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A Perception Study of Intermediate Phrasing in Spanish Intonation

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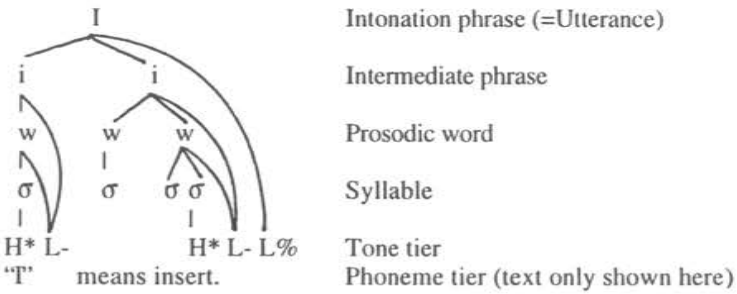
1. Introduction

Pierrehumbert's model of intonational structure differentiates several hierarchical levels of phrasing beyond the prosodic word level, including the intermediate phrase and the intonation phrase (Beckman and Pierrehumbert 1986, Pierrehumbert and Beckman 1988). An intermediate phrase minimally contains one pitch accent T* and is delimited by a phrase accent T- at its right edge (i.e., [T* T-]). An intonation phrase minimally contains one intermediate phrase and is marked by a boundary tone T% at its right edge (i.e., [[T* T-] T%]). In English, these two distinct levels of phrasing are exploited to create meaning contrasts such as [[*"I" means insert*]L-]L% (with one intermediate phrase) vs. [[*"I"*]L- [*means insert*]L-]L% (with two intermediate phrases). This first utterance answers the question *What does "I" stand for?*, while the second, a citation form, partially answers the question *What do all of these letters stand for?* Figure (1) illustrates the intonational structure of this second utterance following Pierrehumbert's model, where elements on the tone tier are linked autosegmentally to constituents in the prosodic hierarchy.

(1) Intonational structure: associations between tonal elements and constituents in the prosodic hierarchy



While two levels of phonological phrasing exist in English intonation, Sosa (1991) claims that only one level exists in Spanish: the intonation phrase. Accordingly, this prosodic constituent is redefined as minimally containing one pitch accent T* followed by a boundary tone T% aligned at the right (i.e., [T* T%]). Sosa's claim is questionable a priori for a number of reasons outlined in Nibert (1998). This study then presents experimental evidence for two levels of

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phonological phrasing in Spanish intonation based on data elicited from native speakers. This evidence is supported by Prieto's (1997) study of intermediate phrasing in Catalan, given this language's close relation to Spanish. Production and perception tests revealed that subjects made use of the phrase accent in Catalan to differentiate meaning.

The present study seeks to confirm the existence of intermediate phrasing in Spanish intonation by subjecting the production data presented in Nibert (1998) to a perception test. In this data, various phonetic cues suggest the realization of an underlying phrase accent marking intermediate phrase constituents in utterances. The following two questions subsequently arise. First, do native Spanish speakers attend to these phonetic cues? Second, if so, are our suppositions regarding the meanings conveyed by intermediate phrasing choices accurate? The design and methodology followed in both the production and perception tests are described briefly in Section 2. Section 3 presents the composite results of the perception test in reference to the first research question. Section 4 focuses on some of the results in more detail in reference to the second research question. Concluding remarks are offered in Section 5.

2. Test design and methodology

The production data reported in Nibert (1998) consist of groups of proposed minimal pairs of F0 contours, the term *minimal pair* being employed similarly as in segmental phonology. The F0 contours of a group represent different intonational renditions of a single text. Each F0 contour in a group differs minimally, i.e., in *one* way and one way *only*, from at least one other contour in the same group. Thus, a group is a series of minimal pairs of F0 contours of the same segmental make-up. For ease of reference, such a group will be referred to as a *minimal group*. An example of a minimal group is presented in (2).

