.2. ¡H* L%

3.3.2.1 Effect of Context

In order to investigate the effect of context and contour on perceived belief for questions produced with ¡H* L%, the data were analyzed under a mixed-model logistic regression, fit to the data using the R statistical tool (R Development Core Team, 2009). The data analyzed in this model were from those perceived belief scores provided for all trials where the ¡H* L% contour
was heard (n=300). For the model presented here, the dependent variable was perceived belief score and the independent variable was Context (six levels: Contexts 1-6). Context was coded as a discrete variable, and both Participant and Item were included as random effects, using the lmer function in the lme4 package of the R statistical package (Bates, Maechler & Bolker, 2011). Nested models were compared using ANOVA. The model’s fixed effects are shown above in Table 13, alongside the factors’ estimated coefficients and their predictive significance:

<table>
<thead>
<tr>
<th></th>
<th>Estimate</th>
<th>SE</th>
<th>T value</th>
<th>p-value</th>
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<tbody>
<tr>
<td>(Intercept)</td>
<td>4.00</td>
<td>0.16</td>
<td>24.66</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Context (reference level is Context 1)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Context 2</td>
<td>-0.32</td>
<td>0.22</td>
<td>-1.44</td>
<td>0.15</td>
</tr>
<tr>
<td>Context 3</td>
<td>-0.46</td>
<td>0.22</td>
<td>-2.08</td>
<td>0.04</td>
</tr>
<tr>
<td>Context 4</td>
<td>-0.56</td>
<td>0.22</td>
<td>-2.53</td>
<td>0.01</td>
</tr>
<tr>
<td>Context 5</td>
<td>-1.36</td>
<td>0.22</td>
<td>-6.13</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Context 6</td>
<td>0.16</td>
<td>0.22</td>
<td>0.72</td>
<td>0.47</td>
</tr>
</tbody>
</table>

Table 13. Coefficients for the effect of Context on Likert Score for H+L* L%

Again, negative coefficients listed in the ‘Estimate’ column indicate that participants thought the speaker sounded like he had a higher degree of belief that p, while positive coefficients indicate that the speaker tended to be perceived as sounding like he had a lower degree of belief that p (or disbelief that p). The reference level in the model was the neutral context, context 1. The best-fit model includes Context as a significant predictor of degree of perceived belief for the contour ¡H* L%. Degree of perceived belief that p was significantly higher when ¡H* L% was heard with context 3 (t=-2.08, p=0.04), context 4 (t=-2.53, p=0.01) and context 5 (t=-6.13, p<.01) when compared to ¡H* L% heard in a neutral context.
In order to understand the relationship among contexts for the same contour, the same model was fit to the data, but the reference levels were manipulated, i.e. p values were obtained when each of the other contexts (contexts 2-6) was taken as the reference level. This analysis revealed the additional differences in perceived belief between the different contexts. Context 5 had the lowest coefficient of all the contexts and differed significantly from context 2 \((t=-4.69, p=0.00)\), context 3 \((t=-4.05, p<0.01)\), context 4 \((t=-3.61, p<0.01)\) and context 6 \((t=6.855, p=0.00)\). This indicated that participants inferred the highest degree of perceived belief for \(\text{\textdollar H* L\%}\) when they heard with with context 5. In addition to being significantly higher than that of context 5, the coefficient for context 6 was significantly higher than that of context 2 \((t=-2.165, p=0.03)\), context 3 \((t=-2.80, p=0.01)\) and context 4 \((t=-3.35, p<0.01)\). Additionally, participants inferred a significantly higher degree of disbelief when they heard \(\text{\textdollar H* L\%}\) with context 6 when compared to \(\text{\textdollar H* L\%}\) heard with context 2 \((t=-2.165, p=0.03)\), context 3 \((t=-2.80, p=0.01)\) context 4 \((t=-3.35, p<0.01)\) and context 5, as mentioned above.

To summarize:

- Degree of perceived degree of belief was significantly higher for contexts 3, 4 and 5 than for the neutral context, context 1.
- Degree of perceived degree of belief was significantly higher for context 5 than for any other context.
- Degree of perceived degree of belief was significantly lower (disbelief/doubt) for context than for all other contexts, with the exception of context 1, the neutral context.

The results for \(\text{\textdollar H* L\%}\) confirm Gunlogson’s (2003) claim that a contour may take on the bias of context. \(\text{\textdollar H* L\%}\) heard in a neutral context does not result in listeners attributing any sort of bias to the speaker, while \(\text{\textdollar H* L\%}\) heard in three of the five non-neutral contexts was perceived in a way that differed significantly from \(\text{\textdollar H* L\%}\) in a neutral context. The context that
affected ¡H* L% interpretation most strikingly was context 5, the context for which the bias for p is based on both private belief and visual evidence.

The results show that type of bias with which the contour plays a role in perceived belief state. When we compare context 2 to context 5, where the speaker would have had more evidence for p (both a private belief and visual evidence), the latter had a significantly higher degree of perceived belief for participants. This was also the case when comparing context 5 with a context where evidence for p was available visually (context 3) and based on a prior belief (context 4). It seems then that when the speaker had both a prior belief in addition to visual evidence, this made a difference in perceived degree of belief for participants. However, both contexts 3 and 4 had enough contextual evidence to bias the interpretation of ¡H* L% when compared to a neutral context, and even context 2, though not significantly so. It may have been the case that the particular linguistic evidence provided in context 2 not particularly convincing.

Interestingly, context 6 was not shown to behave differently from context 1, though this context did cause the directionality of the scores to reverse: the coefficient was positive. This indicates that ¡H* L% heard in context 6 did tend to be interpreted as conveying doubt or disbelief. It is puzzling, however, that ¡H* L% heard in context 6 would show no significant difference when compared to ¡H* L% heard in a neutral context. We look to the (in)felicity judgments and participant comments to investigate this issue.

3.3.2.2. (in)felicity judgments

As noted above, the speakers had the option to check a box indicating that the intonation did not make sense given the context. I first present the (in)felicity judgments for the entire data set (N=900) in order to examine the effect of both Contour and Context on whether participants
judged a given question as sounding infelicitous. A generalized linear model was fit to the data with infelicity as the dependent variable (i.e. whether or not the participant rated the question as sounding infelicitous), and Contour and Context were tested as potential predictors (fixed effects). This was done using the \textit{glm} function in R. Nested models were compared using ANOVA. Table 14 shows the coefficients for the log odds of the infelicity ratings.

<table>
<thead>
<tr>
<th></th>
<th>Estimate</th>
<th>SE</th>
<th>Z value</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>-2.26</td>
<td>0.30</td>
<td>-7.55</td>
<td>4.41e-14</td>
</tr>
<tr>
<td>Contour (reference level is (H^*L%))</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(H+L%L%)</td>
<td>0.85</td>
<td>0.24</td>
<td>3.50</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>(L^*HL%)</td>
<td>-0.08</td>
<td>0.28</td>
<td>-0.28</td>
<td>0.78</td>
</tr>
<tr>
<td>Context (reference level is Context 1)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Context 2</td>
<td>-0.27</td>
<td>0.37</td>
<td>-0.74</td>
<td>0.46</td>
</tr>
<tr>
<td>Context 3</td>
<td>-0.96</td>
<td>0.44</td>
<td>-2.18</td>
<td>0.03</td>
</tr>
<tr>
<td>Context 4</td>
<td>0.23</td>
<td>0.34</td>
<td>0.67</td>
<td>0.50</td>
</tr>
<tr>
<td>Context 5</td>
<td>-0.21</td>
<td>0.36</td>
<td>-0.58</td>
<td>0.56</td>
</tr>
<tr>
<td>Context 6</td>
<td>0.98</td>
<td>0.31</td>
<td>3.16</td>
<td>&lt;0.01</td>
</tr>
</tbody>
</table>

Table 14. Coefficients for infelicity ratings for entire data set

The numbers in the ‘Estimate’ column indicate coefficients of the log likelihood of a question being judged as infelicitous. The analysis confirms that both Contour and Context were significant predictors for a given utterance to be judged as infelicitous. Looking at Contour, the results indicate that the log odds of classifying an utterance as infelicitous are significantly higher for \(H+L\%L\%\) than they are for \(iH^*L\%\), in general \((z=3.50, p<0.01)\). When we add the interaction with Context, we find that in general, questions heard with context 3 had the lowest log odds for (in)felicity judgments \((z=-2.18, p=0.03)\), while questions heard in context 6 had the highest \((z=3.16, p<0.01)\).
(in)felicity judgments were then analyzed by specific contour. I present an analysis for (in)felicity judgments for ¿H* L% (n=300). A generalized linear model was fitted to the data with infelicity as the dependent variable (i.e. whether or not the participant rated the question as sounding infelicitous), and Context was tested as a potential predictor (fixed effect). This was done using the \textit{glm} function in R. Table 15 shows the (in)felicity judgments for all ¿H* L% questions:

<table>
<thead>
<tr>
<th>Context (reference level is Context 1)</th>
<th>Estimate</th>
<th>SE</th>
<th>z value</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
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<td>0.60</td>
<td>-4.62</td>
<td>0.46</td>
</tr>
<tr>
<td>Context 2</td>
<td>0.55</td>
<td>0.76</td>
<td>0.73</td>
<td>0.47</td>
</tr>
<tr>
<td>Context 3</td>
<td>-1.14</td>
<td>1.17</td>
<td>-0.97</td>
<td>0.33</td>
</tr>
<tr>
<td>Context 4</td>
<td>0.94</td>
<td>0.72</td>
<td>1.30</td>
<td>0.19</td>
</tr>
<tr>
<td>Context 5</td>
<td>-0.43</td>
<td>0.93</td>
<td>-0.46</td>
<td>0.65</td>
</tr>
<tr>
<td>Context 6</td>
<td>1.70</td>
<td>0.68</td>
<td>2.52</td>
<td>0.01</td>
</tr>
</tbody>
</table>

Table 15. Coefficients for infelicity ratings for ¿H* L% heard with Contexts 1-6

Positive values in the ‘Estimate’ column indicate higher log odds of judging a question produced with ¿H* L% as sounding infelicitous in a given context. We see here that context 6 was the only context that had significantly higher log odds of being judged as infelicitous when compared to ¿H* L% heard in a neutral context (z=2.52, p=0.01). This is puzzling since, according to Escandell-Vidal’s prediction, the default contour should be acceptable across contexts. It is helpful now, to turn to the qualitative data that were collected in the experiment. The following are comments provided by participants for ¿H* L% heard with context 6:

(19) \textit{Se lo está ofreciendo, no suena sorprendido}.  
‘He’s offering, he doesn’t sound surprised.’
(20) *Hace falta complementar esto con el gesto para estar seguro de lo que quiere decir.*

‘This needs to be complemented with a gesture to be sure of what he means.’

On the other hand, the comment in (21) justifies its felicity:

(21) *Está bien también, suena sorprendido pero tranquilo.*

‘It sounds fine too, it sounds surprised but calm.’

In context 6, the speaker’s wife implicates that she wants a dog for Christmas. The speaker subsequently seeks confirmation for what he has just inferred, that his wife wants a dog, with the utterance ¿Quieres un perro? ‘You want a dog? The comment in (19) indicates that the utterance can be processed as an offer. However it’s very possible that the presence of *quieres* + direct object may have indeed indicated to listeners that the utterance was an offer. The comment in (20) suggests that some other cue, in this a kinesic one, is necessary for a felicitous interpretation of ¡H* L% in context 6. It is quite possible that (19) also gets at the absence of some cue to surprise, indicating that the speaker does not sound surprised enough for the context. Since we know that in PRS, pitch expansion for ¡H* L% is used to convey surprise (i.e. producing the extra-high tone at an even higher point in the speaker’s tonal space), the absence of pitch expansion could have contributed to the infelicity of ¡H* L% for this context for the participants who judged it as infelicitous. However, the comment in (21) that the speaker sounds “calmly surprised” showed that some speakers had no problem accepting the tokens of ¡H* L% used in the experiment, and that hearing those tokens in a context where the speaker was expected to be surprised does indeed yield a “surprised” interpretation. The adjective “calmly” used by the participant in this example could be a reference to the lack of pitch expansion in this surprised context. Future work should investigate the need for the extra-high tonal target in ¡H* L% questions to be produced higher in the speaker’s tonal space for surprise questions, but also
the contribution of facial gesture to the felicity of specific intonation contours. In any case, there were comments implying that “something more” is needed for the question to be felicitous. That “something more” could be a gesture or pitch range expansion, but remains to be tested. I do acknowledge that the presence of *quieres* may have exacerbated the need for an additional cue to surprise, in order to “deactivate” an offer reading.

### 3.3.3. H+L* L%

#### 3.3.3.1. Effect of Context

In order to investigate the effect of context and contour on perceived belief for questions produced with H+L* L%, the data were analyzed under a mixed-model logistic regression, fit to the data using the R statistical too (R Development Core Team, 2009). The data analyzed in this model were from those perceived belief scores provided for all trials where the H+L* L% contour was heard (n=300). For the model presented here, the dependent variable was perceived belief rating and the independent variable was Context (six levels: Contexts 1-6). Context was coded as a discrete variable, and both Participant and Item were included as random effects, using the lmer function in the lme4 package of the R statistical package (Bates, Maechler & Bolker, 2011). Nested models were compared using ANOVA. The model’s fixed effects are shown in Table 16, alongside the factors’ estimated coefficients and their predictive significance:

<table>
<thead>
<tr>
<th></th>
<th>Estimate</th>
<th>SE</th>
<th>T value</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Intercept)</td>
<td>3.52</td>
<td>0.18</td>
<td>19.10</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Context (reference level is Context 1)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Context 2</td>
<td>0.08</td>
<td>0.24</td>
<td>0.33</td>
<td>0.74</td>
</tr>
<tr>
<td>Context 3</td>
<td>0.10</td>
<td>0.24</td>
<td>0.41</td>
<td>0.68</td>
</tr>
<tr>
<td>Context 4</td>
<td>-0.16</td>
<td>0.24</td>
<td>-0.66</td>
<td>0.51</td>
</tr>
<tr>
<td>Context 5</td>
<td>-0.29</td>
<td>0.24</td>
<td>-1.21</td>
<td>0.23</td>
</tr>
<tr>
<td>Context 6</td>
<td>1.48</td>
<td>0.24</td>
<td>6.07</td>
<td>&lt;0.01</td>
</tr>
</tbody>
</table>

Table 16. Coefficients for the effect of Context on Likert Score for H+L* L%
Again, negative coefficients listed in the ‘Estimate’ column, indicate that participants thought the speaker sounded like he had a higher degree of belief that p, while positive coefficients indicate that the speaker tended to be perceived as sounding like he had a lower degree of belief that p (or disbelief that p). The default (intercept) contour type in the model was the neutral context, context 1. The best-fit model includes Context as a significant predictor of degree of perceived belief for the Contour H+L* L%. The estimate for context 6 was higher it was for context 1, and the model shows that this difference was significant. H+L* L% heard in the other contexts did not differ significantly from H+L* L% heard in the neutral context. When reference levels were changed for each of the contexts, it was found that belief perception ratings for H+L* L% in context 6 differed significantly from H+L* L% heard in any of the other contexts. There were no other significant differences when comparing the other contexts. Looking back at Table 14, we see that even in the neutral context, the mean ratings for H+L* L% tended to be below 4, which indicated a higher degree of perceived belief. Context 6, however, shows a change in the directionality ratings, participants gave ratings indicated lower degrees of perceived belief. Contexts 1-5 confirm that idea that the H+L* L% contour encodes not only interrogativity, but also a belief that p. It is important to bear in mind that in context 6, the speaker gets linguistic evidence that is not in line with his prior belief about p. Therefore, we would expect him to express some sort of disbelief or surprise. I started with the hypothesis that H+L* L% expresses a bias for p. Table 14 confirms that H+L* L% carries a [+belief ] bias, and therefore we can conclude that linguistic and contextual information are competing in context 6.
3.3.3.2 *(in)felicity judgments*

Here I present an analysis for ¡H* L% (in)felicity judgments (n=300). A generalized linear model was fit to the data with infelicity as the dependent variable (i.e. whether or not the participant rated the question as sounding infelicitous), and Context was tested as a potential predictor (fixed effect). This was done using the `glm` function in R. Table 17 shows the (in)felicity judgments for all H+L* L% questions:

<table>
<thead>
<tr>
<th></th>
<th>Estimate</th>
<th>SE</th>
<th>z value</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
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<td>Intercept</td>
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<td>-4.12</td>
<td>3.80</td>
</tr>
<tr>
<td>Context (reference level is Context 1)</td>
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<td>1.00</td>
</tr>
<tr>
<td>Context 3</td>
<td>-4.76</td>
<td>5.70</td>
<td>-0.84</td>
<td>0.40</td>
</tr>
<tr>
<td>Context 4</td>
<td>-4.76</td>
<td>5.70</td>
<td>-0.84</td>
<td>0.40</td>
</tr>
<tr>
<td>Context 5</td>
<td>-7.03</td>
<td>5.98</td>
<td>-1.18</td>
<td>0.24</td>
</tr>
<tr>
<td>Context 6</td>
<td>1.67</td>
<td>4.65</td>
<td>3.61</td>
<td>&lt;0.01</td>
</tr>
</tbody>
</table>

Table 17. Coefficients for infelicity ratings for H+L* L% by context

Note that context 6 is the only one showing a positive value in the ‘Estimate” column, indicating that the log odds of judging H+L* L% in context as infelicitous were significantly higher than they were for H+L* L% heard in a neutral context. Recall in Section 3.3.2.2. I also showed that in general, H+L* L% was the contour that had the highest log odds of being judged as infelicitous. Now we find that it was the H+L* L% / context 6 pairing that had the highest odds of being judged as infelicitous for this contour type. It was judged as infelicitous for 62% of the trials. If H+L* L% indicates some sort of positive bias, then the information in context 6 would be conflicting with the information encoded in the contour. This explanation is supported by the comment in (22):
Debe de son más sorprendido y la entonación no cuadra tampoco.

‘It should sound more surprised and the intonation doesn’t fit either.’

This comment suggests the actual contour simply seemed wrong to the participant given the context. As we can see visually in Figure 22, H+L* L% is relatively less malleable than ¡H* L% in terms of how it is affected by context, but this is when the context is congruent with the directionality of bias for H+L* L%. A second generalized linear model was fit to the data, removing from the model all trials that were deemed infelicitous. Even when the trials that were rated as infelicitous were removed, H+L* L% heard in context 6 was still perceived in a significantly different way from H+L* L% in context 1. Table 18 compares the coefficient table for H+L* L% with infelicity trials with a second model that was fitted to the data when all trials deemed infelicitous were excluded.

<table>
<thead>
<tr>
<th></th>
<th>Estimate</th>
<th>SE</th>
<th>T value</th>
<th>p-value</th>
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</thead>
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<td>19.10</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Context (reference level is Context 1)</td>
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<td></td>
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<td></td>
</tr>
<tr>
<td>Context 2</td>
<td>0.08</td>
<td>0.24</td>
<td>0.33</td>
<td>0.74</td>
</tr>
<tr>
<td>Context 3</td>
<td>0.10</td>
<td>0.24</td>
<td>0.41</td>
<td>0.68</td>
</tr>
<tr>
<td>Context 4</td>
<td>-0.16</td>
<td>0.24</td>
<td>-0.66</td>
<td>0.51</td>
</tr>
<tr>
<td>Context 5</td>
<td>-0.29</td>
<td>0.24</td>
<td>-1.21</td>
<td>0.23</td>
</tr>
<tr>
<td>Context 6</td>
<td>1.48</td>
<td>0.24</td>
<td>6.07</td>
<td>&lt;0.01</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Estimate</th>
<th>SE</th>
<th>T value</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infelicitous trials excluded</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Context (reference level is Context 1)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Context 2</td>
<td>0.06</td>
<td>0.24</td>
<td>0.24</td>
<td>0.81</td>
</tr>
<tr>
<td>Context 3</td>
<td>-0.03</td>
<td>0.23</td>
<td>-0.13</td>
<td>0.89</td>
</tr>
<tr>
<td>Context 4</td>
<td>-0.22</td>
<td>0.24</td>
<td>-0.93</td>
<td>0.35</td>
</tr>
<tr>
<td>Context 5</td>
<td>-0.48</td>
<td>0.24</td>
<td>-2.03</td>
<td>0.04</td>
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<tr>
<td>Context 6</td>
<td>1.33</td>
<td>0.24</td>
<td>5.60</td>
<td>&lt;0.01</td>
</tr>
</tbody>
</table>

Table 18. Coefficients for the effect of Context on Likert Score for H+L* L% (infelicitous trials included vs. excluded)
We observe a significant effect of context 6 on contour 2 even when infelicitous trials are removed. We also find that the effect of context 5 is now stronger. This shows that context indeed affected the perceived belief ratings for H+L* L% for two of the contexts. The conflicting information between contour and context was most likely confusing for participants since it seems that many of them based their perceived belief ratings on contextual information. The histograms in Figures 24-29 demonstrate that perceived belief scores were relatively similar for all contexts with the exception of context 6.

Figure 24. Distribution of perceived belief scores: H+L* L%, Context 1
Figure 25. Distribution of perceived belief scores: H+L* L%, Context 2

Figure 26. Distribution of perceived belief scores: H+L* L%, Context 3
Figure 27. Distribution of perceived belief scores: H+L* L%, Context 4

Figure 28. Distribution of perceived belief scores: H+L* L%, Context 5
If the context were completely overriding the contour, we would expect to find even more left skewedness in Figure 29. In fact, the majority of participants gave the score 4 for H+L* L% heard with context 6. I take this to reflect confusion on the part of the participant in having to make a decision about an incongruent context/contour pairing. As shown in Figures 24-29, the general tendency for H+L* L% is for scores of 3 and 4. In any case, the (in)felicity ratings are important because they support the argument that positive bias encoded in H+L* L%, otherwise, the information would not be conflicting. As a result of a contour-contour pairing with conflicting information, more participants chose perceived belief scores that reflected the context than they did when they heard H+L* L% in other context, while others chose scores similar to the other contexts.

While 4 is a neutral score, I take this to reflect the fact that participants are very aware of the interrogative component of H+L* L%. That is, questions are asked because of the lack of some information.
3.3.4. L* HL%

3.3.4.1. Effects of context

To investigate the effect of context and contour on perceived belief for questions produced with L* HL%, the data were analyzed under a mixed-model logistic regression, fit to the data using the R statistical too (R Development Core Team, 2009). The data analyzed in this model were from those perceived belief scores provided for all trials where the L* HL% contour was heard (n=300). For the model presented here, the dependent variable was perceived belief rating, and the independent variable was Context (six levels: Contexts 1-6). Context was coded as a discrete variable, and both Participant and Item were included as random effects, using the lmer function in the lme4 package of the R statistical package (Bates, Maechler & Bolker, 2011). Nested models were compared using ANOVA. The model’s fixed effects are shown in Table 19, alongside the factors’ estimated coefficients and their predictive significance:

<table>
<thead>
<tr>
<th></th>
<th>Estimate</th>
<th>SE</th>
<th>t value</th>
<th>p-value</th>
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<tbody>
<tr>
<td>(Intercept)</td>
<td>5.12</td>
<td>0.17</td>
<td>30.88</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Context (reference level is Context 1)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Context 2</td>
<td>-0.1</td>
<td>0.22</td>
<td>-0.46</td>
<td>0.64</td>
</tr>
<tr>
<td>Context 3</td>
<td>-0.24</td>
<td>0.22</td>
<td>-1.11</td>
<td>0.27</td>
</tr>
<tr>
<td>Context 4</td>
<td>0.06</td>
<td>0.22</td>
<td>0.28</td>
<td>0.78</td>
</tr>
<tr>
<td>Context 5</td>
<td>-2.62</td>
<td>0.22</td>
<td>-12.17</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Context 6</td>
<td>0.4</td>
<td>0.22</td>
<td>1.86</td>
<td>0.06</td>
</tr>
</tbody>
</table>

Table 19. Coefficients for the effect of Context on Likert Score in the data for L* HL%.

The value in the ‘Estimate’ column for the neutral context (context 1) shows a value over 4, indicating that the participants had a lower degree of perceived belief (i.e. doubt or disbelief) for this contour in a neutral context. The error bars in Figure 23 show that the mean scores for L* HL% were quite similar when heard in contexts 2, 3, 4 and 6. There were no significant
differences when scores for L* HL% heard with these contexts were compared to the scores for L* HL% heard in the neutral context. Figure 23 makes it quite clear, however, that when L* HL% was heard with context 5 (speaker has a private belief that p in addition to visual evidence that p), the directionality of perceived belief reversed. This is also shown in the coefficient in the ‘Estimate’ column in Table 19 since the estimate for context 5 is negative, which indicates the degree of perceived belief for L* HL% was significantly higher when heard with context 5 than it was with context 1 (t=-12.166, p=0.00). When reference levels were changed to compare the different contexts to each other, the perceived belief scores for L* HL% heard with context 5 were always significantly different from all other contexts. Thus when context 5 was the reference level, significant differences were found compared to context 2 (t=11.70, p<0.01), context 3 (t=11.06, p<0.01), context 4 (12.45, p<0.01) and context 6 (t=14.03, p<0.01). This was in addition to differing significantly from context 1 (as shown above). The other contour that showed significant differences when compared to the other contexts was contour 6. In addition to contributing to significantly lower degrees of perceived belief (i.e. disbelief/doubt) when compared to context 5, when context 6 was taken as the reference level it differed significantly from context 2 (t=-2.32, p<0.05), and context 3 (t=-2.97, p<0.05).

The differences found between L* HL% heard with context 6 when compared with contexts 2, 3 and 5 can be explained by the congruence of contour and context found here. The scenario of a husband who always believed his wife hated dogs finding out that the wife in fact wants a dog for Christmas is a context that would conceivably license L* HL%, since the speaker would perhaps be expected to express his incredulity. Unlike H+L* L% in this context, which seemed to be incongruent with context 6 based on (in)felicity judgments, it is reasonable
to hypothesize that L* HL% would actually be quite appropriate in context 6. Thus it seems like when participants heard the L* HL% with context 6, it may have had a bolstering effect: the contour already encodes doubt/disbelief but the congruent context intensifies this meaning. A bolstering effect, however, does not explain the reversal in directionality in perceived belief that we see for context 5 in Figure 23. One possibility is that a context showing a private belief that p on the part of the speaker in combination with visual evidence for p could override the incredulous meaning of L* HL%. This possibility is discussed in the next section.

3.3.4.2. (In)felicity judgments

(In)felicity judgments were then analyzed by specific contour. Here I present an analysis for (in)felicity judgments for L* HL% (n=300). A generalized linear model was fitted to the data with infelicity as the dependent variable (i.e. whether or not the participant rated the question as sounding infelicitous), and Context was tested as a potential predictor (fixed effect). This was done using the glm function in R. Table 20 shows the (in)felicity judgments for all H+L* L% questions:

<table>
<thead>
<tr>
<th></th>
<th>Estimate</th>
<th>SE</th>
<th>z value</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>-1.82</td>
<td>0.41</td>
<td>-4.46</td>
<td>0.08</td>
</tr>
<tr>
<td>Context (reference level is Context 1)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Context 2</td>
<td>-2.08</td>
<td>1.09</td>
<td>-1.91</td>
<td>0.57</td>
</tr>
<tr>
<td>Context 3</td>
<td>-2.08</td>
<td>1.09</td>
<td>-1.91</td>
<td>0.57</td>
</tr>
<tr>
<td>Context 4</td>
<td>0.43</td>
<td>0.54</td>
<td>0.80</td>
<td>0.43</td>
</tr>
<tr>
<td>Context 5</td>
<td>0.30</td>
<td>0.55</td>
<td>0.54</td>
<td>0.59</td>
</tr>
<tr>
<td>Context 6</td>
<td>-2.08</td>
<td>1.09</td>
<td>-1.91</td>
<td>0.06</td>
</tr>
</tbody>
</table>

Table 20. Coefficients for infelicity ratings for L* HL% by context.

Positive coefficients in the ‘Estimate’ column indicate (in)felicity judgments that were higher than the coefficient at the intercept (in)felicity judgments for L* HL% heard with the neutral
context). There were no significant differences in the log odds of judging L* HL% as infelicitous in combination with any of the contexts. The resulting question is then whether the effect of context 5 on L* HL% is so strong, then, that it causes the interpretation to be reversed. The qualitative data presented below are helpful in understanding what exactly drove the reversal in direction of perceived belief for L* HL% with context 5.

While there were no significant differences in (in)felicity judgments across contexts, there were participants who did judge L* HL% heard with context 5 as infelicitous (for 18% of trials containing L* HL% in context 5). (23) and (24) exemplify why some participants might have judged this contour-context pairing as infelicitous:

(23) Éste me confunde, porque en el contexto enfatiza que Carlos sí sabe los hábitos de dormir de Jorge, pero en la entonación comunica otra cosa.

‘This one confuses me, because the context emphasizes that Carlos does know the sleeping habits of Jorge, but the intonation communicates something else.’

(24) No tiene sentido si en la introducción dice que él conoce a qué hora suele despertar su compañero.

‘It doesn’t make sense if in the introduction it says that he knows what time his roommate wakes up.’

Therefore, participants did sense an incongruity between the contour and the context, and it is clear that the meaning of L* HL% was not “blocked” by the context. But why then, weren’t the log odds for (in)felicity judgments higher for L* HL% in context 5? The comments in (25) and (26) offer an explanation:
(25) *Tiene sentido si estaba siendo sarcástico.*
It makes sense if he was being sarcastic.

(26) *Tiene sentido si estaba diciendo lo contrario, o sea, si está siendo irónico está bien. Suena como ‘¿aja?’, irónico.*
It makes sense if he’s saying the opposite, that is, if he’s being ironic it’s fine. It sounds like “mmhmm..”, ironic.

The second set of comments obviate why speakers might have been likely to accept L*HL% as felicitous with context 5. This contour-context pairing allows for an “ironic” or “sarcastic” interpretation. The sarcastic interpretation accounts for the reversal in directionality of perceived belief states from disbelief to belief. The fact that the sarcastic interpretation is possible shows that the contour preserves its incredulous meaning, but given the strong contextual cues in favor of p being the case, the sarcastic meaning is activated. This example shows the usefulness of qualitative data in interpreting the results.

3.4. Discussion

The results present an interesting picture of the way context interacts with the different intonation types available for yes-no questions in PRS. The experiment confirms a default meaning for ¡H* L% - it encodes interrogativity. This was shown based on the fact that ¡H* L% was perceived as neutral in a neutral context, but allowed for biased readings when heard in biased context. However, it does appear that phonetic modifications might be necessary in order to make a surprised interpretation clearer. It is possible that extra communicative cues such as facial gesture would also contribute to felicity in the absence of pitch scaling modifications. With respect to the contours that were hypothesized to encode epistemic information in addition to
interrogativity, little variation was found for perceived belief ratings for H+L* L% in contexts 2, 3 and 4 when compared to context 1. We saw that when trials deemed infelicitous were removed, context 5 affected H+L* L% in that it bolstered the [+belief] meaning. When there was conflicting information between H+L* L% and contextual evidence in context 6, infelicity ratings were higher, and there was a significant increase in disbelief ratings. These results demonstrate that many participants based their response on the context when there was a clash between information in the contour versus that in the context. Comparing the histograms for H+L* L% across the six contexts revealed more variation in perceived belief scores for context 6, indicating that participants may have been confused about how to respond to the infelicitous pairing since there was conflicting information. This behavior for H+L* L% is interesting when we compare it to what happened when the same situation was created for L* HL%, i.e. when L* HL% was heard in a context that clashed with its proposed disbelief meaning. In this case, we did not find significantly higher infelicity ratings, as we did for the infelicitous pairing of H+L* L% and context 6. Instead, the results revealed an ironic interpretation available in PRS for L* HL% - when a speaker believes/knows something to be true (as was specified in context 5), s/he may feign disbelief for an ironic or sarcastic effect (which can be done through L* HL%). This is similar to the case of the ironic interpretation of the American English rise cited by Hirschberg (2000). No such ironic interpretation was available when H+L* L% was heard in context 6. The unavailability of a specialized, contextually-activated interpretation resulted in higher infelicity ratings. We can conclude from this that an incongruity between contour and context will have different consequences, based on which sorts of contextually-activated meanings are available in the variety when the different linguistic forms are heard. Like the case of H+L* L% for context
5, the L* HL% results also demonstrate that when L* HL% is very appropriate given the context, the disbelief interpretation can be strengthened, as it was for the case of context 6. This strengthening effect was only found for H+L* L% in context 5 after having removed trials judged as infelicitous.

This experiment shows that when a question contour does not directly encode epistemic information, speakers rely heavily on discourse context, though the participants’ comments suggest that phonetic manipulations and possibly facial gesture may contribute to how “good” the contour sounds. There are two contours that carry epistemic bias in PRS: H+L* L% and L* HL%. The difference between ¡H* L% heard in a neutral context and H+L* L% heard in a neutral context confirm a positive bias for H+L* L%, though speakers are still quite sensitive to the interrogativity component of the latter. It should be pointed out that only one phonetic realization of H+L* L% was used in this experiment, in terms of the global contour: all recordings of H+L* L% showed a “hat” pattern (Ladd 1996/2008). It is possible that the early fall that I described in Chapter 2 could affect the degree of positive bias encoded by H+L* L%, but that remains to be tested. L* HL% was shown to be a strong cue to disbelief in the variety. The two epistemic contours differed in how participants responded when information in the contour conflicted with information in the context. For H+L* L% this led to significantly higher infelicity ratings and more variation in how participants rated perceived belief, often times relying more heavily on the context. For L* HL%, this kind of situation allows for an ironic interpretation, and therefore we did not see high infelicity ratings. This also shows that the additional epistemic information for a given contour will affect its context-dependent meanings.
3.5. Conclusions

These experimental findings are relevant to prior accounts of bias and questions. The study provides experimental evidence for Gunlogson’s (2003) claim that interrogatives are only neutral when produced in a neutral context, confirmed by the fact that participants perceived ¡H* L% in a neutral context as neutral. Epistemic contours were perceived as biased even in neutral contexts, confirming that at least within the yes-no question domain, the epistemic contours have a generalized meaning. While the effect of contour sometimes overrode the effect of contextual evidence, the results show that incongruity between contextual evidence and linguistically (intonationally) encoded epistemic bias result in confusion when no specialized meaning (such as an ironic interpretation) is available. These findings support Sudo’s argument for two types of bias. Yes-no question intonation interacts in different ways with contextual evidence based on whether the contour is able to take on evidential bias versus whether the contour encodes epistemic bias directly. The epistemic contours encode additional, non-truth-conditional information in addition to marking an utterance for interrogativity. In Escandell-Vidal’s terms, the epistemic contours contain additional processing instructions for the hearer. These additional instructions, at times, dilute the effect of contextual evidence. This is not to say that context does not affect the interpretation of epistemic contours. It may bolster the already-encoded meaning, or guide listeners to a specialized meaning, when available. The results also show that hearers are sensitive to the felicity (congruence) of the contours in context. Hearers are constantly gauging the relationship between contour and context, searching for the best interpretation (as with the sarcastic interpretation of L* HL% with context 5), or perceiving a mismatch between competing linguistic and contextual information (as in the case of H+L* L% with context 6).
Therefore when we ask: *How do contour and context work together to affect perceived degree of belief?* The answer is: It depends. These results show that within the yes-no question domain, the way hearers use context and contour to infer belief states differs depending on contextual evidence and the contour type (i.e. type of bias).

In this chapter I have discussed three intonation contours available for yes-no questions in PRS from a hearer-oriented point of view. From a speaker-oriented point of view, the results also show that while the PRS speaker may opt to let the context to do most of the work as it would for biased interpretations of ¡H* L%, s/he also has the option to choose a contour which hearers will depend on for information about epistemic stance. When the latter is chosen, the speaker is able to add information about his/her internal state to the common ground, i.e. private information may become public. The PRS yes-no question domain seems to be quite rich in intonational marking options, especially if we compare it to a language like Yélî Dyne which Levinson (2010) claims to show neither morphosyntactic nor intonational marking for yes-no questions, and that the main way a yes-no question is detected by the hearer is by “ascertaining that the speaker is unlikely to know the information at issue, and has reason to think that the addressee may know it” (p. 2742). Considering this in light of the present findings, it appears that cross-linguistically we may find different hierarchies for weighting contextual evidence, linguistic encoding (lexical, morphological, intonational, etc.) and perhaps even gesture in different ways. The options available in PRS are similar to those discussed by Escandell-Vidal (1998) for Peninsular Spanish – there is a contour that encodes interrogativity (¡H* L%), and others that impose more restrictions on the inferential process (H+L* L%, L* HL%).
within the same language, Spanish, we find varieties with very specialized linguistic means for marking information about belief.

The types of intonational meaning investigated here fall within one sentence type, yes-no questions. It would be useful to extend work to include different speech act types to better understand how context affects perceived meaning in general. For example, the L* HL% tune in PRS can also be found for vocatives and exhortative requests. We might expect context to play a more dramatic role when sorting out meaning between different speech acts. It is also possible that phonetic specific aid hearers in sorting out intonational meaning as well, as Tomlinson and Foxtree (2011) found for the case of uptalk in American English.

Considering these findings with respect to the larger goals of this dissertation, the results give a helpful overview of what it means to be a hearer that needs to glean information about speaker belief state through intonation and context in PRS yes-no questions. As I have stated earlier in this chapter, children must learn to be speakers of their language(s), but they also learn to be hearers. Drawing on both quantitative and qualitative data, this study gives a clearer picture of the kinds of cues, contextual and linguistic, that a learner of PRS must learn to weight as an adult hearer. To be able to navigate this system at full throttle, PRS-acquiring child must learn how to perceive his/her interlocutor’s belief state by weighting the various cues available. S/he will also learn to manipulate these cues in speech. I have presented innovative methods to better understand how hearers use intonation and contextual evidence to calculate speaker belief states, thereby providing a hearer-based account of the target system for PRS-acquiring children.
4.1. Introduction and background

4.1.1. The adult system

The results from the production study in Chapter 2 and the perception study in Chapter 3 allowed for the following conclusions about three phonologically distinct contours used within the yes-no question domain in Puerto Rican Spanish (PRS): ¡H* L%, H+L* L% and L* HL%:

<table>
<thead>
<tr>
<th>Contour</th>
<th>Speech act</th>
<th>Belief</th>
<th>Contextual licensing</th>
</tr>
</thead>
<tbody>
<tr>
<td>¡H* L%</td>
<td>Interrogativity</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>H+L* L%</td>
<td>Interrogativity</td>
<td>Speaker’s private belief that p</td>
<td>Cannot be an unbiased question</td>
</tr>
<tr>
<td>L* HL%</td>
<td>Interrogativity</td>
<td>Speaker calls attention to incongruence between her belief and recently acquired information</td>
<td>Cannot be an unbiased question, recently acquired information is temporally restricted (information must have just come about in the context)</td>
</tr>
</tbody>
</table>

Table 21. Three phonological contours in PRS

Table 21 shows that all three contours encode interrogativity but differ in the additional, non-truth-propositional information they encode. The three contours also differ in their contextual licensing.

In Chapter 2, I argued that ¡H* L% may be chosen for many different types of intentions within the yes-no question domain. For this reason I referred to it as a default contour, much like the rise in Peninsular Spanish described by Escandell-Vidal (1998). H+L* L% and L* HL% were found to be more restricted, and production data suggested that in addition to encoding
interrogativity, these contours were also encoding epistemic bias on the part of the speaker. In Chapter 3, I confirmed that hearers use these contours to infer information about belief states, while belief state information comes from discourse context for the default contour ¡H* L%. What instructions are there in the input with respect to how to use this system? How do children learn to exploit the system in speech?

**4.1.2. Intonational development in the AM framework**

Much of the recent work on intonational development within the AM framework has concentrated on children’s successful acquisition of the inventory of pitch accents and boundary tones available in the ambient language. Prieto and Vanrell (2007) showed that by the age of 24 months, children show a wide array of language-specific pitch accents and boundary tones. In a study of children aged 16 months to 24 months old, Chen and Fikkert (2007) showed that children master the basic inventory of Dutch pitch accents and boundary tones, correlating this with vocabulary size, and Frota and Vigário (2008) show an adult-like pitch accent and boundary tone inventory at 21 months for their case study in European Portuguese. Prieto et al (2012) showed that for six children acquiring either Peninsular Spanish or Central Catalan, a set of phonologically distinct contours are already being produced from the onset of speech. A few months after the onset of speech an intonational ‘jump’ occurs, at which point children show reliable knowledge of their language’s intonational grammar. Prieto et al. note that these recent studies show a general consensus that “children have largely acquired the adult inventory of pitch accents and boundary tones before the age of two” (p. 33). We know that children are already manipulating prosody for utterances that demand some kind of response (not necessarily linguistic) before the onset of meaningful speech. Even babies have been shown to make
prosodic distinctions based on intentionality. Esteve-Gibert & Prieto (in press) showed that at between the ages of 9 and 11 months, Central Catalan-acquiring children use wider pitch range for requests and protests than they do for statements and responses. Thorson et al. (submitted) looked at Central Catalan and Peninsular Spanish-acquiring toddlers and their parents’ use of intonation for a variety of intentions within the yes-no question domain. They showed that while in CDS parents produce reliable form-meaning pairs based on the contours and meanings known to be available for the two varieties, there were also non-standard pragmatic uses of some yes-no question contours. They also showed that between the ages of 17 and 28 months, children’s form-meaning pairs closely resembled those of their parents. The authors also observed that there was no one-to-one mapping between form and function for any of the question types they investigated. Recently, Prieto et al. (2011) studied Child Directed Speech (CDS) and child speech in their study using the Ornat and Mariscal corpus (2005) and the Ojea and Llinàs-Grau (2004) corpus for Peninsular Spanish. They found three specific question contours that could reliably be associated with different pragmatic intentions in CDS: L* HH% was largely associated with unbiased yes-no questions, L+H* HH% with invitations and L+H* LH% with echoic functions, but again no one-to-one mapping. However, these three contours were already present in child speech at 19 months in their corpus. The case of Peninsular Spanish differs from the case of PRS, which does not have a tendency to use different contours for invitations or echo questions. Thus in the case of Peninsular Spanish, children produced specialized contour types within the question domain based on the tendencies to associate certain contours with specific intentions in CDS. But the intentions being encoded by these contours are intentions that are known to be acquired early in the acquisition process. For example, in early speech, children are
known to produce “repeat” questions, which I classify as echo questions, since they repeat some part of the adult’s previous utterance (Johnson 1983; Brown 1973; Klima & Bellugi, 1966; O’Grady 1997; Estigarribia 2010). As for requests, at 19 months Halliday’s (1984) son Nigel was producing utterances with a “do something!” function, which includes the generalized meaning of ‘I want you to’, ‘I want us to’, etc. Nigel’s “do something” utterances emerged with rising intonation. The Peninsular Spanish case shows us, then, that if there is a reliable relationship between a form-meaning pair, and the intention expressed is accessible to the child, then the form-meaning pair can be acquired. But what happens when the meaning conveyed in the form-meaning pair is epistemic? The PRS yes-no question domain allows us to explore this question.

My analyses from Chapters 2 and 3 allow for me to begin with a clear picture of how the target system works in PRS so that we can now to turn to child-directed-speech (CDS) and child speech to discover 1.) what sort of information caretakers give children about the default and epistemic contours in the input and 2.) what the intonational system within the yes-no question domain looks like for toddlers. In this chapter, I analyze a database of CDS and child speech in PRS for two female toddlers between the ages of 19 and 43 months, with the goal of answering these questions.

4.1.3. Yes-no question acquisition

Most literature on the acquisition of yes-no questions focuses on syntactic development, especially for the case of English. The literature on English typically identifies two separate periods that are part of the child’s development of yes-no questions: an earlier “intonation-based” period where multiword utterances have no special interrogative syntax (but rather are
only characterized by a rise) and later a “syntax-based” period, where multiword utterances indeed show special interrogative syntax (Estigarribia, 2010). I assume that when children produce intonation questions, their parents’ response may provide them with reliable feedback: the child learns that when they use a specific contour, their caretakers respond to them in some way.

Another consideration is that children are hearers of their ambient language before they are speakers of it. Yoshida (1977) considers the child as a hearer, showing evidence that Japanese children respond more to questions marked with rising intonation than questions with certain interrogative particles (kana, desho, ka and no), but no rise. However, as noted in Chapter 2, Caribbean varieties do not typically show interrogative syntax on the surface. This was confirmed in the data- when the two corpora used in this study were pooled, only 13 tokens of 4574 utterances showed inversion. Therefore, I take intonation to be the most important linguistic cue to interrogativity in PRS, or at least in this corpus. This means that while the child in the “intonation stage” of question acquisition for English is not considered to have fully acquired yes-no question marking, this is not necessarily the case for PRS-acquiring children. In PRS, a child marking questions only by intonation could be considered adult-like (if we don’t consider tune-to-text alignment and scaling). But as I have shown in the prior chapters, different types of yes-no question marking through intonation is possible in PRS. Children, at some point, are expected to be exposed to contours encoding information in addition to interrogativity (what Escandell-Vidal 1998 would refer to as procedural information). How are these contours presented to children in the input, or child-directed speech (CDS), and how does this affect their emergence in child speech?
4.1.4. Estigarribia’s elaboration model

Estigarribia (2010a), in his work on non-canonical questions in child speech, investigated how variation in the input facilitates acquisition of yes-no question inversion. He examined the cline of acquisition in terms of increased syntactic complexity, proposing a Right-to-Left Elaboration (RTL-Elaboration) model. In this model, non-canonical yes/no questions (questions without interrogative syntax) bridge the gap between the structure of fragmentary yes/no questions that are produced early on, and more complex auxiliary inverted yes/no questions. For example, a child would acquire a fragment (Cold?), later a subject-predicate question (You cold?) and finally a question showing inversion (Are you cold?). The utterances become more elaborate at the left edge in their subsequent stages. Two claims are made: 1.) simpler forms are learned earlier and 2.) early forms are eventually elaborated “right to left” by the addition of subjects first, and auxiliaries last. With respect to simpler forms, Estigarribia’s data also show that less than half of CDS questions were inverted. Cameron-Faulkner et al. (2003) has also claimed that simpler structures are found in CDS when compared to adult-directed speech. While I do not take Estigarribia’s second claim to be relevant for the case of intonational development, the first claim would indeed have implications for the PRS yes-no question system, since it is possible to view the system in terms of complexity. Table 22 shows the same information presented in Table 21, this time classifying the contours in terms of their complexity.
I propose that the three contours used in the PRS yes-no question domain differ in degrees of *complexity*. Bane (2008) proposes that the best approach to measuring morphological complexity is to:

“…begin with an *a priori*, mathematical notion of complexity, which is essentially an elaborated statement of our intuitive grasp of the difference between ‘complex’ and ‘simple’ objects in the most general sense (*an object is more complex insofar as it takes longer to describe*), and to examine how it might be applied to linguistic systems like the morphological component of a grammar” (p. 74).

Assuming that that nuclear configurations are intonational morphemes, and if we apply the intuitive idea about an object being more complex in that it takes longer to describe, then Table 22 shows that the contours increase in complexity from $\ddot{i}H^* L\%$ to $H+L^* L\%$ to $L^* HL\%$. Neither $\ddot{i}H^* L\%$ nor $H+L^* L\%$ depends on context but speakers encode information about their own beliefs with $H+L^* L\%$, so it would be considered more complex than $\ddot{i}H^* L\%$ according to Bane. $L^* HL\%$ depends on the activation of information in the context, and in addition the speaker must perceive an incongruence between his/her belief and that activation. Thus I consider $L^* HL\%$ to be the most complex of the three contours. The complexity of

<table>
<thead>
<tr>
<th>Contour</th>
<th>Speech act encoded</th>
<th>Belief encoded</th>
<th>Contextual licensing</th>
<th>Complexity</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\ddot{i}H^* L%$</td>
<td>Interrogativity</td>
<td>No</td>
<td>No</td>
<td>Least complex</td>
</tr>
<tr>
<td>$H+L^* L%$</td>
<td>Interrogativity</td>
<td>Speaker’s private belief that $p$</td>
<td>Cannot be an unbiased question</td>
<td>More complex</td>
</tr>
<tr>
<td>$L^* HL%$</td>
<td>Interrogativity</td>
<td>Speaker calls attention to incongruence between her belief and recently acquired information</td>
<td>Cannot be an unbiased question, recently acquired information is temporally restricted (information must have <em>just</em> come about in the context)</td>
<td>Most complex</td>
</tr>
</tbody>
</table>

Table 22. Complexity of $\ddot{i}H^* L\%, H+L^* L\%$ and $L^* HL\%$
multidimensionality of incredulous intonation is discussed in Asher & Reese (2005) as well as Cohen (2007) (see Section 2.2).

Therefore we find varying degrees of complexity among the contours in terms of the type of information they encode, their licensing conditions and the cognitive process that occurs prior to the speaker encoding the information. Taking this into consideration I hypothesize that, in addition to frequency, the complexity (how many components of the contour’s meaning need to be learned to successfully use the intonational morpheme) will affect the emergence of intonation contours in the yes-no question domain. Hence for this particular intonational system, in this particular domain (yes-no questions), the prediction would be that the simplest and possibly most frequent form, ¡H* L%, would be learned earliest, then H+L* L%, then L* HL%.

Another claim from Estigarribia’s (2010b:187) proposal is that children learn progressively more information about target question structures: “Children latch onto a subset of properties of a morphosyntactic construction (namely, parts of fuller question strings), and then incrementally expand their knowledge”. Another prediction of the model, then, is that children may show a partial knowledge of specific constructions. This too can be applied to the acquisition of question intonation in PRS with respect to the function of the contours. The question types I have been discussing throughout the dissertation are comprised of varying components, as shown in Tables 21 and 22. Following the idea of incrementality, I would predict that the element “interrogativity” or even more generally “response eliciting utterance” could be acquired earlier than the epistemic components of the questions.
4.1.5. Other considerations

By considering the complexity of the form-meaning pairs, we can address the cognitive mechanisms that must be in place in order to extract the correct information out of the input (CDS) for categorization. As Bowerman (1994) notes, “some children may have a normal ability to scan the input for cues to categorization, but nevertheless be limited in their ability to make sensible guesses about what the needed grouping principles might be” (p. 356). But what are caretakers providing in the input in the first place? It is well-known that prosody is manipulated by mothers and other caretakers in infant-directed speech, using expanded pitch contours and more focused words (Fernald, 1994; Fernald & Simon, 1984; Fernald et al. 1989; Papoušek et al. 1985; Papoušek et al. 1987, among many others). Ko (2012) showed that CDS speaking rate changes non-linearly with a shift occurring early in the multiword stage. She also presents some evidence for an additional breakpoint when children are just beginning to speak. Estigarribia (2010a, 2010b) and Cameron-Faulk et al. (2003) both discuss simplification of forms in CDS in the syntactic realm. These studies show the dynamic nature of the input, and how it may change depending on the needs of the child. Could this be the case for more complex intonation contours that encode information about speaker belief states, i.e. epistemic information? Papafragou (1998) has suggested that for the case of modal expressions, it is reasonable to assume that in CDS parents tend to produce modals dealing with permission, delegation, ability and other related notions, but not modal expressions dealing with inference of evaluation of necessity or possibility. This means that in CDS the use of epistemic expressions could be simplified as well, especially since to use them the speaker must evaluate his/her own thoughts. Following Papafragou’s logic then, it might also be reasonable to assume that in CDS caretakers would generally avoid question types that involve the evaluation of propositional content, and therefore
we might expect to find parents avoiding the epistemic contours H+L* L% and L* HL%, favoring the default contour ¡H* L%. Through the choice of the ¡H* L% contour, speakers can exploit contextual evidence in such a way that they can really get by without the use of any other specialized yes-no question contour, since ¡H* L% will take on contextual bias and can be phonetically manipulated if need be (e.g. surprise questions). But when do parents begin to produce the different pieces of the system, and when do children begin to use them? The end of the analysis here is at 43 months, a point that could quite possibly be before either of the children have acquired a representational Theory of Mind. Depending on the points in the corpus, the children whose speech I analyzed could be expected to have the following, according to Papafragou (1998):

1.) a non-representational grasp of desire, seeing desires as drives towards objects and perceptions as awareness of visual contact with objects (2-year-olds)

2.) a non-representational conception of belief (3-year-olds)

Milligan et al. (2007) note that typically it is by the age of five that children are able to understand that “people represent the world in their minds and understand that these representations determine what a person says or does, even in cases where they are misrepresentations of the actual world” (622). This ability to represent the beliefs of others, or Theory of Mind, has been shown to constrain the acquisition of epistemic modal terms such as may and must (Papafragou, 1998). But younger children have been shown to have Theory of Mind skills as well. O’Neill showed that when two-year-olds had to ask their parents to retrieve a
toy for them, they were more likely to name it and gesture to it if the parent had not witnessed the hiding of the toy, versus when the parents knew what and where the toy was. While I do not specifically evaluate children’s Theory of Mind development in this study, it is still helpful to consider the general age-related claims that are relevant to the kind of “mind-reading” that children would need to do in order to 1.) extract information about caretakers’ mental states when epistemic forms are heard in the input and 2.) make an evaluation of their own mental states when they produce the forms.

Behrens (2006) points out that acquisition studies set the criteria for acquisition either by measuring onset of productivity (use of a given structure with a specific number of lexical items or morphological contrasts) or full mastery. Full mastery refers to the use of a grammatical feature in at least 90% of all obligatory contexts. Behrens argues that the disadvantage of the 90% criterion is that it can only be used when we are talking about grammatically obligatory features (Behrens gives the example of 3rd person agreement or plural marking in English). When dealing with pragmatic or stylistic variation then, there is no way to apply the 90% criterion. This observation is especially relevant to the acquisition problem I wish to describe. The choice to encode belief states is not obligatory, and the types of contexts where belief-encoding might arise are not easily predictable. For example, we cannot predict how often a speaker will choose to linguistically encode their belief state, nor can we predict how often a speaker might evaluate new information as unexpected, or contrary to an existing belief s/he had. In a corpus study it is impossible to gain access to a running list of the belief states of speakers prior to and at the time of the utterance. Additionally, it is not the case that for every yes-no question a speaker utters, that they are constantly choosing between the three contours. Not every
situation allows for the use of the contours. The epistemic contours are expected to be less frequent than the default contour, given their restrictions. That said, I start off with the assumption that while the epistemic contours may be less frequent overall, their use can still be telling with respect to how they are acquired.

4.1.6. Goals and hypotheses

The goal of this chapter is to determine how the three contours described in Chapters 2 and 3 (¡H* L%, H+L* L% and L* HL%) are used in CDS and child speech during the toddler years. My first hypothesis is based on Behren’s (2006) observations about grammatical obligatoriness. Speakers do not always have the option to use the epistemic contours, so the sheer number of possibilities for epistemic contour use would then be lower.

I hypothesize that:

H1: In general, epistemic contours will be lower in frequency than ¡H* L% in CDS and child speech because they have less possibilities for occurring\(^\text{15}\).

Estigarribia (2010a; 2010b) proposes that for syntactic acquisition, the more complex the form, the later it is acquired. He also claims that children latch onto a subset of properties of forms. This behavior is possible with the epistemic contours, since they differ in degrees of complexity. By virtue of being complex, the epistemic contours can be broken down in terms of the information they convey as well as how they are restricted. Therefore it is possible that like morphosyntactic constructions, children might partially acquire the epistemic contours, i.e. they

\[^{15}\text{While it is possible that in CDS, epistemic contours are avoided because their meaning is less simple, I have no spontaneous speech corpus of adult speech to compare relative frequency to. The database from Chapter 2 was designed to elicit specific contour types so it is impossible to compare adult and CDS frequency.}\]
may use them based on some, but not all of the properties that make up the contour. Hypotheses (2) and (3) are based on these possibilities.

**H2**: Complexity: If epistemic contours do indeed emerge, H+L* L% would be predicted to emerge before L* HL% based on the differences in degree of complexity.

**H3**: Incrementality: If epistemic contours do appear in CDS, it is possible that given the complexity of the contours, some but not all elements of the contours’ meanings may be available to children. I predict that the first of these elements would be speech act information (i.e. interrogativity).

### 4.2. Methods

#### 4.2.1. Participants

The data from this study come from a corpus of two PRS-acquiring children (Ana and Cristina), their parents, and in the case of one of the children (Cristina), two experimenters that were conducting the study. The decision to include the experimenters in the analysis was based on the fact that the speech they produced when speaking to the child is in fact CDS by definition, i.e. it is speech directed to a child.

The first child whose pseudonym is Ana, is from a middle-class family and was being raised in Mayagüez, Puerto Rico. Her corpus, retrieved from the CLESS database (the University of Connecticut’s Cross-Linguistic Early Syntax Study project)\(^\text{16}\) (Villa-García et al. 2010; Villa-García to appear) includes transcripts and not-yet-transcribed recordings. The CLESS corpus ranges between 19 months and 41 months, though there were no recordings between the ages of

\(^\text{16}\) I am grateful to William Snyder and Diane Lillo-Martin from the University of Connecticut for making this corpus available to me.
35 and 39 months. Not all sessions of Ana’s corpus were analyzed due to the fact that we did not have permission to analyze all adult individuals who appeared in the corpus. The second corpus comes from the PAELMA corpus - *Proyecto de adquisición del español como lengua maternal*\(^{17}\) (Rivera-Ayala, 2006; Vaquero, 2003), coordinated by Drs. Carmen Hernández and Sunny Cabrera. The PAELMA corpus began when the child, Cristina, was 24 months old with audio recordings, and 26 months old with video recordings. The corpus ends when the child is 48 months old. Only the video recordings were analyzed here. Cristina also comes from a middle-class family, and was being raised in Río Piedras (San Juan Metropolitan Area), Puerto Rico. The PAELMA corpus included not-yet-transcribed recordings. The technique used in both of the corpora consisted of presenting the child with toys or materials, following certain dialogues to produce different specific utterance types. One important difference between the two corpora was that in the PAELMA corpus, in some sessions two experimenters interacted with the child, and in others the child’s parents interacted with her. It is worth noting that Experimenter 2 is Cristina’s maternal aunt. In the CLESS corpus, only the child’s parents were analyzed interacting with the child.

### 4.2.2. Materials

Table 23 lists the names of the two children, the age range analyzed, the number of sessions, and the total number of meaningful utterances analyzed for each child. For a more comparable analysis, Cristina’s data were analyzed up until shortly after the end point of Ana’s corpus (43 months).

---

\(^{17}\) I am grateful to Carmen Hernández from the University of Puerto Rico at Río Piedras for making this corpus available to me. I also thank Nadja Fuster and John Rueda for help digitizing the corpus.
<table>
<thead>
<tr>
<th>Name</th>
<th>Ages (mos.)</th>
<th>Freq.</th>
<th># recordings analyzed</th>
<th>Typical duration of sessions</th>
<th>Total duration analyzed</th>
<th># meaningful utterances</th>
<th>% child speech database</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ana</td>
<td>19-34; 40-41</td>
<td>Weekly, biweekly</td>
<td>60</td>
<td>15-30 min.</td>
<td>1335</td>
<td>429</td>
<td>65%</td>
</tr>
<tr>
<td>Cristina</td>
<td>26-43</td>
<td>Weekly, biweekly</td>
<td>87</td>
<td>30-40 min.</td>
<td>3045</td>
<td>232</td>
<td>35%</td>
</tr>
</tbody>
</table>

Table 23. Session information for Ana and Cristina

Table 24 shows the number of meaningful utterances produced by caretakers, and the percent of the CDS database they make up.

<table>
<thead>
<tr>
<th>Caretaker</th>
<th># meaningful utterances</th>
<th>% CDS database</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ana’s Mother</td>
<td>1138</td>
<td>25</td>
</tr>
<tr>
<td>Ana’s Father</td>
<td>414</td>
<td>9</td>
</tr>
<tr>
<td>Cristina’s Mother</td>
<td>1330</td>
<td>29</td>
</tr>
<tr>
<td>Cristina’s Father</td>
<td>26</td>
<td>1</td>
</tr>
<tr>
<td>Experimenter 1</td>
<td>759</td>
<td>17</td>
</tr>
<tr>
<td>Experimenter 2</td>
<td>905</td>
<td>19</td>
</tr>
</tbody>
</table>

Table 24. Meaningful utterances - caretakers

The total number of utterances from child speech was 661. The total number of utterances from CDS was 4574. Over half of the CDS corpus (54%) was made up of maternal speech, 36% of the CDS corpus was made up of non-parental caretakers (the experimenters) and 10% of the corpus was made up of paternal speech.
4.2.3. Corpus annotation

The recordings were digitized for analysis with the Phon software for phonological analysis (Rose et al. 2006). This software allows the researcher to watch the videos from the corpus and create both video clips and audio segments for analysis, as well as providing tiers for annotation. These tiers were used for the pragmatic transcription. All yes-no questions in the corpus were isolated and transcribed pragmatically and prosodically by the author. It is widely accepted that intentions must be transcribed separately from intonation contours (Prieto et al. 2012; Crystal 1973; 1986; Snow & Balog 2002) and this was followed here was well. In this way, the risk of using the contour as a cue to the intentionality, resulting in circularity, is avoided. The videos were used for the pragmatic coding since they contain visual information about the discourse context. Gestural information (both corporal and facial) was also available through the video analysis. Thus the pragmatic coding was performed in Phon with the following tiers:

1) Orthographic – orthographic transcription of the utterance
2) Corporal gestures (CG) – any accompanying gestures that were physical, but not facial
3) Facial gestures (FG) - any facial gestures produced by the speaker
4) Whether the utterance was a type of construction – whether the utterance had some specific syntactic marker or structure (C)
5) Whether the last syllable of the utterance bore stress – (e.g. ¿Tú vienes también?) this information was recorded to keep track of how often speakers truncated (UFS)
6) Specific question category – see pragmatic coding (Cat)
7) Subcategory, when applicable – see pragmatic coding (Subcat)
8) Whether there was a response – this included both verbal and physical responses (R)
9) Any additional paralinguistic information – surprise, excitement, etc. (Paraling)

Not all coded information was included in the analysis. The audio files were exported from Phon and imported in Praat (Boersma & Weenink, 2009).

4.2.4. Pragmatic coding

Since the objective of the analysis was to determine the intonation contours being used within the domain of yes-no questions for CDS and child speech, it was necessary to isolate all instances of yes-no questions in the corpus. The recognition and classification of yes-no questions without the help of syntax is a known methodological issue, even in adult-directed speech. Safarova (2006) discusses problematic approaches to yes-no question identification in the past. She observes that Prévot (2004) identified questions based on the intonation contour itself, which would obviously be circular for the present research. Fónogy and Bérard (1973) classified questions as all utterances that were answered with a yes or no in French as questions. Safarova claims that such an approach is both too weak and too strong. It allows utterances that are simply acknowledged with a “yes”-type answer to be included as questions, and it does not allow for contextually-entailed yes-no or I-don’t-know answers. Following Safarova, the general criterion for classifying an utterance as a yes-no question was a speaker’s partial or complete ignorance with respect to the truth of the contained proposition (see also Beun 1990, for Dutch). This ignorance could be feigned, which we often find in CDS when parents ask children questions that they actually know the answer to. Additional cues that helped to clarify an utterance’s membership to the class “yes-no questions” included: discourse context, gestural information and lexical content. Often times physical information such as sustained visual contact, eyebrow raising, head tilts and head nods are associated with both biased an unbiased
yes-no questions (Borràs-Comes et al. 2012), and this information was considered as well. In some cases these cues were not necessary to determine the status of interrogativity. For example, tag questions are characterized by a specific group of tag words (in PRS ok, verdad, no, sí) and they have a specific structure where speakers produce a statement followed by a non-IP-final juncture (a 3 break in Sp_ToBI) and finally the tag word in nuclear position.

Recent work on intonational development and pragmatic intentions such as Prieto et al. (2012), Prieto et al. (2011) and Thorson et al. (submitted) has followed Snow’s (2006) criteria for identifying meaningful utterances, and I followed these as well. A meaningful utterance had to show: (1) some phonetic relation to an adult-biased word (2) use in appropriate context (3) consistency; and (4) parent confirmation that the utterance was meaningful. Also following Prieto et al. (2012), imitated utterances were not included in the quantitative analysis. The initial labeling had very many question types that were often times very specific, but in the end were grouped into 6 general categories of questions for which a yes or no (or “I don’t know) response would be felicitous):

1. Unbiased questions (NoBIAS): True yes-no questions, where it seems the speaker does not know whether the answer will be yes or no. This often includes questions in play where the caretaker asks “pretend” questions. E.g. The child is pretending to cook the parent asks ¿Tú vas a hacer una sopita? ‘Are you going to make me soup?’

2. Biased questions (BIAS): If it could be logically assumed that the propositional content of question being asked would be shared information, the question was coded as biased. This included discourse-old information that would logically be shared between the caretaker and the child as well as evidence that was in the immediate discourse situation. Ostensibly marked biased questions such as tag questions, questions with the word sí or no that were used to confirm a prior utterance and referred to the polarity of that prior utterance and echo questions were included in this section. These last three question types were classified as subtypes (see (7) in Section 4.1.3. but not analyzed separately in the analysis. E.g. The child demonstrates to her mother how babies act and the mother confirms ¿Así hacen los bebes? ‘That’s what babies do?’
3. **Offers (OFF):** This included offers made to the hearer, these often include constructions such as ¿Quiieres X? (Do you want X?) or ¿Vamos a X? (Are we going to/shall we X?) for invitations. E.g. True offers: ¿Quiieres leche? ‘Do you want milk?’; invitations: ¿Vamos a recoger? ‘Are we going to pick up’.

4. **Requests (REQ):** Early in the corpus, it was difficult to tease apart an imperative from a request. In Stage 1 of the corpus, for example Ana would point and say a word until her caretaker responded and did so. Such utterances are classified by Halliday (1985:243) as ‘pragmatic’ and have “do something!” meaning. In English they have a rising tone indicating “response demanded”. This includes ‘give things’ meaning: (goods and services) e.g. more égg (accent mark indicates rising pitch accent), ‘do’ meanings (‘I want you to’ (e.g. star för-you), I want [me to be allowed to’ (get down), ‘I want us to’ (e.g. now room). ‘Papafragou (2000) has referred to a 14-month-old points, using gaze alternation, vestigial crying and lipsmacking as indicators of “something close to a request”. I considered these utterances with these intentions to be proto-requests, and included them in the broader category of requests, since I defined a request as an utterance expressing a desire. These sorts of questions are sometimes responded to with a positive or negative answer (or they are simply responded to by performing the requested action, which would entail a positive answer) and so they were included in the analysis. E.g. At 19 months Ana requested milk with one word: ¿[eʃe]? (i.e. leche) ‘Milk?’

5. **Reactivating questions (REAC):** These questions are characterized by short utterances which don’t include actual lexical content such as [a:], or [m]. They are used to reactivate a prior question the interlocutor has failed to respond to. These questions were included in the analysis only if it could be gathered from the context that a ‘yes’ or ‘no’ answer was expected. E.g. Cristina’s mother asks Cristina if she visited her aunt today. Cristina doesn’t respond and the mother presses further ¿Ah? ‘Hmm?’

6. **Post wh- suggestion questions (PWS):** A common behavior practiced by caretakers was asking the child a wh- question and providing a suggested answer to that wh- question directly afterwards. In this way parents introduce new vocabulary to the child in a way that the child must interact. An affirmative response to these types of questions, early on, would be the child repeating the word. E.g. ¿Qué es esto, bebé? ¿Oso? ‘What is this, baby? A bear?’

Figure 30 shows a screenshot of the pragmatic coding in Phon.

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18 Note that a common affirmative response strategy in general, early in the corpus is not for the child to use the affirmative particle sí, but rather to repeat some chunk of the caretaker’s previous utterance (e.g. Mother: Se queda en la casa? Child: En la casa.)
4.2.5. Prosodic coding

As was done for the adult data from the production experiments analyzed in Chapter 2, the intonational analysis of the child speech and CDS speech was done following the AM framework (Beckman & Pierrehumbert, 1986; Jun, 2005; Ladd, 2008; Pierrehumbert, 1980, among others). The same prosodic coding methods were followed as those found in Section 2.3.4.1 (see Chapter 2). Each meaningful utterance was annotated in *Praat* using (1) an orthographic transcription tier and (2) a prosodic transcription tier using the labeling conventions for Puerto Rican Spanish proposed in Armstrong (2010) and summarized in Appendix A. An example of the prosodic coding in *Praat* is shown in Figure 31.
Figure 31. Prosodic coding of the question ¿Vas a guardar las frutas? ‘Are you going to put the fruits away?’ produced by Cristina’s mother when Cristina was 28 months old. The question is produced with a L*+H prenuclear pitch accent on Vamos and the ¡H* L% nuclear configuration on frutas.

4.3. Results

4.3.1. Distribution of contours

Figures 32 and 33 present stacked bar charts for the distribution of different question types across the stages of the corpus.
Figure 32. Distributions of pragmatic question categories for CDS
Perhaps the most striking information shown in the bar charts is that most of both CDS and child speech are mainly made up of biased questions. Caretakers show a general tendency to favor BIAS questions across stages, the lowest use being 64%. Some variation is found for the other contour types in CDS. There is a large drop in PWS production in CDS during the time when the toddlers are between 25 and 33 months old. In general, there is not a great deal of variation found in terms of the different types of questions produced in CDS.

In the child speech we see that children favor biased questions even more than the caretakers, although at the very beginning of the corpus Ana produces a high number of requests, bringing the biased questions down to 56% during that period. Between 22 and 30 months the children consistently produce BIAS questions for above 90% of their yes-no questions, though
by 30 months they are producing at least four intention types (which include REQ and OFF questions, like the children in Prieto et al. 2011). Between 34 and 36 months, we find an increase in intentions types that are not BIAS questions. For example, the children produced more OFF questions than they had in earlier parts of the corpus. NoBIAS questions are more frequent after 37 months. In general, it can be said that after 34 months children start to distribute their intentions in a more adult-like way. PWS questions were not found in child speech, which is not surprising since they have an instructional function in CDS – they are often used to introduce new concepts and vocabulary. Crucial to the present study is the fact that most questions produced in CDS and child speech are BIAS questions, since the two epistemic contours I am interested should mainly be restricted to this general intention type.

There are further restrictions found for the biased contours. For example, in adult speech we don’t find either H+L* L% or L* HL% on tag questions. Tag questions comprised 2% of biased questions produced in child speech data and 5% of biased questions from the CDS data. Additionally, while L* HL% can occur on echo questions, H+L* L% is never found on echo questions in adult speech. Echo questions comprised 11% of biased questions in child speech, and 7% of biased questions in CDS.

To test the first hypothesis, that CDS and child speech would be generally characterized by ¡H* L%, I first report the overall distribution for the contours themselves in both CDS and child speech. Table 25 shows that both groups indeed favor ¡H* L%
Immediately we notice that the PRS situation is quite different from the Peninsular Spanish one described by Prieto et al. (2011). While in CDS Peninsular Spanish, caretakers favored L+H* HH% questions (48.70%) they used other contours rather frequently as well (L* HH% - 21.04%, L+¡H* L% - 22.9%) and these contours had already appeared by 19 months in child speech. Figures 34 and 35 show the frequency of contour use by intention in CDS and child speech, respectively for the PRS data. The PRS-acquiring children barely show variation in their production, producing ¡H* L% just about categorically.
Figure 34. % frequency of contour use by intention type – CDS

Figure 35. frequency of contour use by intention type – child speech
There was no intention type for which ¡H* L% was not heavily favored in CDS. As expected, L* HL% was only found for biased questions. H+L* L%, on the other hand was found for BIAS questions in addition to OFF and and REAC questions in CDS. H+L* L% only appeared for REAC questions when the speaker added a vocative to the question (e.g. ¿ah, Cristina?). As we might have surmised, L* HL% was only found for BIAS questions. These data allow us to generalize that, with respect to the intentions where the contours are possible in CDS: ¡H* L% is least restricted, H+L* L% is more restricted and L* HL% is most restricted. This mirrors the complexity relationship I proposed for the contours, where ¡H* L% is the least complex in meaning and L* HL% is the most complex, with H+L* L% somewhere in the middle.

Like their caretakers, children prefer ¡H* L% over the other contours in their production. The only epistemic contour that appears in the child corpus, H+L* L%, appears within intentionality categories where the contour is also acceptable in CDS: BIAS questions and OFF questions. Therefore, with the very few tokens of epistemic intonation available in the corpus, the children seemed to be sensitive to which sorts of intentions are acceptable for H+L* L% use. Since both CDS and child speech have been shown to be dynamic (Foulkes et al. 2005; Estigarriba 2010a, 2010b; Ko 2012), I now present the data looking at contour use across time. Figure 36 presents percentage of use of each contour for each of the stages for CDS, and Figure 37 for child speech. Note that since values for epistemic contours were very low, the scale on the x-axis begins at 75%. For each age period in the corpus, n shows the number of questions analyzed.
Figure 36. % contour across time – CDS
Figure 36 shows heavy ¡H* L% use at every point of the corpus in CDS. L* HL%, but not H+L* L%, is used in the earliest stages of the corpus. H+L* L% appears in CDS during the period when the children were 25-27 months, and from that point on the contour appears in each stage. Starting at that stage, the relative frequency of the three contours remains the same throughout the corpus - ¡H* L% is more frequent than L* HL%, and L* HL% is more frequent than H+L* L% in CDS. Figure 37 shows that this distribution and relative frequency is only reflected in child speech with respect to ¡H* L%, i.e. the most frequent contour in CDS is the most frequent contour in child speech. The only appearance of an epistemic contour in child speech, however, is H+L* L%, the least frequent contour in CDS.

Because there were non-parents included in the study, the effect of caretaker group was tested for each of the contours, with Cristina’s parents as the reference level. This was done for
CDS only since there was such little variation for children. This analysis allowed me to assess whether the two sets of parents differed from each other, and whether Cristina’s parents’ use of contour types differed significantly from her experimenters’. The models were created (one for each contour type) using the glm procedure in R (R Development Core Team, 2009). One model was fit for each contour type, with contour as the dependent variable and caretaker group as the independent variable. Coefficients for the three models are presented in Table 26. For each contour type, Cristina’s parents’ use was found to be significantly different from Ana’s parents’ contour use, but not Cristina’s experimenters’ contour use. There were no significant differences between Cristina’s parents and experimenters for any contour type. Ana’s parents used significantly more ¡H* L% than Cristina’s parents (2.38/3.02), less H+L* L% (-3.53/-4.93) and less L* HL% (-2.18/-3.19) than Cristina’s parents. Cristina’s parents used slightly less ¡H* L% than Cristina’s experimenters (2.38/2.57), slightly more H+L* L% (-3.54/-3.86), and slightly less L* HL% (-2.81/-2.93), though none of these differences were significant. Ana’s parents used significantly less epistemic contours in general. The analysis showed that Cristina’s two caretaker groups were comparable in how often they used the default contour vs. the epistemic contours. However, each child produces the same number of epistemic contours (2), so the difference between Ana and Cristina’s parents in terms of epistemic contour use did not lead to any differences in the child speech corpus.
<table>
<thead>
<tr>
<th></th>
<th>Estimate</th>
<th>SE</th>
<th>z value</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>¡H* L% (reference level is Cristina’s parents)</td>
<td>2.38</td>
<td>0.10</td>
<td>24.422</td>
<td>&lt;0.01</td>
</tr>
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<td>Ana’s parents</td>
<td>0.64</td>
<td>0.16</td>
<td>4.14</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Cristina’s experimenters</td>
<td>0.19</td>
<td>0.14</td>
<td>1.41</td>
<td>0.16</td>
</tr>
<tr>
<td>H+L* L% (reference level is Cristina’s parents)</td>
<td>-3.54</td>
<td>0.16</td>
<td>-21.56</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Ana’s parents</td>
<td>-1.39</td>
<td>0.34</td>
<td>-4.05</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Cristina’s experimenters</td>
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<td>0.24</td>
<td>-1.35</td>
<td>0.18</td>
</tr>
<tr>
<td>L* HL% (reference level is Cristina’s parents)</td>
<td>-2.81</td>
<td>0.12</td>
<td>-23.96</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Ana’s parents</td>
<td>-0.38</td>
<td>0.18</td>
<td>-2.19</td>
<td>0.03</td>
</tr>
<tr>
<td>Cristina’s experimenters</td>
<td>-0.12</td>
<td>0.16</td>
<td>-0.76</td>
<td>0.45</td>
</tr>
</tbody>
</table>

Table 26. Coefficients – effect of caretaker group on contour production

4.3.2. ¡H* L% use

4.3.2.1. Phonological observations

Figure 35 shows an example of ¡H* L%, the most commonly produced contour, by Ana’s mother.
Ana’s phonetic implementation of ¡H* L% is particularly interesting. As I discussed in Chapter 2, speakers have the option to truncate a low boundary tone L% when the nuclear stressed syllable is IP-final. Ana seems to overgeneralize this rule to all yes-no questions in the sessions before she is 25 months old. That is, Ana always truncates the final low boundary tone L% regardless of whether the nuclear stress syllable is IP-final or not during those stages. Based on Armstrong (2010), truncation has not been observed for any other utterance type in PRS. For instance, narrow focus statements with H* L% do not show truncation. The only nuclear configuration in the variety that has been shown to find an extra-high suspended F0 contour is ¡H* L%, and this nuclear configuration is specific to yes-no questions. Figure 39 shows an example of Ana’s early truncation on a question bearing nuclear stress on a syllable that is not
IP-final in the echo question ¿dos mitades? ‘Two halves?’ Instead of a fall after the stressed syllable in mitades the fundamental frequency remains suspended until the offset of the utterance (% indicates that the L tone was truncated).

Figure 39. Waveform, spectrogram and F0 trace for a (biased) echo question produced by Ana at 25 months, truncating the low boundary tone L% for the question ¿dos mitades? ‘Two halves?’ produced with a L*+H prenuclear pitch accent followed a H* nuclear pitch accent that remains suspended until utterance offset.

Ana’s first productions of the low boundary tone L% emerge when she acquires the tag question ¿viste? ‘Did you see?’ when she is 25 months of age. This is a type of perception-checking question. An example of a viste question is provided in Figure 40, produced by Ana at 25 months.
Figure 40. Waveform, spectrogram and F0 trace for the (biased) perception-checking question produced by Ana at 25 months, ¿viste? ‘Did you see?’ produced with a ¡H* nuclear pitch accent followed by a fall to a low boundary tone L%.

But it is not the case that once Ana produces a L% boundary tone, she completely sorts out the truncation rule. Figure 41 shows that up until 33 months, Ana shows variable use of the L% boundary tone for utterances that are not candidates for truncation (doing so categorically between 19 and 21 months). By 33 months, Ana no longer violates the rule. This is the same point at which Ana starts to show evidence that she recognizes the optionality of truncating versus compressing, although she shows no specific trend in that variation after 27 months. By 33 months there is evidence of Ana’s awareness that: 1.) truncation only occurs in a specific phonological context and 2.) where truncation is acceptable, it is also optional.
Ana’s parents’ data do not show any specific trend in terms of more or less truncation throughout the corpus, as shown in Figure 42. In contexts where there was an option to truncate, Ana’s parents chose truncation over compression 86% of the time, overall. By 41 months, Ana is truncating at a rate more similar to her parents (83%).
Figure 42. % truncation use in appropriate contexts for Ana’s parents (n=561)

Cristina’s truncation patterns are quite different from Ana’s. Where Ana starts out truncating categorically, Cristina starts off showing sensitivity to the optionality of the rule, albeit conservatively. At 26 months, when Cristina’s corpus begins she is already producing the L% boundary in [H* L%. Figure 43 shows an example from Cristina when she was 28 months of age.
Figure 43. Waveform, spectrogram and F0 trace for the (biased) echo question produced by Cristina at 28 months: ¿Uva? ‘Grape?’ produced with H* nuclear pitch accent followed by a fall to a low boundary tone L%.

Figure 44 shows that around 33 months, Cristina is truncating 80% of the time in contexts where truncation is acceptable, truncating less in the next stage, and building up again gradually to 75% by the end of the recordings analyzed here. There is one example at the end of the corpus where Cristina does in fact produce truncation a question with post-nuclear segmental material where truncation is not appropriate, using a contour that would be phonetically labeled as L* HH% in Sp_ToBI. In the absence of early data, it is difficult to determine whether this is residual behavior from an earlier stage\(^\text{19}\).

\(^{19}\) An informant commented that this use of L* HH% sounded like la niña se equivocó cuando hizo la pregunta, como hacen los niños a veces ‘the girl made a mistake when she asked the question, like kids do sometimes’.
Figure 44. % truncation use for Cristina (truncation candidates vs. non-candidates) (n=232)

Cristina’s caretakers truncated in appropriate contexts 83% of the time, with the same frequency as Ana’s parents. As Figure 45 shows, there is little variation in terms of the extent to which Cristina’s caretakers choose truncation over compression in appropriate contexts throughout the corpus, though they show the lowest percentage of truncation at the beginning of the corpus.

suggesting that this rise might be characteristic of child speech that speakers are aware of. A look at question intonation in child speech prior to 19 months would be helpful to sort out this issue.

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Figure 45. Truncation use in appropriate contexts for Cristina’s parents (n=937)

When considering how Ana deals with truncation in her acquisition of questions intonation compared to Cristina, we should keep in mind that it is well known that a great deal of individual differences are found in L1 segmental phonological acquisition (Vihman, 2006), and in that sense acquisition. Thus we might expect differences in the way children acquire an optional rule in this variety shows evidence for individual differences as well\(^\text{20}\). Production work is needed for languages that show optionality for truncation and compression. It should also be pointed out that it seems that caretakers tend to truncate more than they compress for questions that are truncation candidates, and it could be the case that Ana was sensitive to this distribution early on, overgeneralizing it for all yes-no questions.

\(^{20}\) Another possible explanation for the difference between Ana and Cristina in terms of L% truncation is the dialectal difference between the San Juan area and Mayagüez. Ana’s parents also show the dialectal phenomenon of realizing the low boundary tone L% as a mid tone M%. A possible speculation is that variation in the input in addition to the optionality of truncation where appropriate could lead the child learner of Mayagüez PRS to make the overgeneralization that low boundary tones are not obligatory.
4.3.2.2. Pragmatic observations

As shown in Figures 34-37, both caretakers and children rely on ʔH* L% the most as a yes-no question contour. Caretakers do this less, since they produce a great deal more epistemic contours than the two toddlers do. However, the fact that by the end of the corpus the children are producing four and five intention types shows that children understand that ʔH* L% can be used for multiple intention types. This may actually be something that is reinforced through more experience to the ambient language, rather than learned specifically. Halliday (1975) describes his son Nigel as going through a phase where he uses rising tones for all “pragmatic” utterances (utterances that require a response) and falling tones for “mathetic” utterances (those that do not require a response). It is possible that children start off with the larger category “response-eliciting”. In this sense, the ability to use ʔH* L% for a wide array of response-eliciting intentions would only confirm the child’s initial hypothesis. The fact that in CDS speech ʔH* L% is used for many intention types would serve as positive evidence for children that one intonation contour can be used to elicit responses that differ in their intention. The almost categorical use of ʔH* L% in child speech confirms the first two hypotheses. The high frequency contour is the most commonly used contour not only in child speech, but also in CDS. Additionally it is the least complex contour, the one encoding interrogativity and nothing more, that has the highest frequency and emerges first.

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21 While I did not analyze them, the corpus showed many instances of imperatives and declaratives with final rises. A very preliminary suggestion is that these imperative and declarative rises instruct the hearer that some sort of response is required. For imperatives, the response required is the action that has been ordered, for declaratives it is less clear. However, this is interesting with respect to the learning problem of the PRS child – s/he will need to make distinctions in response-eliciting utterances in order to fully comprehend how contour choice works in this general area.
4.3.3. **H+L* L% use**

4.3.3.1. *Phonological observations*

The typical realization of H+L* L% in CDS is characterized by an initial prenuclear rise that stays high throughout the utterance, a fall to a low tone within the nuclear stressed syllable and finally a low boundary tone.

Figure 43 shows an example of H+L* L% produced by Ana’s mother.

![Waveform, spectrogram and F0 trace for the (biased) question produced by Ana’s mother, ¿y vas a llamar a titi madrina? ‘And you’re going to call your godmother?’ produced with H+L* nuclear pitch accent followed by a fall to a low boundary tone L%](image)

Figure 46. Waveform, spectrogram and F0 trace for the (biased) question produced by Ana’s mother, ¿y vas a llamar a titi madrina? ‘And you’re going to call your godmother?’ produced with H+L* nuclear pitch accent followed by a fall to a low boundary tone L%
Figure 47 shows an example of a biased question ¿una grande? produced with H+L* L% by Cristina when she was 42 months old. As in CDS speech, Cristina realized the leading H tone on the pretonic syllable na, falling onto the nuclear stressed syllable gran.

![Figure 47](image)

Figure 47. Waveform, spectrogram and F0 trace for the (biased) echo question produced by Cristina (42 months), ¿una grande? ‘a big one?’ produced with the H+L* nuclear pitch accent that remains low at the boundary tone L%. The rise is found in the prenuclear syllable, the onset of the fall is at the nuclear syllable’s onset and continues to fall throughout the nuclear stressed syllable.

4.3.3.2. Pragmatic observations

H+L* L% is not found in CDS between the ages of 19 and 24 months. Note that Cristina’s data was not included during this time. H+L* L% indeed emerges in CDS, and this is not simply because Cristina’s data have been added at that point. Ana’s mother is the first
caretaker in the corpus to produce H+L* L%, when Ana was 25 months old. Ana’s parents produced 17% of the H+L* L% questions found when the girls were between the ages of 25 and 28 months. As shown in Table 25 and Figure 37, H+L* L% does eventually emerge in child speech, albeit only 4 tokens out of the entire corpus. The first emergence of H+L* L% is produced by Ana, when she was 32 months old. Cristina’s H+L* L% productions come later, one at 41 months and the other at 42 months. Ana’s second H+L* L% token is produced at 41 months. As noted above, there were three types of questions where CDS speakers produced H+L* L%: biased questions (which would have been predicted based on the findings from Chapters 2 and 3), but also offers (OFF) and reactivation (REAC) questions. Of the four tokens of H+L* L% produced in child speech, three were produced in biased contexts, and one was produced as an offer (by Cristina). Thus the very few tokens of H+L* L% in child speech were restricted to the same question types as in CDS. Figures 34 and 35 showed that for the very few times the children use H+L* L%, it is used for two of the intentions where the contour is found in CDS. This suggests that children are also sensitive to pragmatic restrictions on epistemic contours. According to Tomasello & Stahl’s (2004) caveats about sample size, four tokens of a given form should be thrown out of the analysis. I argue that while the tokens are very few, we need these to come to a better understanding how intonational development works, and should at the very least be analyzed qualitatively. Because H+L* L% encodes the private beliefs of a speaker, it would be impossible to know whether the girls were indeed choosing H+L* L% in

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22 It is worth noting that in the months prior to her H+L* L% production Ana has a tag question “explosion”. This is relevant because during Stage 4 Ana produces tags such as ¿viste? ‘Did you see?’ which calls attention to visual perception, as well as ¿verdad que sí? ‘Is it true?’ which calls attention to the truth value of a proposition. During Stage 5 Ana continues her tag explosion producing a great deal of verdad que questions at this stage differ in polarity, i.e. ¿verdad que sí? or ¿verdad que no? Her awareness of confirming information based on evidence as her ability to confirm truth values and differentiate them based on polarity seems relevant to the ability to use the epistemic contour H+L* L%. 

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order to linguistically encode their belief states. (27) shows the context from Cristina’s H+L* L% production in Figure 45:

(27) E1: ¿Tú sabías que hoy nació una girafa, en el zoológico de Mayagüez?
Cristina: (nods)
E1: Nació una girafa bebé.
Cristina: ¿Una grande? (H+L* L%)
E1: Había una grande, sí. Muy alta.

E1: Did you know that a giraffe was born today, in the Mayagüez Zoo?
Cristina: (nods)
E1: A baby giraffe was born.
Cristina: A big one. (H+L8 L%)
Cristina: There was a big one, yes. Very tall.

Though there are no prior conversations in the corpus during which Cristina learns about this baby giraffe, but from this conversation it certainly seems that she knew about the baby giraffe, and that it was big. In fact, the experimenter’s reaction in the video suggests that she was surprised that Cristina, who was 41 months old at the time, was so informed on the subject. It seems possible then, that Cristina had a prior belief about the baby giraffe being large, and this is also accepted by the experimenter at the time of utterance. It is also important to note that all H+L* L% tokens produced by the children were answered by caretakers, who showed no signs of any sort of perceived infelicity (note that in Chapter 3 I showed it was possible to find contexts where H+L* L% was infelicitous). The child’s felicitous use of the contour in context and the caretaker’s response can be construed as positive evidence to the child, i.e. the child “tried” H+L* L% and it “worked”.

It is important that this contour occurs with felicitous use, obeying the pragmatic restrictions available in the input. This use confirms the prediction that H+L* L% should be
produced felicitously in child speech before L* HL%. The child does not have to deal with contrasting her beliefs to some proposition, nor are there temporal restrictions on the use of H+L* L% for it to be acceptable in context for an adult speaker.

4.3.4. L* HL% use

4.3.4.1. Phonological observations

L* HL% was the more frequent of the two epistemic contours in the CDS data. Figure 46 shows an example of a typical L* HL% token from the CDS data, produced by Experimenter 1 from Cristina’s data. In the word dedos we find the typical low, flat tone in the nuclear stressed syllable with a subsequent rise and fall in the post-tonic syllable.
Figure 48. Waveform, spectrogram and F0 trace for the (biased) question produced by Experimenter 1 when Cristina was 41 months old, ¿te chupas los dedos? ‘You suck your fingers!? produced with a H* prenuclear accent, a L* nuclear pitch accent that remains flat and low until the onset of the post-tonic, where it rises and falls again.

One possible argument for why L* HL% is not felicitously produced in the corpus is its complex boundary tone – perhaps children are conservative in their use because the contour is simply too difficult to produce due to physiological difficulties. Counterevidence to this explanation was found in the corpus, since Cristina in fact produced a L* HL% token that was not included in the analysis because it was very obviously pragmatically infelicitous, as I will discuss in 4.3.4.2. Figure 49 shows the waveform and F0 contour for Cristina’s phonologically, but not pragmatically acceptable production of L* HL%. This was produced when Cristina was
28 months old. Note the low, flat tone followed by a rise-fall complex boundary tone in the post-tonic syllable, as found in adult speech.

![Waveform, spectrogram and F0 trace](image)

Figure 49. Waveform, spectrogram and F0 trace for Cristina’s biased question (at 28 months), ‘¿Esto?’ ‘This?’ produced with a L* nuclear pitch accent followed by a subsequent rise and fall at the boundary tone – HL%.

4.3.4.2. Pragmatic observations

When the utterance shown in Figure 48 was produced by Experimenter 1, Cristina had just admitted to the experimenter that she sucks her fingers. The experimenter uses the incredulity contour here since Cristina is now three years old, an age where she “shouldn’t” be sucking her fingers anymore, according to her rules/norms (or at least the experimenter’s question implicates so). Here the experimenter conventionally conveys her disbelief about Cristina sucking her fingers, making her prior beliefs known about whether children should suck
their fingers, which ages children suck their fingers at, etc. This is a good example of the deontic use of L* HL%, since the experimenter conveys to Cristina that given the rules/norms of the world, perhaps ‘big girls shouldn’t suck their fingers’.

The following conversation shows L* HL% use in a conversation between Cristina and her mother when Cristina is 28 months old:

(28) Mother: Ese libro, ¿es grande o pequeño? ¿Ah? ¿Cómo es el libro?
Cristina: Pequeño.
Mother: ¿Pequeño? L* HL%
Cristina: Pequeño. (smiling)
Mother: ¿Sí? L* HL%
Cristina: Sí.
Mother: ¿De verdad? L* HL%
Cristina: Sí.
Mother: Pero si tú sabes que ese es el libro grande…
Cristina: Este..
Mother: ¿Ah?
Mother: ¿Ese libro es grande o pequeño?
Cristina: Pequeño.
Mother: ¿Pequeño? L* HL%
Cristina: Sí (nodding and smiling)
Mother: ¿Sí? L* HL%
Cristina: Sí. (laughing)
Mother: ¡Tú eres una bandida! Y qué tú estás viendo, ¿el abecedario?
Cristina: ¿Esto? (pointing to a picture in the book) L* HL%, ¿esto? L*HL%
Mother: ¿Qué tú dices?
Cristina: ¿Esto? L* HL%
Mother: ¿Qué es esto?
Mother: That book, is it big or small? Hmm? What is the book like?
Cristina: Small.
Mother: ¿Small? L* HL%
Cristina: Small. (smiling)
Mother: Yes? L* HL%
Cristina: Yes
Mother: Really? L* HL%
Cristina: Yes.
Mother: But if you know the book is big…
Cristina: This…
Mother: ¿Hmm?
Mother: Is that book big or small?
Cristina: Small.
Mother: Small? L* HL%
Cristina: Yes. (nodding and smiling)
Mother: Yes? L* HL%
Cristina: Yes. (laughing)
Mother: You’re a little rascal! And what are you looking at, the alphabet?
Cristina: This? (pointing to a picture in the book) L* HL%, This? L*HL%
Mother: What are you saying?
Cristina: This? L* HL%
Mother: What is this?

L* HL% is largely used in CDS when the caretaker encourages the child to reformulate an answer. In this way the caretaker may actually extend disbelief to implicate “that’s wrong”, i.e “what you have just said it not the case”. Cristina’s mother uses L* HL% in (28), for example, to implicate to Cristina that the book is not small, but big. In (28) Cristina is holding a very large book (it is almost larger than Cristina herself), and her mother asks her if it is big or small. The obvious answer to the mother is “big”, but Cristina answers “small”. Cristina’s mother’s use of L* HL% when she echoes ¿pequeño? conventionally conveys, ‘I think the book is not small, but big.’ Cristina continues to supply the wrong answer. The mother begins to assume that Cristina is just being silly, calling her a little rascal. Cristina’s mother later changes the subject by asking Cristina if she is looking at the alphabet (in the book). Cristina replies to this question with what is seemingly an echo question (since she looks at her mother as if waiting for an answer). She produces the question ¿esto? two times while pointing at the page in the book, each time with L* HL%. However, unlike when the children produced H+L* L% and the conversation continued to flow, Cristina’s use of L* HL% does not result in continuous flow of the conversation. In fact, it impedes it. Cristina’s mother asks “What are you saying?”, searching for meaning in Cristina’s
last utterance. She says to Cristina ¿Qué es esto? as if to say, “Are you trying to ask me what this is?” This is an effort to attempt to understand what Cristina meant with ¿esto? It is obvious here that Cristina’s L* HL% use has confused the mother. For example, had Cristina used ¡H* L%, we could expect that the conversation would have continued without problems, since this is the typical intonation used for non-epistemic echo questions. Cristina violated the felicity conditions of L*HL%, since there was simply nothing in the context that could have caused Cristina to be incredulous. Violating the felicity conditions led to an impasse in the flow of conversation. I argue that the lack of success in Cristina’s use of the form is a type of feedback that serves as evidence to Cristina that she has not used the form correctly.

There is plenty that this error can show us about development of epistemic intonation. Cristina’s usage shows that she recognizes at least two components about L* HL% use: 1.) its interrogativity (speech act type) and 2.) its temporal restrictions. The missing component here is the epistemic one, where the speaker expresses the mismatch between his/her belief and the information just acquired. The example supports my second and third hypotheses: it shows evidence that the most complex of the contours is not comprehended prior to three years of age. On the other hand, it shows that Cristina is sensitive to two important components of the contour: it’s basic component of interrogativity, and its temporal restrictions (i.e. the relationship to the activation of the propositional content and the time of utterance). It should also not be overlooked that Cristina’s mother had repeatedly used the contour prior to Cristina uttering it, so this error, to a certain extent, is due to imitation and for this reason (in addition to it being infelicitous use) it was not included in the quantitative analysis.
How do children gain access to the epistemic component of specific contours? At least for L* HL% the data analyzed here show that caretakers indeed provide additional cues to the epistemic meaning of L* HL%. Often times, when caretakers use L* HL% with the intention of getting the child to reformulate an answer, they call attention to the incongruence between their belief and what the child has just said saying things like *yo creo que no* ‘I don’t think so’ or *yo creo que* ‘I believe that’ followed by their actual belief, which contrasts with what the child has just said. CDS shows that children are indeed provided with additional cues for the epistemic meaning of L* HL%. The caretaker may also make a suggestion through another question such as ¿*no será que*…? ‘Isn’t it probably the case that…?’ where the caretaker suggests how they think things may be in actuality. While neither of the girls show evidence for felicitous production of L* HL%, by around 38 months both girls show evidence that they at least understand that L* HL% means they said something “wrong”, as in the exchange between Cristina and Experimenter 1 when Cristina is 38 months old in (29):

(29) E1: Y qué hace mamita con la ropa sucia?
Cristina: La bota.
E1: ¿La bota? L* HL%
Cristina: (shakes her head no)
E1: No, ¿qué hace?

E1: What does Mommy do with dirty clothes?
Cristina: (She) throws them away.
E1: She throws them away? L* HL%
Cristina: (shakes her head no)
E1: No, what does she do?

In this example, as soon as Cristina hears the L* HL% confirmation question she changes her stance on her previous answer. Unfortunately Experimenter 1’s facial gestures were not available for this example. The corpus shows evidence that after the 3rd birthday, children at least
know that L* HL% is used as a reformulation strategy, though it is not clear that they understand its epistemic meaning. There is also evidence that use of the three contours is maximally contrastive in CDS. In (30) Experimenter 2 (Cristina’s aunt) produces all three contours in a row, as she responds to Cristina’s answers in a conversation about Cristina’s grandfather’s truck. Cristina tells her aunt that the truck outside is hers and her aunt responds:

(30) E2: ¿Es tuya? L* HL%
Cristina: (nods)
E2: ¿Y no será de papío? H+L* L%
Cristina: No.
E2: ¿No es de papío? ¡H* L%
Cristina: No.
E2: ¿No es de papío? L* HL%

E2: ¿It’s yours? L* HL%
Cristina: (nods)
E2: Isn’t it Grampa’s? H+L* L%
Cristina: No.
E2: ¿It’s not Grampa’s? ¡H* L%
Cristina: No.
E2: It’s not Grampa’s?! L* HL%

Cristina had claimed that the truck outside was hers (which obviously was not true). The experimenter knows that the truck was the child’s grandfather’s and not Cristina’s. To implicate that she knows this to not be the case she questions Cristina’s assertion, using L* HL%. The experimenter then asks Cristina a second question ¿Y no será de papío? “Isn’t it Grampa’s?”

This is an example of an outer negation question, like the ones I described in Chapter 2. The negative particle no does not have scope over the propositional content, and the question conveys the experimenter’s belief that it is the case that the truck is Cristina’s grandfather’s. Cristina responds that it is not. The experimenter then uses ¡H* L% as a confirmation echo/question.
saying ¿No es de papío? By changing the contour, the experimenter changes the scope of the negative particle. She is now confirming Cristina’s assertion that the truck is not her grandfather’s. Once the experimenter confirms this, she expresses her disaccord with the assertion through L* HL%, where again the negative particle has scope over the propositional content – she conveys the incongruence between her belief about the proposition and the assertion that Cristina has made. This example shows very clearly that in CDS there are clear contrasts between the different contours and their meanings in context, giving Cristina information about the grouping principles for the contours.

4.3.3. Child responses to contour types

As stated earlier, the data were coded for whether or not a response was given. A “response” was classified as any sort of verbal or physical reaction to the question produced within a 200ms window after the offset of the caretaker’s question. Both linguistic and physical responses were included (e.g. shaking of the head for “no” or nodding the head for “yes”). While it is not expected that the lack of response to a given contour type unequivocally means the child did not comprehend the contour for that token, a general idea of how frequently children respond to the contours can still give us information about children’s comprehension of the component of interrogativity for the contours. Because the epistemic contours were produced so infrequently, we can at least determine whether or not children tend to process epistemic questions as being [+interrogative], or at the very minimum, [+response eliciting]. Table 27 gives the raw number of questions responded to, divided by the number of questions asked in CDS, as well as the mean percentage of questions responded to by Ana and Cristina. The mean percentages show that while the two children are rather similar in their response rate for ¡H* L% questions, they differ
in their response rates for the epistemic contours H+L* L% and L* HL%. While Ana responds even more to the epistemic contours, Cristina responds to only about half of H+L* L% questions. Her response frequency for L* HL% questions is more similar to her response frequency for ¡H* L% questions.

<table>
<thead>
<tr>
<th></th>
<th>Ana</th>
<th>Cristina</th>
<th>All</th>
</tr>
</thead>
<tbody>
<tr>
<td>¡H* L%</td>
<td>988/1480 (67%)</td>
<td>1735/2789 (62%)</td>
<td>2723/4269 (64%)</td>
</tr>
<tr>
<td>H+L* L%</td>
<td>8/11 (72%)</td>
<td>33/72 (49%)</td>
<td>41/83 (49%)</td>
</tr>
<tr>
<td>L* HL%</td>
<td>45/61 (74%)</td>
<td>95/161 (59%)</td>
<td>140/222 (63%)</td>
</tr>
<tr>
<td>Total</td>
<td>1041/1552 (67%)</td>
<td>1863/3022 (62%)</td>
<td>2904/4574 (63%)</td>
</tr>
</tbody>
</table>

Table 27. Raw numbers and percentages of responses to CDS questions

One important difference in the two corpora is that 55% of the CDS questions directed to Cristina (1664/3022) were produced by the two experimenters conducting the study. We might expect Cristina to respond to the experimenters less than she would to her parents due to shyness, lack of confidence etc. (although Experimenter 2 is Cristina’s maternal aunt). Figure 50 shows the percentage of questions responded to for each group.
To explore any significant differences in how the children responded to the contours, three generalized linear models were run, one for each group of caretakers shown in Figure 50. The dependent variable was whether or not the question was responded to, the independent variable was the contour type. Table 28 shows the coefficients for the different contour types as predictors of whether or not a child responded to a question for each caretaker group.

Figure 50. % questions responded to by caretaker group
Ana showed no significant differences in response frequency when comparing the different contours, and Cristina showed no significant differences in response frequency to the different contour types when responding to her parents. When Cristina heard questions from the experimenters she responded to $H^+L^*\ L\%$ significantly less than she did when compared to $\acute{H}^*\ L\%$ questions produced by the experimenters (she shows the same tendency when responding to her parents as well, though it’s not significant). A possible explanation for Cristina’s lower response rate for $H^+L^*\ L\%$ questions is that the contour may not be as perceptually salient as $\acute{H}^*\ L\%$. The latter has an extra-high tone in the nuclear stressed syllable, while the former has a fall throughout the nuclear stressed syllable. Additionally, many declarative utterances in the PRS show $H^+L^*\ L\%$. Ana’s overgeneralization of the truncation rule early on also suggests that the extra-high tone is an important cue to interrogativity for children. Neither of the children show any differences in responding to $L^*\ HL\%$ questions versus $\acute{H}^*\ L\%$ questions. Since $L^*\ HL\%$ actually shows a low tone rather than an extra-high tone followed by a complex boundary movement, this contour two may also be considered perceptually salient for children.
The overall picture here is that children respond fairly well to all question types. Small children can be expected to simply ignore questions based on mood, shyness, distraction, attention span, etc., but we see that for the most part, especially when they are responding to their parents, Ana and Cristina have an awareness about the component of interrogativity associated with the three contours. This analysis shows that the three contours are meant to elicit a response to some extent prior to age four, showing that the children have at least partial knowledge about the contours.

4.4. Discussion

As stated earlier, speakers do not have the option to encode epistemicity for every question they utter. The possible contexts where epistemic contours may occur are restricted by the speaker’s actual belief state at the time of utterance, and for the case of L* HL%, temporal restrictions on the activating of contextual evidence. Therefore we start out with the assumption that these contours will be less frequent than the default contour, a contour we know to be acceptable across many different context types. As predicted, ¡H* L% is overwhelmingly the preferred contour in this corpus for both CDS and child speech. Prieto et al.’s (2011) Peninsular Spanish data showed much more variation in nuclear configurations within the yes-no question domain, even at the earliest stage of their corpus (though there is still a strong preference for L+H* HH% in both CDS and child speech for the Peninsular Spanish case). It seems that in the Peninsular Spanish data, a malleable, default-like contour is also used for many contexts, and this is reflected in the children’s data as well. In fact, the Peninsular Spanish data are similar to the PRS data in terms of what they tell us about frequency. In PRS CDS, ¡H* L% is much more frequent than the epistemic contours, and children start out producing ¡H* L% contour
categorically. In Peninsular Spanish, the three most frequent question contours in CDS have already emerged at 19 months. The intentions most frequently associated with these three contours in Peninsular Spanish are intentions that children are known to acquire early on, such as offers, invitations and echo questions. The Peninsular Spanish results indicate that if there is a reliable relationship between form and meaning, and if the meaning is included in the child’s existing repertoire of intentions, this form-meaning pairing emerges. Prieto et al.’s (2011) Peninsular Spanish data show that the relationship between form and function need not show one-to-one mapping between form and meaning, just a reliable relationship with a given frequency (although we cannot be sure what the threshold for that frequency is). Even in the PRS corpus, children showed evidence for the production requests, invitations and offers. We might surmise that if there were specific contours associated with these intentions, they might have emerged in the data as well. Contour choice, however, is not governed by just intention in PRS. It is restricted based on speaker belief states, and children’s sensitivity to such belief states is known to develop later than much of the data analyzed here.

The emergence of the one epistemic contour in the PRS data cannot be predicted based on frequency, however, since H+L* L% it is the less frequent of the two epistemic forms. Here I use the word “emerges” quite loosely, since the sample size for H+L* L% is so small. But we should also not ignore evidence for the production of an epistemic question contour that does not disrupt the discourse flow. Ana’s H+L* L% use at 33 months comes after her (productive) acquisition of other constructions available in the language that show her awareness of evidence and truth values of propositions such as the perceptual tag ¿viste? and the truth-confirming tag ¿verdad? tag. Ana’s use of these constructions suggests that she is able to infer propositions and
confirm them, paying special attention to evidence (perception checkers – ‘Did you see?’) and truth conditions (tag questions like verdad, verdad que sí and verdad que no explicitly check the interlocutors assessment of the truth of a proposition). These components are important in the formation of belief states, particularly positive belief states like those encoded through H+L* L%. But encoding private belief about a proposition is perhaps a less daunting task than perceiving a mismatch between your own belief and some information that you have just come to know. A falsifiable hypothesis to be tested in future work would be that the amount of processing that must be done just prior to producing a L* HL% question would be higher when compared to producing a H+L* L% question, since for L* HL% the mismatch would have to be perceived, and a subsequent decision to encode that mismatch in the utterance would have to be made. Though L*HL% does not emerge felicitously in this database, its non-appearance supports a hypothesis for its late acquisition based on its complexity. For the case of epistemic modal verbs, Papafragou (1998) points out that children do not tend to express epistemic modality (modal verbs expressing possibility, likelihood or certainty) before 36 months of age, and they generally don’t appear in production until the child is around 42 months old. All tokens of H+L* L% are produced after the age of 33 months, suggesting that production of epistemic intonational marking might show similar temporal patterns to production of epistemic modals. It would be helpful to carry out a follow-up study investigating the two girls’ production of modal verbs, to get a more complete picture of when they begin to encode epistemic meaning.

Finally, I showed evidence that children have access to the most basic component of the contours, they are meant to elicit a response. Children frequently provide responses to all three contour types, demonstrating that they understand the response-eliciting function of the
utterances. Cristina’s L* HL% imitation/error suggests that she understands not only the interrogative component of L* HL%, but also its temporal restrictions, showing that the epistemic function of the contour and perhaps the “incongruent” meaning are not yet available to her at 28 months. Later sessions do suggest that children are at least privy to the “you said the wrong thing, now say the right thing” element of L* HL% questions in CDS. While the complexity of L* HL% poses a problem, there is evidence that children have access to information about the contour (response-eliciting and temporal restrictions on the contour) whether or not the epistemic component is computed by the child.

An additional observation is that the more complex of the epistemic contours, L* HL%, was the more frequent epistemic contour found in the CDS the database. I would like to propose that this is due to the specialized uses of L* HL% in CDS. L* HL% can be used not only for the reformulation use that I have mentioned, but its meaning is also exploited in CDS to show increased interest. Oftentimes caretakers react to children’s assertions as if they are unbelievable, in the sense that they are very interesting or important to the parent. In this way the caretaker shows the child that her contribution to the discourse is interesting and important. This too is a L* HL% use specific to CDS. This difference in specific CDS uses of L* HL% could also pose an additional problem for the child learner. At times L* HL% is used to convey to the child that she made an error, and other times it is used in a positive way by the caretaker to let the child know that their conversational contribution is very interesting. These are both context-specific uses of L* HL% that the child must learn as well. They are not uses of L* HL% we would expect to find in adult speech, although Chapter 3 showed evidence for a contextually-activated use of L* HL% in adult speech that wasn’t found for H+L* L%. It could be the case that L* HL%
simply has more contextually-activated meanings than H+L* L%. However, it could be the case that contextually-activated uses of H+L* L% exist and simply did not come up in the data analyzed here. In any case, the contextually-activated uses of L* HL% in CDS may account for why this contour was used more by caretakers when compared to H+L* L%.

4.5. Conclusions

This study investigated the use of three yes-no question contours: ¡H* L%, H+L* L% and L* HL% in CDS and child speech in PRS. Crucially, this study was based on a detailed account of intonational grammar for the adult system that includes how the system works for both speakers (Chapter 2) and hearers (Chapter 3). This defined the target system that I assume children to be acquiring. All three hypotheses were confirmed: the default contour, ¡H* L%, is the most frequent contour in the corpus for both CDS and child speech (H1). This is also the simplest contour, in terms of complexity (H2). We find very few felicitous uses of epistemic marking through intonation in the corpus. H+L* L% is the only epistemic contour produced. It is the contour that I argued was the less complex of the two epistemic contours (H2). H+L* L% is produced late in the corpus (starting at 33 months), and sparsely. The most complex of the three contours is never produced felicitously in the corpus (H2). Children do seem to be sensitive to components of the epistemic contours. They know they are response-eliciting, and tend to respond to them in conversation. Cristina shows knowledge about the temporal restrictions of L* HL%, and both girls show sensitivity to the response-reformulating use of L* HL% by the end of the corpus (H3). The confirmation of hypotheses H2 and H3 shows that the notions of complexity and incrementality are factors that should be considered in intonational development,
i.e. the same notions that were key in accounting for syntactic development for Estigarribia’s (2010a; 2010b) data can be applied for intonational development.

The research also highlights a need to pay close attention to the conceptual development that is taking place alongside the development of the child’s intonational grammar. The differences in the findings reported on here, and those discussed in Prieto et al.’s (2011) work on intonational development within the yes-no question domain in Peninsular Spanish, also make clear the need to examine the role of intentionality and conceptual development in studies on the acquisition of the intonational grammar. PRS and Peninsular Spanish differ in the pragmatic division labor of contour types used in the yes-no question domain. In these specific cases, it meant that Peninsular Spanish-acquiring children had more contours available for yes-no questions at ages during which PRS-acquiring children had only one. This shows that studies in intonational development should be approached with caution. Frequency in the input is, of course, an important factor in intonational development. We saw this bear out both the Peninsular Spanish and the PRS case as well. But the function of the contour will play an important role as well.

It does not seem to be the case that any specific contour type (in terms of nuclear configurations) emerges first because of biological constraints as has been suggested in the past (Snow 2006; Lleó et al. 2004), since in intonation languages contours are associated with meanings. If anything there does seem to be some preference for high boundary tones if we consider Ana’s truncation behavior in addition to Thorson et al.’s (submitted) findings that children always produce rising question contours before falling ones, but the truncation overgeneralization could not be confirmed for Cristina’s data. Soderstrom et al. (2011) also
found a preference for (rising) question intonation over declarative intonation for babies, which physically meant that the infants preferred rises over falls.

Taken together, this chapter demonstrates that in order to understand the emergence (or lack thereof) of contours, it is essential that we have a clear picture of the pragmatic meanings associated with the contours we are investigating. This allows us to better understand the dynamic interaction between frequency, complexity and cognitive development involved in intonational development, factors that also have been shown to play a role in the acquisition of syntactic, semantic and morphological development.
CHAPTER 5: DEVELOPING THE ABILITY TO COMPREHEND BELIEF STATES THROUGH INTONATION

5.1. Introduction and background

In Chapter 4, I showed that although 
$L^* \text{HL}_%$, a contour highly associated with incredulity in PRS, is available in CDS, it is not felicitously produced by either of the children in the study. I also showed an example that at 28 months, it does not seem that the epistemic, “disbelief” component of the incredulous contour is comprehended by Cristina, though the “response-eliciting” component does seem to be processed and responded to (she answers questions with this nuclear configuration). She also seems sensitive to the temporal restrictions of the contour, since her sole production of it was as an echo question, which repeats information that the speaker has just heard. I also argued that the incredulity contour was the most complex of the three intonation contours I have been discussing throughout the dissertation, and for this reason should be acquired late. In addition to encoding interrogativity, felicitous use of this contour requires that the speaker juxtapose her belief state to some recently acquired information, and conclude that they are incongruent with each other. The speaker must also obey its temporal restrictions in order to produce it correctly. But the question remains, when are PRS-speaking children reliably processing epistemic information associated with the incredulity contour in discourse? In this chapter I will discuss a linguistic comprehension task designed to assess incredulity comprehension for 4-, 5- and 6-year-old PRS speakers. The motivation for testing these specific age groups is discussed in the sections below. There is little research investigating a child’s knowledge of how incredulity or disbelief is encoded linguistically,
through intonation or other linguistic strategies. One of the objectives of this study is to fill this gap.

5.1.1. Prosodic comprehension

Throughout the years, it has been clear that “prosodic comprehension” cannot be considered holistically, since age of acquisition and the extent of variability found within different age groups tends to vary based on the specific function of prosody that is being acquired (Cruttenden, 1985; Cutler & Swinney, 1987; Wells et al. 2004; Martínez-Castilla & Peppé 2008). Wells et al. (2004) devised a battery of prosodic tasks looking at different aspects of prosody, namely Chunking (prosodic phrases), Affect (affective or attitudinal meaning), Interaction (affirmation vs. questioning) and Focus, assessing both production and perception in these areas. The methodology in Wells et al. was based on the Profiling Elements of Prosodic Systems procedure – PEPS, which had been devised for testing adults (Peppé, 1998; Peppé et al. 2000), though in this case they investigated children between the ages of 5;6 and 13;9. Well et al.’s test includes the Interaction task, which is perhaps the most related aspect of the PEPS battery since it dealt with sentence-level prosodic meaning. In this task, children heard a word produced with either a “low fall” with “affirmative meaning”, or a “high rise” with “questioning meaning”. The child would see a picture of a single object. The child had to name the object in the picture. In order to test the child’s comprehension of the two contours in conversation, the experimenter would then repeat the word produced by the child with either of the two intonations. If the experimenter produced the word with falling intonation, the child should have considered it a cue to move on to the next picture. If produced with rising intonation, the “correct” behavior expected of the child was to repeat the word, since it was assumed that the
rise would be understood as a confirmation question. 5-year-olds were above chance at this task. This is perhaps not surprising since Soderstrom et al. (2011) found evidence that even infants have the attentional and perceptual skills to begin to form the categories that distinguish declaratives from questions intonational before they have morphosyntactic knowledge. The 5-year-olds in Wells et al.’s study were also successful on the Affect task, though they were less successful on the Chunking and Focus tasks. Overall, Wells et al. found that there was a great deal of variation across tasks for the different age groups, but for the Interaction task, 5-year-olds were relatively successful at judging speaker intentionality based on falling versus rising intonation.

Cruttenden (1985) also tested a rise versus fall distinction in his study testing 10-year-olds’ prosodic comprehension. Like many of the examples in the battery designed by Wells et al., Cruttenden used a picture-association task to assess a range of different prosodic meanings. Most relevant to the present study, Cruttenden examined the contrast between surprise and neutral intonation at the sentence level. Children saw two pictures: a little girl with a surprised face, and a girl with an “impassive” face. They heard the phrase “She’s gone away” produced with either a fall-rise or a rise-fall. Children’s scores were significantly lower than adults for this task, but even adults seemed to associate both contours with the surprised face. This is likely due to the fact that both contours might be construed as questions in Cheshire English, though Cruttenden (p.c.) has noted that the surprised intention of the rise should be clear because it is marked with ‘squeaky voice’ at the end. Even so, since the rise-fall is also a possible question marker in British English, if an utterance produced with this contour were to be construed as a question rather than a declarative, the fact that the speaker would be questioning the
propositional content at all might have been associated with surprise. This brings into question the role of discourse context in prosodic comprehension tasks designed for children. This missing element in the prosodic comprehension literature is criticized by Ito et al. (2012), who were interested in children’s comprehension of prosodically-marked focus: “In such context-free tasks, children’s performances may have reflected their failure to detect the contrastive relations in the visual stimuli or to instantly link the prosodic prominence to the visual contrast, rather than their inability to comprehend contrastive intonation for representing referential relations in natural discourse” (p. 266). Indeed, in their eyetracking study, the authors found that both visual and discourse contexts were important for determining whether or not children were able to inhibit a recent referent and attend to a new one.

Armstrong, Andreu i Barrachina and Prieto (2012) integrated both visual and discourse contexts in an eyetracking study that investigated incredulous intonation in Central Catalan. The authors tested children’s pragmatic child ability to comprehend a speaker’s rejection or acceptance of a proposition p through intonational cues. Participants watched a series of 6 videos with 2 actors, each of whom played with a stuffed bunny on their respective chairs. The actors each left their bunny on their respective chair and left, closing the doors to the room. A puppet came along, replacing one of the actor’s bunnies with a stuffed donkey and leaves. The actors returned, each approaching and looking at their respective chair. The video would then freeze and the child would hear an audio stimulus. The audio stimulus was one of two identical segmental strings *Aquest és el meu peluix* ‘This is my doll’, produced with one of two intonation contours. The participants heard either an incredulity question (L* HH% in Cat_ToBI, produced with pitch expansion and breathy voice) or an intensified declarative (L* L%). The videos were
presented on a portable Tobii Eyetracker (online task). At the end of each video, the participant was asked to point to the actor who they thought produced the utterance (offline task). Each participant saw 2 familiarization trials followed by four test trials (two trials “reject p” condition, 2 trials “accept p” condition) for a total of six trials. Each test trial had a different pair of actors. 23 5-year-olds and 27 6-year-olds participated along with a control group of 6 adults. A total of 200 trials were included in the analysis. The results showed that both groups of children started looking at the incredulous actor once s/he entered the room. This is not unexpected since the child would have been anticipating the actor’s reaction to the switch in animals. However, if children were using intonation to decide which actor spoke, incredulous intonation should have facilitated a higher proportion of fixations to the incredulous actor. This was not the case for 5-year-olds. However, the proportion of fixations to the actor who would be incredulous did increase for 6-year-olds before the offset of the word meu, about 60ms after the first pitch accent on Aquest. This is not dissimilar to the behavior of adults in a gating experiment by Crespo-Sendra (2011), who tested Valencian vs. Central Catalan speakers’ ability to identify an utterance as incredulous. In their experiment there were three gates for the question Venen mandarines? (Gate 1: [Ve], Gate 2 [Venen], Gate 3 [Venen ma-] and Gate 4 [Venen mandarines]. Central Catalan speakers were able to identify a question as incredulous (vs. neutral) during the third gate. In this study, since the stressed syllable in Aquest ([a.’ket]) is the second one, this means that the initial rise in proportion of fixations took place three syllables after the stressed syllable where the first pitch accent occurred, just one syllable later than explicit identification was found by Crespo-Sendra. Though the effect was weak for 6-year-olds
in Armstrong et al.’s experiment, it seems that they are beginning to respond to intonation in an adult-like way at this age, while there is a complete lack of such a response for 5-year-olds.

The literature also presents evidence for cross-linguistic differences in prosodic comprehension. Martínez-Castilla & Peppé (2008) also used the PEPS battery with Peninsular Spanish-speaking children using the same age groups investigated in Wells et al. The authors found similar tendencies between the two language groups for the most part, but also language-specific differences. For instance, for expression and comprehension of questions versus declaratives, younger Spanish children were just as accurate in comprehension as older Spanish children, while the younger English-speaking children did not perform as well as the older group. Younger Spanish children also outperformed younger children. The authors do not explain why this may have been the case, but it is reasonable to conjecture that perhaps Peninsular Spanish has more perceptually salient or distinguishable strategies for marking these differences than Edinburgh English, though this is purely speculation. It is clear, then, that children’s prosodic abilities vary based on the type of prosody being examined. We know, though, from the literature on children’s comprehension of prosody used to convey sarcasm, that school-aged children (6-10-year-olds) depend on prosodic modifications in order to comprehend sarcasm or irony (Capelli et al. 1990; de Groot, Kaplan, Rosenblatt, Dews & Winner 1995; Keenan & Quigley 1999).

5.1.2 Looking to other parts of the grammar

One aspect that authors do not tend to devote much attention to in the prosody/intonation literature is what we know about children’s comprehension of grammatical categories having similar/comparable functions to prosodic functions. Since L* HL% in PRS encodes epistemic
meaning, i.e. it draws attention to the speaker’s present state of disbelief, it is important to gauge children’s comprehension of belief state information though other areas of the grammar, such as the lexicon. Therefore it is useful to look to the literature addressing children’s comprehension of mental state verbs or epistemic modal verbs, lexical items that convey information about the mental states of speakers. In general, 4-year-olds appear to be making serious strides in terms of their comprehension of both mental state and modal verbs, which has been claimed to be related to their emerging metacognitive abilities affected by a developing Theory of Mind (Miller 2004; Papafragou 1998). For instance, while verbs like think and know are known to appear in production around the first year (Bretherton & Beeghly, 1982; Shatz, Wellman & Silber, 1983), they are not known to be distinguished in comprehension until some time around age four (Papafragou et al. 2007; Johnson & Maratsos, 1977; Moore, Bryant & Furrow 1989; Moore & Furrow 1991; Naigles 2000). Papafragou & Ozturk (2007) observed that while children may start to use modal vocabulary very early on, it is not until age four that they are able to differentiate between modal expressions. It has also been shown that children can make distinctions between know/be sure and think/guess during the fourth year (Moore, Bryant & Furrow, 1989; Moore & Davidge, 1989). Papafragou (1998) discusses the success of 4- and 5-year-olds (though more reliably 5-year-olds) in making strength distinctions in modal verbs. She also claims that it is not until the sixth year that the child reaches a fuller understanding of the underpinnings of modals, leading to developing the full adult system. The literature makes it clear that the period between ages 4 and 6 is key with respect to the development of both modal and mental state verbs. But it has been claimed that such verbs are perhaps difficultly acquired due to the lack of an objective physical correlate to mental states.
Papafragou et al. (2007) call attention to the fact that it is much easier to observe that a jumper is performing the action of jumping when compared to observing that a thinker that is performing the activity thinking. If we assume that word learning starts by relying on finding the relationships between what is ostensibly happening and linguistic forms, then the task of acquiring mental state verbs seems rather daunting. Papafragou and her colleagues eventually find that both children and adults may rely on syntactic cues in order to glean the relevant information about lexical items that reference mental states.

Since I established that the L* HL% contour encodes epistemic information, namely disbelief, it becomes obvious that a child’s development of mental state verbs as well as gradient differences in epistemic modal meanings are quite relevant to this acquisition problem. The L* HL% contour is very often used on a segmental string that does not include any syntactic indicators with respect to whether the contour refers to the speaker's mental state (e.g. the way a complementizer might give information about the type of verb think or know is). Thus the child learner of PRS is faced with a similar problem to the acquisition of mental state verbs when acquiring this contour to convey disbelief in addition to question-marking. Like mental state verbs and modal verbs, the child must be cognizant about distinctions in belief states, but these are not visibly ostensible when L* HL% is uttered.

Language specific differences have been shown in how children respond to questions about belief, based on the strategies for encoding belief states they have available to them. Shatz, Diesendruck, Martínez-Beck and Akar (2003) looked at children acquiring languages that lexically mark false belief versus languages that do not. Child speakers of Turkish, PRS, English and Brazilian Portuguese participated in a series of four change-of-location false belief tasks.
Two experimenters interacted with each child. Experimenter 2 (E2) brought the child into a room with Experimenter 1 (E1). E1 took out a blue box as well as an explicitly marked crayon box. E2 touched the crayon box and said she wanted to draw with the crayons, and would go get some paper, and then left the room. E1 asked the child “Which box do you think has the crayons in it?” It turned out that the crayons were in the blue box, and the crayon box was empty. At that point E1 asked the child the following:

(31) Where does [name of E2] think the crayons are?
(32) Where is [name of E2] going to look for the crayons when she returns to draw?

E2 then came back to the room and touched the crayon box, claiming that she couldn’t find drawing paper while she was gone. She then went to the corner to look for drawing paper in her bag, with her back turned. At this point the child was asked:

(33) Why did [E2] pick/grab the crayon box? (to elicit explanations of E2’s behavior)
(34) Where are the crayons really? (Asked as a reality check)

This was repeated three times with a series of stories with situations analogous to the real life one. Turkish and PRS both make lexical distinctions for belief based on whether the speaker is neutral about the truth value of the belief (“Mary thinks John is tall”) versus when the speaker is reporting a belief s/he knows to be false (“Mary thinks Los Angeles is in Idaho”). Turkish uses the verb düsün for the former, and san or zannet for the latter. PRS uses creer for neutral truth value cases but when the speaker is sure that a false belief is held s/he can use creerse. For
example, in (35) the speaker is neutral to whether Juan’s belief is false or not, while in (36) the speaker is sure that the belief is false, s/he knows that the fork is not in the drawer, but Juan believes it to be there.

(35) Juan cree que el tenedor está en la gaveta.
‘Juan thinks the fork is in the drawer.’

(36) Juan se cree que el tenedor está en la gaveta.
‘Juan thinks that fork is in the drawer (but I know the fork isn’t in the drawer).’

These distinctions are not possible neither in English, nor Brazilian Portuguese. In general, child speakers of Turkish and PRS answered question (33) correctly more often than the English or Brazilian Portuguese speakers. However, it was also shown that Turkish and PRS-speaking children were at chance when they had to answer question (33) when the neutral form was in the question (i.e. there was no encoded information about disbelief), and above chance when they heard the question with the form marking false belief. 3-year-olds with a false belief marker in their language performed at chance, while those without performed below chance, and 4-year-olds performed better than 3-year-olds in general. In a second experiment that controlled for socioeconomic status, 4-year-old PRS versus English-speakers were tested with the same questions. It was found that 4-year-olds PRS-speakers were significantly above chance on question (33) when the question is asked with creerse, while their English-speaking counterparts were not (though there were differences in low versus high socioeconomic status for both languages). Thus we might conclude that overt marking of belief-state information for a given language might give children an advantage.
We know that for the case of PRS, as I showed in Chapter 3, that L* HL% is quite a strong cue to disbelief or incredulity. Differently from other dialects of Spanish, this epistemic meaning can be marked intonationally on even the shortest of utterances. For example, a speaker may ask the question ¿sí? ‘yes?’ with L* HL%, and we can expect this marking to conventionally convey the speaker’s state of disbelief. Thus, similar to the marking of false belief in the creerse case, we might expect PRS children to have a comprehension advantage for the L* HL% disbelief interpretation, since they have a separate intonational category available for this meaning. Considering that it is around 4 years of age that children start to become competent in the distinctions of certain mental state verbs as well as modal verbs through the use of different lexical items, then we might expect to find success in the comprehension of an intonational contour marking epistemic information for 4-year-olds acquiring a language with overt intonational cues to this kind of information. Since we know intonational morphemes are used to mark utterances for sentence type, just as any segmental particle might, then we can hypothesize that it should not matter whether an epistemic marker is segmental or suprasegmental. Following this hypothesis, if epistemic meaning is overtly marked in the language (segmentally or suprasegmentally), we could then expect 4-year-olds to be relatively successful at such a task, based on the idea that this is an age at which 4-year-olds are also successful in comprehension of mental state and modal verbs. However, we might expect 6-year-olds to be even better than 4-year-olds based on Papafragou’s claim that it is in the sixth year that children are truly developing the full-blown modal system – we might expect 6-year-olds to be particularly good at a comprehension task for which they must be able to extract the epistemic information from an intonational marker of epistemicity. If it were the case that 4-year-old PRS
speakers were indeed successful at the comprehension of the incredulity contour, it would show a cross-linguistic difference when compared Armstrong et al.’s results for Central Catalan. But there are relevant differences in how incredulity is encoded when comparing Central Catalan and PRS. Crespo-Sendra (2011) showed that incredulity meaning within the question domain in Central Catalan is primarily signaled through pitch scaling. Her identification task results as well as reaction time measurements showed that the pitch scaling of the final H boundary tone for incredulity questions in Central Catalan must be higher than the H tone used for neutral yes-no questions. She showed evidence for a gradient, rather than phonological distinction between incredulous and neutral yes-no questions. But for PRS, hearers rely on a phonological difference: when a speaker chooses to linguistically encode incredulity in an utterance she will choose the L* HL% nuclear configuration over the default ¡H* L% nuclear configuration. Bearing in mind Armstrong et al.’s results, if PRS 4- and 5- year olds are successful at a comprehension task testing their knowledge of the meaning of L* HL%, this would suggest that the overt marking of incredulity in PRS through intonation gives PRS-speaking children an advantage, much like the case of false belief marking with creerse in PRS when compared to English speakers who don’t have a specific lexical item or morpheme to mark false belief on the verb think. Such a difference would be similar to the cross-linguistic differences found by Martínez-Castilla & Peppé (2008) for Peninsular Spanish versus Edinburgh English. However, if PRS-speaking 4- and 5- year olds were to perform below chance on such a task, and only 6-year-olds were found to be successful as in the case of Central Catalan, the result would imply that it is more difficult for children to extract information about speaker belief state through intonation versus lexical items, based on the claims for comprehension of mental state verbs and epistemic modal
distinctions. These possibilities are visited in the comprehension experiment described in the next section, which tests the ability of 4-, 5- and 6-year-old speakers of PRS to perceive the disbelief meaning of L* HL%. Crucially, this experiment differs from the work of Cruttenden (1975, 1985), Wells et al. (2004) and Martínez-Castilla & Peppé (2008) since it provided the children with a discourse context, which Ito et al. (2012) argued was paramount when testing a child’s comprehension of intonational meaning.

5.2. Methods

5.2.1. Participants

A total of 36 Puerto Rican Spanish-speaking children participated in the experiment: 8 4-year-olds (mean age: 4;6, ranging from 4;0 to 4;8), 16 5-year-olds (mean age: 5;6, ranging from 5;0 to 5;11) and 12 6-year-olds (mean age: 6;4, ranging from 6;0 to 6;8). The children came from lower-middle class and middle-class families. They were recruited from several schools in San Juan, Bayamón, Levittown and Guaynabo City, Puerto Rico and tested individually in a quiet room outside the children’s classroom. Additionally, a control group of 10 Puerto Rican Spanish-speaking adults living in the same areas was recruited and tested on the same linguistic task.

5.2.2. Stimuli and procedure – Linguistic comprehension task

5.2.2.1. Materials

*Visual materials*

Visual materials were presented on a Powerpoint presentation by the experimenter. Participants always saw a set of twins, Verónica and Marisol, and their friend Jeni, in addition to pictures of different animals, which were the animals that Jeni told the twins she saw.
Audio materials

In order to avoid bias based on voice, all the materials were produced by one speaker, a female speaker of Puerto Rican Spanish, who was 33 years of age when the materials were recorded. For familiarization and filler trials, the speaker produced an utterance with a proposition that was either affirmed (¡Pues sí, yo te creo que viste un tigre. ‘Well, yeah. I believe you that you saw a tiger.’) or negated (¡Ay no, yo no te creo que viste un tigre. ‘Oh no, I don’t believe you that you saw a tiger.’). For the test trials, the speaker recorded short echo questions produced with either (¡H* L%) or (L* HL%). Therefore the listeners heard either a contour that marks the utterance for questionhood only, versus a contour that marks an utterance for questionhood in addition to disbelief. Figures 51 and 52 show typical phonetic implementations of the ¡H* L% contour (Figure 51) and the L* HL% contour (Figure 52) that were used in the study.
Figure 51. Typical realization of \( \text{\`H}\* \text{L}\% \) used in stimuli for the question ¿un mono? ‘a monkey?’

Figure 52. Typical realization of \( \text{L}\* \text{HL}\% \) used in stimuli for the incredulous question \( \text{i\`eun mono?!} \) ‘a monkey?!’
5.2.2.2. Procedure

Participants were introduced to the two characters, Verónica and Marisol, and told that they were twins. The experimenter confirmed that the child understood what a twin was. They were then told that the twins had a friend, Jeni, and that Jeni had just returned from vacation with her family. Jeni was telling the twins about the animals she saw while she was on vacation. Participants were then told that there was always one twin that did not believe Jeni, and that they would know which twin that was by listening to the twins speak. The participants received two training trials. They saw a picture of the twins and their friend (two left figures in Figure 53), along with Jeni (right figure in Figure 3) and a picture of the animal Jeni said she saw. Below each twin was a sound file represented by a speaker, which the children saw the experimenter click on. The process lasted about 10 minutes per child.
The experimenter then said to the participant, *Jeni les dice que vio un tucán.* ‘Jeni tells them that she saw a toucan’. The experimenter then said …*y Verónica le dice…* ‘…and Veronica says…) followed by clicking on the sound file under Verónica with either the affirmation or negation statement. The experimenter then continued to say …*y Marisol le dice...* ‘…and Marisol says…’ followed by clicking on the other statement. In this way, one twin affirmed a belief that Jeni saw the toucan, and the other negated a belief that Jeni saw a toucan. The experimenter then told the participant *Señala a la nena que no le cree a Jeni.* (‘Point to the girl who doesn’t believe Jeni’). In the familiarization trials, if the participant pointed to the wrong twin, the child was corrected and given feedback. The participants received two familiarization trials. At test, the same process was repeated except instead of the affirming and negating statements, the participant heard an echo question with confirmation (¡H* L%) or incredulous
(L* HL%) intonation. There were 12 targets and 6 fillers presented to each child, for a total of 18 trials. The fillers were just like the training trials, with affirming and negating statements. Each participant was presented with one of two lists with differing randomized orders to control for order of presentation. Both lists also controlled for which of the twins “talked” first, whether the twin “talking first” was on the left or right, and whether the confirmation or incredulous intonation was heard first (affirming vs. negating for fillers). Each participant’s session was recorded on the web camera of the laptop that the Powerpoint was presented on.

6.3. Results

Puerto Rican Spanish-speaking adults were at 100% on all questions in the task, i.e. they always decided that the twin who “said” the incredulity question was the one who didn’t believe Jeni. I now turn to the child results. Figure 54 shows the percentage of correct answers for each of the age groups (Age 4, Age 5 and Age 6). The error bars indicate standard error.

![Figure 54. Percent correct for each age group with error bars](image-url)
Figure 4 shows that all groups have average scores higher than 50%. 4- and 5-year-olds showed very similar performance on the task (77% vs. 76.66%). Six-year-olds performed the best, with 92% accuracy. A one-sample T test was used to test each age group against chance performance (50% correct). All groups performed significantly above chance: 4-year-olds ($t(7) = 3.70, p = 0.008$, 5-year-olds (77% accuracy) ($t(14) = 4.88, p<0.001$) and 6-year-olds (92% accuracy) ($t(12) = 7.81, p <0.01$) was all significantly above chance. The error bars in Figure 4, however, indicate that there is less variability in performance with age, and indicated by the error bars in Figure 4 – 5-year-olds showed less variance than 4-year-olds, and 6-year-olds showed less variance than 5-year-olds. To test whether age was a significant predictor of performance on the task, the data were then analyzed under a mixed-model logistic regression, which was fit to the data using the statistical tool R (R Development Core Team, 2009). For the model presented here, the dependent variable was whether the child identified the twin associated who used incredulous intonation as the one that did not believe Jeni. Age was tested as a potential predictor (as a fixed effect). Order of presentation, List, and Participant were included as random effects, using the lmer function in the lme4 package of the R statistical package. The model’s fixed effects are shown in Table 29, alongside the factors’ estimated coefficients and their predictive significance. In order to understand differences between all three groups, I present the results first with Age 4 as the reference level, and then results from the same model with Age 5 as the reference level.
When the reference level was Age 4, the model had a significant intercept (z= 2.57, p<0.01, z=3.33, p<0.01 with Age 5 at reference level). The model shows Age as a significant predictor of correct response choice. When 4-year-olds are compared to 5-year-olds, no significant differences were found. 6-year-olds, however, performed significantly better than 4-year-olds (3.91/1.87). When we change the reference level to Age 5, we also find that 6-year-olds were significantly more likely to succeed on the task when compared to 5-year-olds (3.91/1.84). The patterns in behavior we find here are similar to previous findings about epistemic modal verbs. 4- and 5-year-olds are about the same in their ability to distinguish interrogativity from incredulous interrogativity. Both age groups perform above chance. But 6-year-olds are significantly better than both 4- and 5-year-olds at doing so.

### 5.4. Qualitative Analysis

Further information about awareness of the meaning of L* HL%, in addition to the \( \text{H}^* \) L% nuclear configurations comes from analysis of the video recordings. Three of the twelve 6-year-olds showed a reaction to the linguistic stimuli that none of the other groups showed: reactions through facial gesture. In a production study looking at Catalan and Dutch, Crespo-

|                     | Estimate | SE  | z value | Pr(>|z|) |
|---------------------|----------|-----|---------|----------|
| (Intercept)         | 1.87     | 0.72| 2.57    | <0.01    |
| Age (reference level is Age 4) |          |     |         |          |
| Age 5               | -0.03    | 0.85| -0.04   | 0.97     |
| Age 6               | 2.04     | 1.00| 2.03    | 0.04     |
| (Intercept)         | 1.84     | 0.55| 3.33    | <0.01    |
| Age (reference level is Age 5) |          |     |         |          |
| Age 4               | 0.03     | 0.85| 0.40    | 0.97     |
| Age 6               | 2.07     | 0.88| 2.35    | 0.02     |

Table 29. Coefficients of fixed effects; higher coefficients indicate a greater likelihood of accuracy.
Sendra (2011) showed that speakers of both languages tended to produce upward eyebrow movements for “information-seeking” yes-no questions, while for counter-expectation/incredulous questions speakers from both languages produced downward eyebrow movements (or furrowing), eye-squinting and head movements described as “down and back”. Three of the 6-year-olds in the study often reacted to the audio stimuli producing similar facial gestures/head movements upon hearing the audio stimuli. Furrowing was often produced prior to the offset of incredulous questions, while raising was often produced in the post-tonic syllable, just after hearing the \( \text{iH}\) nuclear pitch accent. The photos on the left in Figure 5 show neutral expressions, followed by stimuli-induced expressions on the right for both the incredulous contour (L* HL%) and the confirmation question contour (\( \text{iH}\) L%). Two of the participants (those pictured in Figure 5), when asked how they knew which twin did not believe Jeni after the very last trial, replied *Porque ella dice ‘¡un lagarto?!’* (Because she says ‘a lizard!’) producing both the L* HL% nuclear configuration in addition to moving the head back and down, accompanied by eyebrow furrowing. This gesture-accompanied response was never produced by the 4- or 5-year-olds, though older 5-year-olds did at times respond by manipulating intonation. Some 5- and 6-year-olds also had answers such as *porque lo dijo más fuerte* (because she says it stronger) or *porque lo dijo más alto* (because she said it louder). One 5-year-old, when asked how she knew who did not believe Jeni manipulated intonation, producing a non-canonical questions contour (L+H* LH%) that may or may not have been an approximation of L* HL%. In any case the child’s response indicates that she was sensitive to intonation as the main cue to incredulity in the task. These answers indicate some metalinguistic knowledge about the use of intonation and its linguistic use for differing meanings.
5.6. Discussion

I began with the hypothesis that, because 4- and 5-year-olds begin to be successful at comprehending mental state verbs and modal distinctions through the use of segmental content, they should be just as successful in gleaning epistemic information through suprasegmental cues in a language where this sort of information is overtly marked. The results presented here show that 4-, 5- and 6-year-olds speakers of PRS all performed significantly above chance in a linguistic comprehension task evaluating their ability to associate the L* HL% contour with disbelief on the part of the speaker. While 4- and 5-year olds did not show any significant differences when compared to each other, 6-year-olds were significantly more accurate than the younger participants at the task. From a qualitative standpoint, some 6-year-olds also showed an implicit reaction that involved participants producing a facial gesture when hearing the audio stimuli. These facial gestures are known to be related with questioning and incredulity meanings in other languages, as Crespo-Sendra showed for Dutch and Central Catalan. I propose that this behavior is related to a general sophistication of 6-year-olds in understanding epistemic notions, which for the case of modal verbs, as Papafragou (1998) claims, leads to “full-blown development of the adult modal system” (p. 389). This full-blown development is happening at the age of 6 for the case of intonational categories that mark epistemic information in PRS as well. Thus the performance of 4-, 5-, and 6-year olds for comprehension of an epistemic meaning encoded intonationally seems to follow general tendencies found for other epistemic uses found in language, such as those of mental state and modal verbs in English. Papafragou & Ozturk (2007) claim that there is a relationship between 4- and 5-year olds having an established representational model of mind and their readiness to distinguish mental contents from reality.
Just as 4- and 5-year-old children have been shown to distinguish between think and know, the results presented here show that the same age groups are capable of extracting epistemic information from L* \( H^* L\% \). The results also show that they know that this information about the belief state of the speaker is not encoded through the \( H^* L\% \) contour.

While the task used in Armstrong et al. (2012) was indeed more complicated and perhaps involved more pragmatic inferences for the children, it is still striking that the eyetracking results showed no effect of intonation for 5-year-olds in processing incredulity meaning, an effect that was indeed present for 6-year-olds. The present experiment showed that even in an explicit task, 4- and 5-year-old PRS-speakers were using intonation as a cue to disbelief. Taking the results presented here together with those from Armstrong et al., it seems that children learning a language with overt intonational marking of incredulity have an advantage – 5-year-old Central Catalan learners don’t seem to be aware that prosodic modifications are cues to incredulity. For the PRS-speaking children, overt incredulity marking by means the intonational morpheme L* HL\% is sufficient for 4- and 5-year-olds. Prieto et al. (2012) showed that even in production, children are not adult-like in the scaling of some pitch accents and boundary tones in their early production (2;5 and younger), and so it is perhaps not surprising that scaling differences are problematic in comprehension. It is important, however, to point out the performance of 6-year-olds for both the cases of Central Catalan and PRS. Whereas in Central Catalan we find a difference between non-ability and ability between 5- and 6-year-olds, in PRS we find ability for all age groups. However, Figure 54 showed very little variability for 6-year-olds, many of whom performed at ceiling. This finding, coupled with the qualitative observations mentioned above,
show that even though 4- and 5-year-old PRS-speakers performed above chance, the age of 6 indeed seems key.

In Chapter 1 I pointed out that in recent years, researchers have been successful in using the Autosegmental-Metrical for the analysis child speech production, and that few have employed it for investigations in to child perception. This study shows that the framework is quite useful for comprehension/perception work with children as well. While many of the earlier perception studies assessing child comprehension of sentence level prosody described contours as “falling” or “rising”, this general distinction is not sufficient to account for the two contours used in the experiment – they both have a final fall. The AM framework allows a more fine-grained distinction between the contours, a distinction that was found to be meaningful for the children who participated.

5.7. Conclusions

Earlier studies on prosodic comprehension have made it clear that the specific function of prosody is key in understanding how prosodic comprehension unfolds in children. Wells et al. (2004) note that “To gauge a particular child’s stage of prosodic development it is necessary to establish what aspect of prosody is in question and to look at peer performance” (p. 776). This chapter takes this piece of advice a step further, considering not only the specific aspect of prosody, but also how this aspect (epistemicity) is known to be comprehended outside the prosodic domain. Since it became clear in Chapter 4 that children are able to comprehend the response-eliciting function of the incredulity contour, but perhaps not the epistemic function (i.e. its encoding of disbelief), it was necessary to first look to the large body of literature which discusses how and when children begin to comprehend belief states lexically, namely as mental
state and modal verbs. I then hypothesized that since it is known that 4- and 5-year olds are capable of making distinctions between mental state and modal verbs, then they should be just as capable of making belief distinctions using intonational categories. This hypothesis was borne out in the data: 4- and 5-year olds were well above chance in the task, though 6-year-olds were more sophisticated comprehenders. The success on this task, differently from the 10-year-olds that participated in Cruttenden’s (1985) comprehension task where participants had to distinguish “neutral” from “surprised”, apart from cross-linguistic differences, may also be attributed to the fact that the task presented here provided children with an age-appropriate discourse context, a critical methodological detail according to Ito et al. (2012).

The work presented here makes it clear that when examining prosodic comprehension, specifically for intonational meaning, it is paramount to 1) understand how children use other aspects of the grammar that have comparable functions 2) have a clear understanding of how adults perceive intonational cues for the specific function (as was confirmed in Chapter 3) 3) consider whether information is overtly marked in a salient way and 4) provide discourse context. With respect to (1), it might prove advantageous in future work to look at languages with very rich morphological marking like Korean, Quechua or Tagalog in order to understand how children acquire grammatical markers of the many intentions that can be marked through the use of intonation. For instance, Tagalog has a special counter-expectation marker *pala*. Understanding how Tagalog-acquiring children use and perceive this marker would be quite relevant to the present research, and it is my understanding that no such research exists. Understanding how core concepts are acquired through other aspects of the grammar will help us to better define what sorts of concepts we can expect children to be capable of acquiring through
intonation. Part of the intrigue of intonational studies is the various levels at which intonation operates. While intonation may be used paralinguistically, we also find cases like that of L* HL% in PRS, where the intonation contour acts as a morpheme or particle. The results presented here suggest that information marked intonationally should be treated just like any other part of the grammar – the F0 contour acts as an instruction to guide the hearer to a given meaning. These considerations should allow for a clearer, more principled understanding of the development of prosodic comprehension from a language-specific point of view, but will also help to tease out cross-linguistic tendencies in prosodic acquisition.
CHAPTER 6: CONCLUSIONS AND FUTURE DIRECTIONS

6.1 Summary of findings

In this dissertation, I have provided a comprehensive view of intonation and yes-no questions in Puerto Rican Spanish (PRS) – starting with the adult (target) system, analyzing it from a speaker’s perspective, and later from a hearer’s perspective. I used this detailed description to investigate how the system might be used by caretakers when directing their speech to toddlers, and how toddlers themselves use the system. Finally, I examined how preschoolers comprehend what I argue to be the most complex of the contours I have described here.

The goal of Chapter 2 was to explore the use of intonation within the yes-no question domain in PRS adult speech by means of a production experiment. I used various discourse contexts to explore possible intonational contrasts within the domain of yes-no questions. In order to explore this domain, I used two Discourse Completion Tests (DCTs). DCT1 looked at more general categories of questions and was adapted from Prieto (2001). The specific version used in this dissertation was translated using versions from the Atlas interactivo de la entonación del español, coordinated by Pilar Prieto and Paolo Roseano, 2009-2010 (http://prosodia.upf.edu/atlasentonacion/). This adapted version was translated into Puerto Rican Spanish using both the Madrid and Buenos Aires versions. Only the relevant sentence type, i.e. yes-no questions, was analyzed in this dissertation (Prieto 2001 includes many types of speech acts and intentions). A second DCT was designed to look more closely at nuances in yes-no questions, DCT 2. These tasks revealed three main phonological contours that speakers most
The production experiments in Chapter 2, in addition to establishing the phonological categories available to the PRS adult speaker, allowed me to make generalizations about the types of form-meaning pairs we find for each of the three contours. Based on the results in the constructed discourse contexts, I argued that there are two general strategies speakers can use when asking yes-no questions in PRS, though this optionality will depend on beliefs and context. The first, more general option is for speakers to rely on a default contour, ¡H* L%, that does not encode any sort of information about bias. Escandell-Vidal (1998) also proposes that Peninsular Spanish uses a default contour that can be used for many different types of yes-no questions. When this default contour is used in biased contexts, according to Gunlogson’s (2003) predictions, it should take on the bias of the context – carrying therefore an evidential bias. This means that any information available in the discourse context is the evidence for the bias (i.e. the bias is not linguistically encoded). The data also revealed that speakers have the option to encode bias directed through choice of intonation contour. Through H+L* L% the speaker is able to make a private belief that p public by means of the contour, while with L* HL% the speaker is able to express incredulity or disbelief with respect to some proposition. Evidential bias is not enough to account for these question types because not only does the speaker encode interrogativity through intonation, but also epistemic information. Thus data from PRS support Sudo’s (forthcoming) proposal for a second category of bias, epistemic bias. Speakers will not always have the optionality to choose between the default contour and contours encoding epistemic bias, since speakers are not constantly in an appropriate epistemic state that would allow them to choose an epistemic contour. Therefore the
data analyzed in Chapter 2 provide evidence for two types of contours, a default contour (¡H* L%) and two epistemic contours.

An additional finding from the phonological analysis was that on the surface, it seems that PRS has the categories ¡H* HH%, L* HH% and L+H* HH%, especially for the case of tag questions, which tend to either by monosyllabic or oxytones (e.g. ¿OK?, ¿verdad?, ¿sí?). That is, some data suggested that PRS shows final rises for yes-no questions. However, these tunes were found to be phonetic realizations of one category: ¡H* L%. The different phonetic realizations are due to an optional truncation rule in PRS. Establishing the possible phonetic realizations and contextual rules is crucial when establishing the possible target categories that a child is to acquire. In Chapter 2 I also situate PRS among other varieties of Spanish that also have been described as encoding questions through falls.

The next step was to test the claims from Chapter 2 with a perception experiment. This experiment was designed to test how hearers perceive the belief states of speakers when the three contours, ¡H* L%, H+L* L% and L* HL% are heard with different types of contexts. The goal of this experiment was not only to confirm the conventional meanings associated with the contours described in Chapter 2, but also to understand their possible contextually-induced meanings. I looked at how six different context types (neutral, biased based on linguistic evidence, biased based on visual evidence, biased based on prior belief, biased based on prior belief in addition to visual evidence and biased based on a prior belief incongruent with linguistically activated information. In this perception experiment, participants rated perceived speaker belief state based on a 7-pt. Likert scale. The results demonstrated that the epistemic contours behave differently than the default contour, ¡H* L%. When ¡H* L% is heard in a
neutral context, no bias is perceived, while when H+L* L% is heard in a neutral context, a bias for p is perceived. When L* HL% is heard in a neutral context, disbelief for p is perceived. This shows that the contours indeed carry epistemic information that is linguistically encoded. Additionally, ¡H* L% was found to be more malleable in terms of how much participants relied on discourse context when perceiving the speaker’s belief state. This effect was diluted for the epistemic contours. There was less variation in perceived belief states across contexts for H+L* L% and L* HL% when compared to ¡H* L%. However, this does not mean speakers completely ignore discourse context. It was found that specific discourse context-contour combinations may lead to infelicity (since the belief state of the speaker would be strange given the context, which happened in the case of H+L* L%), or they may lead to specialized interpretations (such as an ironic/sarcastic interpretation found for L* HL%). These findings again support the idea that two categories of bias are necessary to account for the role of intonation in the yes-no question domain in PRS. When ¡H* L% carries bias it is because of context, and therefore the bias perceived by the hearer is evidential bias. The hearer relies on epistemic bias for epistemic contours, though this may interact with evidential bias leading to either infelicity or specialized meanings. In sum, Chapter 3 allowed for a more in-depth look at the intrinsic values of the three contours and how these values are affected by discourse context.

With a clear overall picture of how the adult system works from both the speaker’s (production) and the hearer’s (perception) perspective, Chapter 4 looked at how these contours are used in child-directed-speech (CDS) and child speech using the CLESS corpus and the PAELMA corpora. The speech of six caretakers and two female toddlers were analyzed. The range of ages analyzed is between 19 and 43 months of age. A total of 5235 utterances were
analyzed – 661 from CDS and 4574 from child speech. The epistemic contours were predicted to emerge later since they are more complex in meaning than the default contour. Additionally, the fact that the type of information being encoded is epistemic also led me to predict that these contours would be acquired later, since other forms encoding epistemic information (like epistemic modal verbs) are known to begin to be distinguished around age 4 or 5 (Papafragou 1998). I also expected epistemic contours to be lower frequency in CDS, since they are dependent on specific belief states on the part of the speaker, and therefore we do not expect the speaker to have the choice to encode such belief states every time s/he asks a question. As expected, the analysis revealed that in CDS, the vast majority of questions are characterized by the default contour, ¡H* L% (93%), followed by L* HL% (4.9%) and H+L* L% (1.8%). Therefore the epistemic contours are much less frequent than the default contour in CDS. 99% of all yes-no questions identified in child speech used the default contour. The only contour shown to felicitously occur in child speech was H+L* L%, and the first token was produced by Ana when she was 33 months old. Ana produced one other token of H+L* L% at 41 months. Cristina used the contour once at 36 months, and another time at 42 months. There were a total of four tokens of H+L* L% produced, two from each child. There was no felicitous use of L* HL% in the corpus for the two toddlers. The form itself was produced by Cristina at 28 months as an echo question, but the discourse context made clear that she was not producing the contour to convey incredulity. This led to an interruption in the flow of the conversation. I classify this use as an “intonational error”, since it demonstrates how while Cristina may have been aware of some components of the use of the contour (interrogativity, questioning of a very recently activated proposition), she was not aware of the epistemic component. Intonational errors are
difficult to find in child speech, perhaps because if a child uses the wrong contour, adults search for the most relevant meaning and try to make sense out of the child’s utterance. The error also gives evidence that children may only understand subcomponents of a contour’s conventional meaning.

Lleó & Rakow (2011) showed that by 24 months monolingual children acquiring Peninsular Spanish have already acquired the four crucial points associated with what is presumably the default contour for yes-no questions in that variety (though tune-to-text alignment is not mastered until 3;0). Prieto et al. (2011) showed that at 19 months, children acquiring Peninsular Spanish can produce at least three contours associated with general interrogativity, invitations and echoic functions. The data presented here confirm Lleó & Rakow’s findings in terms of the presence of a default contour by 24 months (and even earlier in this corpus), as well as Prieto et al.’s findings in terms of the emergence of a general marker of interrogativity. However, a major difference between the data presented here and those from Prieto et al. is that while the Peninsular Spanish children are already producing three contours at 19 months of age, the earliest point of production of a second contour in the PRS data is 14 months later, at 33 months. This important contrast can only be explained by the fact that PRS-acquiring children must learn to deal with epistemic meaning to acquire the additional contours available within the yes-no question domain. Epistemic contours are less frequent in CDS and have complex meaning and restrictions. The contours are more complex than the default because they encode more information. L* HL% was considered to be the most complex because not only does it encode additional information (that requires juxtaposition to some recently acquired
knowledge) but the point at which it can be uttered is also restricted (it must be uttered just after
the recently acquired knowledge is processed).

In Chapter 4, I argued that the three contours differed in their complexity based on the
information they encode and their contextual licensing with \( \text{¡H}\% \text{L}\% \) as the least complex, \( \text{H+L}\% \text{L}\% \) as more complex and \( \text{L}\% \text{HL}\% \) as the most complex. Based on earlier work by Estigarribia
(2010a; 2010b) on the acquisition of yes-no questions from a syntactic point of view, I
hypothesized that the complexity of the contours would play a role in their development. Under
this hypothesis, \( \text{H+L}\% \text{L}\% \) (the contour encoding the speaker’s bias towards a given proposition)
should have been the first of the epistemic contours to emerge. Albeit with very few tokens, this
was the case. In order to use \( \text{H+L}\% \text{L}\% \) felicitously, the child must only decide to encode her
belief about a proposition, differently from \( \text{L}\% \text{HL}\% \) (the incredulous/disbelief contour) where
she must contrast her disbelief with respect to a proposition with contextual evidence for that
proposition, at the same time obeying temporal constraints on when that evidence becomes
available in the context. The emergence of \( \text{H+L}\% \text{L}\% \) in the data cannot be explained in terms of
frequency, since \( \text{H+L}\% \text{L}\% \) was less frequent than \( \text{L}\% \text{HL}\% \) in CDS. Therefore, I proposed that
just like Estigarribia (2010a; 2010b) proposes for the acquisition of inversion in English yes-no
questions, the notions of complexity and incrementality apply to the acquisition of epistemic
contours in PRS. I argue that the late emergence (and non-emergence) of the contours when
compared to other work on intonational development in yes-no questions in Spanish is due to the
interaction between their complexity, low frequency and perhaps most importantly, the epistemic
information they encode.
In Chapter 5 I predicted that 4- to 6-year-olds would have access to the disbelief meaning of \( L^* \) \( HL\% \), since it is around these ages that children have been shown to make distinctions in epistemic modality as well as mental state verbs, parts of the language that encode cognitive concepts related to the epistemic contours I have been describing. I tested children from three age groups: 4-, 5- and 6- year old speakers of PRS, in a linguistic comprehension experiment looking at how children at these ages comprehend the disbelief meaning of \( L^* \) \( HL\% \) in context relative to \( \text{¡H}^* \) \( L\% \), which would encode no epistemic information. The results showed that all age groups were significantly above chance in their performance on the task, though 6-year-olds performed significantly better than 4- and 5-year-olds. I argued that because PRS has quite a reliable intonational marker of disbelief/incredulity, it should not be surprising that we find success on this task for these specific age groups. Thus while the error observed in Chapter 4 suggests absence of knowledge about the epistemic meaning encoded through \( L^* \) \( HL\% \) at 28 months, the contour seems to be comprehended well after age 4. However, 6-year-olds were most adult-like in their performance, and seemed to have a more refined comprehension of the contours. For instance, some 6-year-olds produced facial gestures that are typically associated with the two question contours in the stimuli as they listened to them, indicating a more sophisticated knowledge of intonational meaning at this stage.

6.2. What have we learned about intonational development?

This dissertation shows several applications of the AM framework, displaying not only how it can be applied for adult production and perception, but also production and perception for children. The model allowed me to analyze three different phonological contours, all of which are falling. Unlike many early studies that have been concerned with the maximal contrast
between a fall versus a rise in the acquisition of intonation, I looked at how children acquire three falling question contours, and their meanings. One of the most important things I have demonstrated here is how very crucial it is to have a clear description of the pragmatic division of labor of intonation contours in adult language. If I were to have characterized the contours described here as simply “information-seeking” or “confirmation-seeking”, a great deal of information about intonational development would have been lost. The toddlers studied here produce both types of questions before they ever produce a second intonation contour. While in other language varieties it could be the case that these broad categories govern choice of intonation contour, this is not the case for PRS. The fact that belief states do affect contour choice in this variety had a consequence for their acquisition, linguistically encoded belief states are something children are known to use and perceive later. With this in mind, we expect intonational development to vary cross-linguistically based on the restrictions for contour choice in each variety.

Halliday (1975) noted that his son Nigel had just one intonational distinction at the onset of speech – rising utterances that require a response, and falling ones that do not. If children associate utterances that need responses with their language-specific question intonation, and ones that do not with the declarative intonation in their variety, then the PRS-acquiring child has to learn that some response-eliciting utterances use ɁH* L%, but not others do not. For example, the PRS-acquiring child must learn that ɁH* L% can be used for requests, but not imperatives (which Halliday also includes as response-eliciting utterances). For yes-no questions,

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23 In fact, the corpora used in this study show even more variation in response-eliciting utterances in this variety – response-eliciting declaratives and imperatives often show a fall-rise (L* H%), complicating the learning problem for the PRS-acquiring child in terms of response-eliciting utterances.
children later learn that when they have certain beliefs about propositional content, they can choose between a more informative contour (epistemic) or a less informative contour (default). Therefore the child would then learn to exercise Grice’s Maxim of Quantity with respect to contour choice, using the more informative contour when needed, or the less informative one when it is sufficient. Caretakers also provide cues to children with respect to the meanings of epistemic contours as well, this was most notably the case for L* HL%: after producing L* HL% utterances caretakers provide elaborations such as *I don’t believe*... or other elaborations that clue children into the “mismatch in belief” meaning of L* HL%, for example. At 38 months there is evidence that Cristina at least understands that L* HL% is used in CDS to encourage children to reformulate answers. When Experimenter 1 asks Cristina what her mother does with dirty clothes and Cristina responds that her mother throws them away (*La bota*), Experimenter 1 replies *¿la bota?* (L* HL%) and Cristina immediately retracts her response by shaking her head ‘no’, indicating that she understood Experimenter 1’s intent to get Cristina to change her stance on the proposition. It is also possible that the frequency of corporal or facial gestures with one contour versus another one could provide children with information about category formation. The role of gesture in intonational development is an important area for investigation in future studies.

This dissertation shows, just by analyzing intonation in the domain of yes-no questions, that not all systems are alike with respect to intonational meaning, and that this will have implications for acquisition. The Peninsular Spanish-acquiring child who at 19 months might produce three contours yes-no questions will not have the same experience as the PRS-acquiring child who uses only one contour 19 months, and may continue to use this contour into her
preschool years. The results here show that this is due to the kind of intentionality that is encoded through intonation between the two varieties, and to when these intentions become part of the child’s repertoire.

This research opens up an unexplored area with respect to intonational development. While there has indeed been recent interest in showing which contours children use for different intention types, there has been no focus on how children develop the ability to encode epistemic meaning through intonation (and very little work on how adults do this). We can begin to look at how intonational morphemes mark utterances for information beyond the sentence type, and how children acquire these. By comparing my results to Prieto et al.’s (2011) results for Peninsular Spanish, it becomes clear that there will be different consequences in the cline of acquisition based on the type of information encoded intonationally. Simpler intentions encoded through intonation should emerge earlier, as they did for the Peninsular Spanish case. More conceptually complex forms should emerge later. But as Chapter 4 shows, if the complex form is a reliable cue in the language (as I showed for L* HL% I Chapter 3), the form should be readily comprehended once the child is cognitively mature enough. These predictions obviate the need for research looking for a correlation between a child’s ability to make epistemic distinctions through other parts of the grammar (i.e. lexical items, morphology, etc.) and their ability to distinguish epistemic differences through intonation. In any case, the results presented in this dissertation suggest that when information is encoded through intonation, it will be acquired just like any other part of the grammar. Because of the many functions of intonation, however, an integrated approach to studying intonational development that includes both phonological and semantic-pragmatic analysis is needed.
6.3. Future directions

Future studies are of course needed to understand when the epistemic contours emerge productively. This is difficult of course since, as I have noted multiple times, the contours are more restricted, and therefore less frequent than the default contour. Methodology is needed for reliable elicitation tasks suitable for children to better understand the development of the epistemic forms. Because this work deals directly with belief states, it can be expanded to atypical populations such as high-functioning autistic children, or children with specific language impairment. Were there to be differences between typically developing children and autistic children for example, this could be a possible practical application of the AM model – a way to focus on specific prosodic categories in clinical work and strategies for interventions that deal with prosodic aspects of language. Evaluations testing a child’s intonational comprehension could also be added to batteries of tests used for diagnosis.

It will be important to continue to expand studies similar to this one to other varieties of Spanish as well as other intonation languages. This, of course, would entail more detailed pragmatic accounts of adult speech for other varieties and languages, but it is my hope that this dissertation will obviate the implications that detailed studies of the pragmatic functions of intonation will have for expanding our knowledge of intonational development, and language development in general. It will also be interesting to understand how intonation is developed across sentence type domains. For example, in PRS L* HL% is also used for vocatives. How do children (or even adults) handle the polysemy of contours perceptually? Since we know children to be sensitive to phonetic differences, are there phonetic differences for polysemous forms like L* HL% that help children (or adults) maintain contrasts? Do these cues differ in CDS versus
adult speech? The role of phonetics in guiding hearers to the appropriate intonational meaning could prove to be a fruitful area of inquiry, especially considering the findings of Hirschberg & Ward (1992) and Tomlinson and Fox Tree (2011). Going back to Crystal’s (1986) observation that there are fewer pitch patterns available in a language than there are situations to be differentiated, it seems likely that languages might use other cues that help to lead hearers to the desired meaning. Production studies investigating the phonetic differences between phonologically identical contours across different meaning types would help us to accomplish this, and perception studies testing how hearers infer these meanings with and without context would also help to understand the role of additional phonetic cues for intonational meaning. In addition to phonetic cues, the role of kinesic cues in guiding hearers to a specific meaning also merits investigation.

New research looking at novel construction learning (Wonnacott, 2011; Wonnacott et al. 2011) also provides interesting methodology that could be applied to intonational development. Experimental work investigating children’s sensitivity to input for novel contours in learning tasks could be very interesting for investigating how children learn to make the associations between a novel intonational form and and various mental-state-related meanings. As referenced above, it would be interesting to compare the performance of typically-developing children with the performance of high-functioning autistic children. Like Armstrong et al.’s (2011) work, psycholinguistic methods such as eyetracking or ERP would be helpful in understanding how intonational meaning is processed throughout the cline of development, and could also help us to better understand the notion of complexity from a processing point of view.
In order to enhance our knowledge of how intonation is developed (both for typical and atypical populations) it will be necessary to first enhance our knowledge of what intonation is capable of doing in the grammar. Therefore, while I have investigated only one domain, it will be necessary to investigate how intonation is operating at higher levels and across domains. From a semantico-pragmatic perspective it will be interesting to account for how intonation works from a theory of implicature – which intonational meanings are generalized, default meanings and which are context-dependent? These more general observations will be useful in understanding how the forms emerge in acquisition. Cross-linguistic work comparing languages that use intonation in different ways will also bring us closer to a theory of how children acquire their intonational grammar. This dissertation showed that data from two varieties of the same language yield different results for intonational development just within the domain of yes-no questions. If researchers are able to adopt a holistic approach (i.e. a detailed account of both form and meaning) to providing intonational descriptions of language varieties, this will facilitate more fruitful studies of intonational development.
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Appendix A: Inventory of monotonal and bitonal pitch accents in Puerto Rican Spanish and their schematic representations

### Monotonal pitch accents

<table>
<thead>
<tr>
<th>Accent</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>L*</td>
<td>This accent is phonetically realized as a low plateau at the minimum of the speaker’s pitch range. In this corpus, it is found in nuclear position for disjunctive questions, tag questions and incredulity questions.</td>
</tr>
<tr>
<td>H*</td>
<td>This accent is phonetically realized as a high plateau with no preceding F0 valley. In this corpus, it is used in nuclear position for narrow focus statements, exclamatives and in prenuclear position in yes-no questions.</td>
</tr>
<tr>
<td>¡H*</td>
<td>This pitch accent occurs in nuclear position, with the high tone produced obligatorily higher in the speaker’s pitch range than H*. Its phonetic realization in nuclear position is affected by the following boundary tone. When followed by a high boundary (top), the high plateau persists throughout the duration of the tonic syllable. When followed by a low boundary (bottom), the F0 persists throughout the syllable onset and may begin the fall anywhere from early in the vowel to about three quarters of the way through it. It is found in nuclear position for polite questions, imperative questions and broad focus yes-no questions.</td>
</tr>
</tbody>
</table>

### Bitonal pitch accents

<table>
<thead>
<tr>
<th>Accent</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>L+H*</td>
<td>This accent is phonetically realized as a rising pitch movement during the accented syllable with the F0 peak located within this syllable. The peak may occur somewhere around the vowel midpoint, or it may be aligned with the end of the syllable. This pitch accent is typically found in prenuclear position for statements and in nuclear position for narrow focus statements and exclamatives.</td>
</tr>
<tr>
<td>L+&gt;H*</td>
<td>This accent is phonetically realized as a rising pitch movement throughout the accented syllable with the F0 peak located in the posttonic syllable. These can be found in prenuclear position in narrow focus statements and echo wh-questions.</td>
</tr>
</tbody>
</table>
This accent is phonetically realized as a flat F0 valley throughout the accented syllable with a subsequent rise on a post-accented syllable. This is by far the most common prenuclear pitch accent in the data for this dialect, and can be found for statements, yes-no questions, wh- questions and commands, among others.

This accent is phonetically realized as a F0 fall throughout the nuclear accented syllable for wh- questions (top). For positive confirmation questions, onset of the fall is found in the pretonic syllable (bottom).

Schematic representations of monotonal and bitonal boundary tones in Puerto Rican Spanish

**Monotonal boundary tones**

<table>
<thead>
<tr>
<th>Tone</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>L%</td>
<td>L% is phonetically realized as a low sustained tone or a falling tone at the baseline of the speaker. It is attested at the end of broad and narrow focus statements, yes-no questions, wh- questions and imperatives, among others.</td>
</tr>
<tr>
<td>M%</td>
<td>M% is phonetically realized as a rising (right) or a falling (centre) movement to the end of a non-final constituent, or a sustained midtone after a high nuclear pitch accent (left). It is attested in broad and narrow focus statements, and also at the end of commands and statements of the obvious.</td>
</tr>
<tr>
<td>H%</td>
<td>H% is phonetically realized as a rising pitch movement coming from a low or a high pitch accent. It may be found at the end of non-final constituents, but also at the end of an intonational phrase. A final rise from a low pitch accent is found in tag questions and echo wh- questions. A sustained high tone is found for imperative yes-no questions in this variety.</td>
</tr>
</tbody>
</table>

**Bitonal boundary tones**

<table>
<thead>
<tr>
<th>Tone</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>HL%</td>
<td>HL% is phonetically realized as a peak in F0 followed by a fall. It is commonly found for incredulity questions, exhortative requests and stylized calling contours.</td>
</tr>
</tbody>
</table>
LM% is phonetically realized as a low F0 valley followed by a rise to a mid tone. It is attested in statements of the obvious.
Neutral yes-no questions
1. Entras en un mercado y le preguntas al empleado si tiene jalea.
   ¿Tiene jalea? ¿Tienes jalea?
   You enter a market and you ask the employee if they have jelly.
   Do you have jelly?

2. Estás en la calle y quieres preguntar la hora.
   ¿Ud. tiene la hora?
   You’re on the street and want to ask the time.
   Do you have the time?

3. Pides permiso para pasar al consultorio donde te espera el médico.
   ¿Puedo entrar? ¿Puedo pasar? Se puede?
   You ask for permission to enter the doctor’s chambers.
   May I come in?

4. Llamas por teléfono a casa de una amiga que se llama María pero no está. Más tarde llamas de
   nuevo, pero ella no te atiende al teléfono. ¿Cómo preguntas si ya llegó?
   ¿Ya llegó María? ¿María ya llegó?
   You call your friend María’s house on the phone but she’s not there. You call again, but she
   doesn’t answer the phone. How do you ask if she has already arrived?
   Is María home yet?

5. Organizaste una comida y decides cambiar la fecha para que todos los invitados puedan ir.
   Pregúntales si van a poder venir si la comida es el primer domingo de mayo.
   ¿Pueden venir a la comida, si la hacemos el primer domingo de mayo?
   You organized a meal and decide to change the date so that all the guests can come. Ask them if
   they can come if the meal is the first Sunday in May.
   Can you (guys) come if we do it the first Sunday in May?

6. Estás buscando a María pero no la puedes encontrar. Te cruzas con alguien que la conoce y
   después de hablar un poco sobre ella le preguntas si la ha visto.
   ¿Oye, la has visto, a María?
   You’re looking for María but you can’t find her. You see someone who you know and after
   talking for a bit you ask if they have seen her.
   Hey, have you seen her, Maria?
Biased questions
Focus
7. Estás hablando de María con alguien y oyes que entra una persona. Pregúntale si es María la persona que está entrando.
¿Es María la que está entrando?
You’re talking to María with someone and you hear a person entering. Ask if it’s María who is entering.
Is that Maria coming in?

Exclamative questions
8. El electricista tenía que venir a las 10. Tuviste que salir a comprar y tu hija se quedó esperándolo. Llegas de la compra y el electricista aún no ha llegado.
¿Todavía no ha llegado?
The electrician was coming at 10. You need to go out shopping so your daughter stays home waiting for him. You get home and the electrician has still not arrived
He still hasn’t arrived?

¿¡ Tienes frío?!
You’re having dinner at a restaurant. It’s very hot. Next to you, your son is shivering cold. Surprised, you ask him if he’s cold.
You’re cold?!

Tag questions
10. Juan dijo que iba a venir a comer pero quieres confirmarlo. ¿Qué le dices a Juan?
¿Vienes a comer, ¿verdad?
Juan said he would come to eat but you want to confirm. What do you say to Juan?
You’re coming to eat, right?

11. Antes de ir a trabajar tu hermano dijo que no se sentía muy bien. Al volver, lo encuentras en la cama temblando de frío. Ves que no se siente bien, pero se lo preguntas, sabiendo cuál va a ser la respuesta.
Te sientes mal, ¿verdad?
Before going to work your brother said he doesn’t feel so well. Coming back, you find him in bed, shivering cold. You see that he doesn’t feel well, so you ask him even though you know what the answer is.
You don’t feel well, do you?
12. Necesitas subir tres pisos porque te dejaste el wallet arriba. Vas con un nene chiquito y, para ganar tiempo, lo dejas abajo. Dile que no se mueva.

No te muevas, OK?
You need to go up three floors because you left your wallet upstairs. You go with a small child and to save time, you leave him below. Tell him not to move.

Don’t move, OK?

13. Tienes muchas ganas de que alguien venga a una cena que organizaste. Se lo pides de modo que no pueda decir que no.

¿Te veo en la cena, verdad?
You really want to see someone who you invited to a dinner. You ask him in a way that he can’t say no.

I’ll see you at the dinner, right?

Echo questions

Full repetition

14. Invitaste un amigo al cine y te dijo que no puede venir. Te parece que no le entendiste bien. Le preguntas para aclararlo.

¿Dijiste que no vas a venir?
You invited your friend to the movies and you he told you he can’t come. It seems that you didn’t understand well. Ask him again to clarify.

You said you’re not coming?

15. Te dicen la hora, pero no oíste bien. Piensas que te dijeron que son las nueve. Vuelves a preguntar.

¿Dijiste las nueve?
Someone tells you what time it is, but you didn’t hear it well. You think they told you that it was nine.

You said nine?

16. Te preguntaron dónde vas y cuándo vas a volver. Pero no sabes si entendiste bien. Pregunta si es esto lo que te dijeron.

¿Me estás preguntando a dónde voy y cuándo vuelvo?
Someone asked you where you’re going and when you’re coming back. But you’re not sure if you understood well. Ask if this is what they asked you.

Are you asking me where I’m going and when I’m coming back?
17. Te han preguntado dónde vas, pero no estás seguro si entendiste bien la pregunta. Averigua si es eso lo que habían preguntado.

¿(que) a dónde voy?
You’ve been asked where you are going, but you’re not sure if you understood the question well. Confirm if this is what you’ve been asked.

Where I’m going?

18. Te comentan que una compañera tuya, Marina, quiere ir a bailar, y sabes que no le gusta janguear. No lo crees y preguntas si es Marina la que quiere ir.

¿Quiere ir, Marina?
Someone tells you that a friend, Marina, wants to go dancing, and you know she doesn’t like going out. You can’t believe that it’s Marina that wants to go.

She wants to go? Marina?

19. Te dicen que un compañero tuyo, Mario, se postula para alcalde. No lo crees y lo vuelves a preguntar.

¿Qué MARIO se postula para alcalde?
Someone tells you that your friend, Mario, is running for mayor. You can’t believe it and you ask again.

MARIO is running for mayor?

Incredulous (with focus)

20. Tus nietos arman mucho alboroto y no te dejan oír la televisión. Les pides que se callen.

¿Se pueden callar? ¿Pueden callarse?
Your nieces and nephews are making a racket and you can’t hear the TV. You ask them to be quiet.

Can you be quiet?

21. No te hacen caso y esta vez lo pides más enojada (order)

¿Se quieren callar?
They don’t pay attention and this time you ask them again, angrier.

Can you be quiet?

22. Les preguntas a tus sobrinos si quieren dulces.

¿Quieren dulces?
You ask your nieces and nephews if they want candy.

Do you guys want candy’
23. Le preguntas a un amigo si se quiere venir a tomar una cerveza contigo.

¿Vamos a darnos o bebernos una cerveza?
You ask a friend if he wants to go get a beer with you.

Want to get a beer?

Exhortative intention

24. Organizas una fiesta en tu casa y tienes muchas ganas de que un compañero tuyo vaya. Pídele si quiere venir.

¿Vas a venir a la fiesta?
You organize a party at home and are really hoping that your friend can come. Ask him if he wants to come.

Are you coming to the party?

Rhetorical questions


¿Habrá tranquilidad alguna vez en esta casa?!
You need tranquility but you’re surrounded by craziness. Ask if there will ever be tranquility in the house.

Will there ever be tranquility in this house?
Appendix C: DCT2 Materials

DCT2 Part 1

A. Negative answer expected

1. Cocinaste una cena rica de mofongo para tus amigos. Mientras todo el mundo está comiendo te fijas que tu amigo Juan no está comiendo.
Le preguntas:
You made a delicious dinner for your friends. While everyone is eating you realize you friend Juan isn’t eating. You ask him:

¿No te gusta el mofongo?
‘You don’t like mofongo?’

2. Estás en una fiesta hablando con los hermanos de una amiga, Marina. No habías hablado con ella todo el día y querías saber si ella había pasado su examen. Pero dicen los hermanos que hoy llegaron de Aguada, y que no han estado en casa hoy. Entiendes, entonces, que no han visto a Marina, y lo confirmas:
You’re at a party talking with your friend Marina’s brothers. You haven’t talked to her all day and want to see if she passed an exam she took. But her brothers, who just got back from Aguada, say she she hasn’t been home today. You take this to mean that they haven’t seen Marina, but you confirm:

¿Hoy no vieron a Marina?
‘You haven’t seen Marina today?’

3. Sabes que hay una reunión en tu trabajo esta semana pero no sabes cuándo.
Tu colega te dice: Como no hay nada importante mañana podemos salir temprano e ir a la playa.
You know that today there’s a meeting at work, but you’re not sure when.
Your coworker: Since there’s nothing important at work tomorrow, we can leave early and go to the beach.
Tú: ¿No hay reunión mañana?
You: ‘There’s no meeting tomorrow?’

4. Tu amiga te está hablando de una amiga suya, Marina.
Tu amiga: Marina está feliz ahora que no vive en Aguada.
Tú: ¿Marina no vive en Aguada? Entonces, ¿dónde vive?
Your friend is talking about her friend, Marina.
Friend: Marina is happy now that she doesn’t live in Aguada.
You: ‘Marina doesn’t live in Aguada?’ Where does she live then?
5. Vas a una tienda para comprar empanadilla de guayaba. Cuando entras, la mujer que normalmente te atiende te mira, y después mira hacia la vitrina, que ya no tiene más empanadilla de guayaba. Le dices:
¿No hay empanadilla de guayaba?
You go to a store to buy guayaba turnovers. When you enter, the women who normally waits on you and then looks at the display. There’s no more guayaba turnovers.
You say to her: ‘There’s no guayaba turnovers?’

B. No specific response expected

1. Vas a hacer una cena y quieres preparar mofongo. Vas a invitar a un amigo, José, pero no sabes qué tipo de comida le gusta a él. Le llamas, y después de charlar un ratito le preguntas:
¿Te gusta el mofongo?
You go to a dinner and you want to make mofongo. You invite a friend, José, but you don’t know what type of food he likes. You call him, and after chatting for a bit you ask him:
‘Do you like mofongo?’

2. Estás en una fiesta y ves los padres de tu amiga, Marina. Ella ha estado viajando y sabes que vuelve hoy, pero no sabes a qué hora. Quieres saber si sus padres la han visto hoy. Preguntas a los padres:
¿Hoy vieron a Marina?
You’re at a party and you see your friend Marina’s parents. She’s been traveling and you know she gets back today, you just don’t know what time. You want to know if her parents have seen her. You ask her parents:
‘Have you seen Marina today?’

3. Sabes que hay una reunión esta semana pero no tienes ni idea qué día es. Una colega te ha pedido llevarle al aeropuerto pero no sabes si puedes por causa de la reunión. Llamas a la secretaria de la oficina y le preguntas:
¿Hay reunión mañana?
You know there’s a meeting this week but you don’t have any idea when. Your coworker asked you to bring him to the airport but you don’t know if you can, because of the meeting. You call the secretary at the office to find out.
‘Is there a meeting tomorrow?’

4. Tu amiga te está hablando de una colega suya, Marina. Vas a hacer una fiesta y quieres invitarle a Marina pero no sabes si vive en Aguada u otra ciudad (y tú vas a hacer la fiesta en Aguada.) Le preguntas:
¿Marina vive en Aguada?
Your friend is talking to you about a friend of hers, Marina. You’re having a party and you want to invite Marina but you don’t know if she lives in Aguada or some other city (you’re having the party in Aguada). You ask your friend:
‘Does Marina live in Aguada?’

5. Estás de vacaciones en otra parte de la isla. Tienes ganas de comer empanadilla de guayaba. Entras en la tienda y le preguntas a la mujer si la hay:
¿Hay empanadilla de guayaba?
Your’re on vacation on another part of the island. You want to eat guayaba turnovers. You go in a sore and ask the woman if they have any.
‘Are there guayaba turnovers?’

C. Propositional content unexpected
1. Estás con unos panas en un restaurante. Tu amiga Ana, que no come el mofongo nunca, pidió, y está comiendo felizmente, mofongo. Tú creías que no lo gustaba, así que le dices:
¿Te gusta el mofongo?
You’re with some friends at a restaurant. Your friend Ana, who doesn’t ever eat mofongo, is happily eating mofongo. You thought she didn’t like it, so you ask her:
‘You like mofongo?’

2. Tu amiga Marina ha estado en Aguada por una semana, y crees que vuelva mañana. Pero ves a sus hermanas en una fiesta y están hablando del vestido que ella llevó hoy a la iglesia, que te da la impresión que la han visto, que es raro, porque creías que volvía mañana. Les preguntas:
¿Hoy vieron a Marina?
Your friend Marina has been in Aguada for a week, and you think she is coming back tomorrow. But you see her sisters at a party. They are talking about the dress she wore to church, giving you the impression that they had seen her, which is strange because you thought she was coming back tomorrow.
‘You saw Marina today?’

3. En tu oficina, nunca hay reuniones los viernes. Estás almorzando con una colega el jueves, y empieza a quejarse de la reunión mañana, viernes. No sabías nada de la reunión. Le dices:
¿Hay reunión mañana?
In your office there are never meetings on Fridays. You’re having lunch with a colleague on Thursday, and he starts to complain about the meeting tomorrow, Friday. You don’t know anything about the meeting and you ask him:
‘There’s a meeting tomorrow?’

4. Estás hablando con un amigo sobre otra amiga Marina, que estaba viviendo en Chile. No sabías que ella se había vuelto a Aguada.
Tu amigo: Vi a Marina aquí en Aguada la semana pasada. Su apartamento está cerca del centro.
Tú: ¿Marina vive en Aguada?
You’re talking with a friend about another friend Marina, who has been living in Chile. You didn’t know she had come back to Aguada.
Your friend: I saw Marina here in Aguada last week. Her apartment is really close to downtown.
You: ‘Marina lives in Aguada?’

5. Siempre vas a la misma tienda para desayunar, y en esa tienda siempre hay dos tipos de empanadilla: de queso y de carne. Un día entras y ves que hay una nueva etiqueta que dice 'empanadilla de guayaba'. Miras a la mujer que te atiende y le preguntas: ¿Hay empanadilla de guayaba?
You always go to the same place to have breakfast, and there are always two types of turnovers: cheese and meat. One day you go in and see a new sign that says “empanadilla de guayaba”. You look at the woman who is about to wait on you and ask her:
‘There’s guayaba turnovers?’

D. Affirmative response expected
1. Pana: La amiga de mi mamá llamó ayer para saber si me gustaba el mofongo. Va a hacer una comida el jueves.
Tú: ¡Ya sé que te gusta!
Pana: Entonces mamá se lo dijo.
Tú: ¿que te gusta el mofongo?
Pana: Sí, entonces ¡me va a hacer uno de camarones!
Friend: My mom’s friend called yesterday to find out if I liked mofongo. She’s going to have a dinner on Thursday.
You: Well I know you like it!
Friend: Yeah, that’s what my mom told her.
You: That you like mofongo?
Friend: Yep, she’s going to make me SHRIMP mofongo!

2. Estás en una fiesta hablando con la mamá de tu amiga, Marina.
Mamá de Marina: Y me dijeron sus hermanos que la vieron como a las 11.
Tú: ¿que vieron a Marina?
Mamá: Sí.
You’re at a party talking to your friend Marina’s mother.
Marina’s mom: And they told me that they saw her at 11.
You: ‘That they saw Marina?’
Marina’s mom: Yes.
3. Tienes una reunión mañana, y el viernes. Crees que tu colega está hablando de la reunión de mañana.
Tu colega: Tenemos que preparar todo para la reunión.
Tú: ¿La reunión de mañana?
You have a meeting tomorrow, Friday. You think your colleague is talking about that meeting.
Your colleague: We have to prepare everything for the meeting.
You: The meeting tomorrow?

4. Estás hablando con una amiga sobre una pareja, Carlos y Marina.
Amiga: …y Carlos no quiere salir con Marina porque vive en Aguada, que está lejos.
Tú: ¿Marina vive en Aguada?
You’re talking with a friend about a couple, Carlos and Marina.
Friend: …and Carlos doesn’t want to date Marina because she lives in Aguada, and it’s far.
You: ‘Marina lives in Aguada?’
Friend: Yes, near my grandparents.

5. Tu amiga había entrado en la tienda para saber si había empanadilla de guayaba. Ella entra en el carro:
Amiga: Dice la señora que sí las hay.
Tú: ¿que hay empanadillas de guayaba?
Your friend just went into a store to see if there was any guayaba turnovers. She gets back in the car:
Friend: The woman says there are.
You: That there are guayaba turnovers?
Friend: Yes!

DCT2, Part 2 (Questions adapted from Ladd 1981)

**Inner negation - A**

Tu amigo: Como Uds. son vegetarianos, no podemos comer en este barrio. Todos los restaurantes aquí son más para los que comen carne.
Tú: ¿Por aquí no hay ningún restaurante vegetariano?

Your friend: Since you guys are vegetarians, we can’t eat in this neighborhood. All the restaurants here are more for meat-lovers.
You: ‘There’s no vegetarian restaurants around here?’
**Inner negation - B**

Tu amigo: Vamos a tener que ir a Piñones para comprar piononos. En este barrio va a ser difícil.
Tú: ¿*Por aquí no hay ningún lugar que venda piononos*?

Your friend: We’re going to have to go to Piñones to eat piononos. In this neighborhood it’ll be difficult.
You: *There’s nowhere that sells piononos around here?*

**Neutral - A**

Tu amigo: Quiero llevarte a comer esta noche. ¿Adónde quieres ir?
Tú: ¿*Por aquí hay algún restaurante vegetariano*? Ya sabes que no como carne.

Your friend: I want to take you out to eat tonight. Where do you want to go?
You: *Is there a vegetarian restaurant around here?* You know I don’t eat meat.

Tu amigo: Te quiero llevar a comer comida típica de Puerto Rico. ¿Qué quieres comer?
Tú: ¿*Hay por aquí algún lugar que venda piononos*? Es que me encantan los piononos.

Your friend: I want to take you out for typical Puerto Rican food. What do you want to eat.
You: *Is there a place that sells piononos around here?* I love piononos.

**Outer negation - A**

Estás visitando a un amigo en Nueva York y te acuerdas que la última vez que lo visitaste comieron en un restaurante vegetariano.
Tu amigo: ¿Dónde quieres comer esta noche?
Tú: (pensando en el lugar adonde fuiste la última vez) ¿*No hay por aquí un restaurante vegetariano*?

You’re visiting a friend in NYC and you remember the last time you visited him you ate at a vegetarian restaurant.
Your friend: Where do you want to eat tonight?
You: (thinking about the place you ate last time) *Isn’t there a vegetarian place around here?*

Tu amigo: ¿Dónde quieres comer esta noche?
Tú: (Crees que hay cerca un lugar que vende piononos) ¿*No hay por aquí un lugar que vende piononos*?
Your friend: Where do you want to eat tonight:

You: (You think there is a place nearby that sells piononos) Isn’t there a place that sells piononos around here?
Appendix D: Discourse contexts and stimuli

CONTEXT 1
NEUTRAL CONTEXT

CONTEXT: José y Enrique se acaban de conocer en su vuelo que va a Nueva York. Están hablando de los alquileres en NYC.

Enrique: Hoy día, hasta en el Bronx pagas un montón.
José: Es verdad.
Enrique: Por todos lados las rentas están más caras que nunca.
José: Tienes razón... ¿Tú vives en la isla?

Context: José and Enrique just met each other on a flight to New York. They are talking about rent prices.

Enrique: These days you pay a lot in the Bronx.
José: It’s true.
Enrique: Rents are high everywhere.
José: You’re right... Do you live on the island?

(It is assumed that given the frequent movement between New York and the Bronx that someone on a flight from Puerto Rico to New York has an equal chance of living in either place).

CONTEXT 2
P IS INFERRED BY THE SPEAKER BASED ON LINGUISTIC EVIDENCE (CONTEXTUAL EVIDENCE PRESENT IN CONTEXT)

CONTEXT: Ramón y Eduardo comparten un apartamento. Eduardo acaba de llegar a casa.

Ramón: ¡Hola! ¡Llegaste temprano!
Eduardo: Sí, hoy la jefa me dejó salir a las 4. Tú también llegaste temprano.
Ramón: Sí, es que me llamó el plomero para decirmelo que lo esperara.
Eduardo: ¿Viene el plomero?

Context: Ramón and Eduardo share an apartment. Eduardo just got home.

Ramón: Hi! You’re home early.
Eduardo: Yes, my boss let me go at 4. You’re home early too.
Ramón: Yeah, the plumber called me to tell me he was coming.
Eduardo: The plumber is coming?
**Contexto:** Raúl y Ernesto están en la playa hablando.

Rául: Oye, mano, el día sí que está bien.
Ernesto: Sí, ¿verdad? Ojalá pudiera hacer esto todos los días.
Rául: Sí… yo dejaría mi trabajo…
Ernesto: (Viendo que Raúl está sacando dinero y viene el vendedor de helado) ¿Tú vas a comprar helado?

**Contexto:** Raúl and Ernesto are on the beach talking.

Rául: Dude it’s a nice day.
Ernesto: I know, right? I wish I could do this every day.
Rául: I know, I would quit totally quit my job…
Ernesto: (Seeing that Raúl is talking out money and there is an ice cream vendor approaching) Are you going to buy ice cream?

**Contexto:** Claudio le había mencionado a Daniel unas cuantas veces que tiene una cita con el médico el viernes.

Claudio: ¿Jugamos baloncesto esta semana?
Daniel: Sí, sí. ¿Qué día te conviene?
Claudio: Escoge tú…
Daniel: A ver… ¿tú tienes cita médica el viernes?

**Contexto:** Claudio had mentioned to Daniel various times before that he had a doctor’s appointment on Friday.

Claudio: You want to play basketball this week?
Daniel: Yeah, what day works for you?
Claudio: You choose.
Daniel: Let’s see… you have a doctor’s appointment Friday?

**Contexto:** Epistemic bias for P, P is inferred by visual evidence (congruence between epistemic state and contextual evidence)
Carlos y Jorge son compañeros de casa. Carlos sabe que Jorge suele dormir hasta la 1 o las dos todos los domingos. Un domingo a la 1:30, Carlos sale de su habitación.

Jorge: Hola Carlos, ¿qué hay?
Carlos: Na, aquí, cogiéndolo suave….
Jorge: ¿Qué has hecho hoy?
Carlos: Fui al gimnasio, hice compra, y tú… (mirando la cara de sueño de Jorge): ¿Acabas de despertarte?

Carlos and Jorge are roommates. Carlos knows that Jorge always sleeps until 1 or 2 on Sundays. One Sunday at 1:30, Carlos emerges from his room.

Jorge: Hey Carlos, what’s up?
Carlos: Not much, just taking it easy…
Jorge: What have you been up to today?
Carlos: I went to the gym, went to the store, and you… (looking at Jorge’s sleepy face…) Did you just wake up?

CONTEXT 5
EPISTEMIC BIAS (PRIOR KNOWLEDGE) WITH INCONGRUENT CONTEXTUAL EVIDENCE (LINGUISTICALLY ACTIVATED)

Oscar sabe que su esposa, Judith, no puede soportar los perros

Judith: He estado pensando en lo que me vas a regalar para la Navidad…
Oscar: Hmm… y has pensado en algo específico?
Judith Pues había pensado que a lo mejor un perrito…
Oscar: ¿Quieres un perro?

Oscar knows his wife Judith can’t stand dogs.

Judith: I’ve been thinking about what you’re going to give me for Christmas…
Oscar: Hmm… and have you thought about something specifically?
Judith Well I was thinking maybe a dog…
Oscar: You want a dog?
Appendix E: Complete instructions for online perception experiment

**Part 1**

**Spanish:**
Ésta es una investigación sobre la entonación del español de Puerto Rico.

La palabra "entonación" se refiere a la melodía de la voz. Por ejemplo, dependiendo de la entonación, sabemos si una frase es una declarativa (e.g. "Es alto.") o una pregunta ("¿Es alto?"). En el experimento vas a escuchar diferentes tipos de entonación de varios tipos de preguntas.

**Es muy importante que tengas una manera (altavoces, auriculares, etc.) de escuchar bien los archivos de sonido del experimento. También es muy importante que siempre leas bien los contextos.**

El experimento durará unos 20 minutos, más o menos.

**English:**
This is a study about intonation in the Spanish of Puerto Rico.

The word “intonation” refers to the melody of one’s voice. For example, depending on intonation we know whether a phrase is declarative (He is tall.) or a question (Is he tall?). In the experiment you are going to hear different types of intonation in different question types.

**It is very important that you have some way (speakers, headphones, etc.) in order to listen closely to the soundfiles in the experiment. It is also very important that you read the contexts well.**

The experiment will last 20 minutes, more or less.

**Part 2**

**Spanish:**
En cada página de este estudio, vas a leer un contexto y un diálogo. Siempre al final del diálogo vas a ver que la última frase es una pregunta, que aparece en negrita. Vas a notar que los mismos contextos se repiten varias veces.

Debajo de la pregunta vas a poder escuchar la versión de la pregunta con audio. Tienes que hacer clic en este archivo, y la puedes tocar cuantas veces quieras.

Aquí hay un ejemplo:

**Contexto:** La última vez que Jennifer habló con Marina, Marina estaba viviendo en Río Piedras.

Fabián: El viernes voy a visitar a Marina.
Jennifer: ¿Sí? ¿Cuánto tiempo tarda para llegar? No mucho, ¿verdad?
Jennifer: ¿Marina vive en Aguada?

On each page of the experiment, you will read a context and a dialogue. At the end of each dialogue, you will always see that the last phrase is a question, appearing in bold. You’ll note that the same contexts are repeated various times.

Under the question you’ll be able to listen to an audio version of the question. You must click on this file, and you can listen to it as many times as you like.

Here is an example:

Context: The last time that Jennifer spoke with Marina, Marina was living in Río Piedras.

Fabián: I’m going to visit Marina on Friday.
Jennifer: Oh yeah? How long does it take to get there? Nor long, right?
Fabián: It takes forever. Marina lives in Aguada.
Jennifer: Marina lives in Aguada?

(listeners heard the target produced with $L^* HL\%$, which would be appropriate for the context.)

Part 3
Spanish:
Después de escuchar la frase vas a tener que tomar una decisión sobre la actitud del hablante que dijo la frase. Puedes volver a escuchar la frase si te ayuda a decidir.

Aquí hay un ejemplo:

Elige la opción que mejor describa la actitud de Jennifer con respecto a esta frase: Marina vive en Aguada.

1. Sabe que es verdad
2. Está convencida de que es verdad
3. Cree que es verdad
4. No sabe si es verdad o no
5. Duda que sea verdad
6. Está convencida de que no es verdad
7. Sabe que no es verdad
After listening to each phrase, you'll need to make a decision about the attitude of the speaker who said the phrase. You can listen to the recording again if it helps you to decide.

Here is an example:

Select the option that best describes the attitude of Jennifer with respect to this phrase: *Marina lives in Aguada.*

1. She knows that it’s true
2. She is convinced that it’s true
3. She believes that it’s true
4. She doesn’t know if it’s true or not
5. She doubts that it’s true
6. She is convinced that it’s not true
7. She knows that it’s not true

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**Part 4**

Spanish:
A veces la entonación de la pregunta no tiene sentido en el contexto. Si fuera el caso, indícalo aquí.

Haz clic aquí si la entonación NO tiene sentido en este contexto.

- [ ] La entonación NO tiene sentido en este contexto.

English:
It’s possible that intonation doesn’t make sense given the context. If this is the case, indicate so here.

The intonation does NOT make sense in this context.
Part 5
Spanish:
Si quieres explicar una respuesta o dar más detalles, lo puedes hacer aquí, pero no es obligatorio.

Comments (optional):

English:
If you want to explain an answer or give more details, you can do it here, though it is not obligatory.

Comments (optional):