(2) An example of a minimal group, using the text *lilas y lirios amarillos*

Proposed T- underlying the F0 contour (or intonational rendition):	Context/presupposed meaning:
(a) [[lilas] [y lirios amarillos]] H- L- L%	(A) 'lilacs and yellow irises'
(b) [[lilas y lirios] [amarillos]] H- L- L%	(B) 'yellow lilacs and yellow irises'
(c) [[lilas y lirios amarillos]] L- L%	(A or B) No context provided (i.e., ambiguous utterance to serve as control contour)

Ten such minimal groups were designed, based on ten different texts containing as many sonorant sounds as possible. Each text had the potential to generate a number of intonational renditions by containing a syntactic and/or semantic ambiguity that might be clarified by intermediate phrasing choices, if indeed this prosodic level were operational in the linguistic system of the native speaker. Syntactic ambiguities arose from the conjunction *y* ('and'), the disjunction *o* ('or'), and the preposition *de*, which in Spanish can mean either 'of' or 'from.' Semantic ambiguities were related to the information structure and the overall function of the text. For each possible interpretation of a given text, a context was created to try to elicit that particular meaning. Disambiguation was predicted to occur through intermediate phrasing choices, which could vary in a number of ways: 1) by the absence vs. the presence of a phrase accent; 2) by the position of the phrase accent in the F0 contour; 3) by the presence of H- vs. L-; and 4) in the case of an intermediate phrase in intonation phrase-final position, by the presence of H- or L- in combination with each boundary tone H% or L%. These first two ways are illustrated in the minimal group presented earlier in (2).

In separate recording sessions, each of the ten minimal groups was elicited from three male speakers of Peninsular Spanish, for a total of approximately 108 utterances. The sessions were structured as follows. Each text was presented to the speaker on a note card. The researcher then read aloud one of the possible contexts for that text, after which the speaker was recorded reading the text accordingly. Sessions proceeded in this way until all contexts for each text were addressed. The data subsequently were analyzed and labeled using Waves™.

Five of these ten minimal groups were included in the perception test. The five groups chosen involved nineteen utterances, taken from all three speakers. Test items were created by pairing each utterance with each of the proposed possible meanings in its minimal group. For example, the minimal group shown in (2) includes three F0 contours corresponding to one or both of two meanings. By pairing each utterance with each meaning, six utterance-meaning correspondences were generated. By making such pairings for all five groups, a total of 67 correspondences were generated. Each constituted an item on the perception test. The order of the test items was randomized. In this order, the appropriate utterances were transferred from computer to cassette tape. The use of the cassette tape assured for equal, consistent conditions across test sessions.

The response booklet for the perception test consisted of three parts, written exclusively in Spanish: 1) a language background questionnaire, 2) test instructions and four practice items, and 3) the 67 test items. These three parts together required approximately thirty-five minutes to complete. Each individual practice and test item required twenty seconds and was structured as follows. After the item number prompt, five seconds of silence elapsed to allow subjects to read a meaning written on the page. The utterance then was heard a first time, followed by a few seconds of silence, and then a second time. Ten seconds of silence followed to allow subjects to circle one of two possible responses: *sí* ('yes') if the meaning given was a possible interpretation of the utterance heard, or *no* ('no') if it was not a possible interpretation of the utterance heard. Subjects were asked to respond to all items (i.e., to not leave any blank).

Five one-time test sessions were held, attended by a total of thirty-three subjects. All subjects were from Spain and were at the University of Illinois at Urbana-Champaign either as a graduate student, postdoc, visiting scholar, professor, or spouse of one of the above. Fourteen subjects identified themselves as

having two native languages, specifically, Catalan, Valencian, or Basque, in addition to Spanish. As bilingualism in one of the above languages and Spanish is a fact of life in Spain, these subjects can be considered representative speakers of Peninsular Spanish. Subjects were between the ages of twenty-three and fifty-five: twenty-two subjects were in their twenties, nine were in their thirties, and two were over forty. Seventeen of the subjects were male, and sixteen were female.

3. Composite results of the perception test

The prediction was for all subjects to respond either *sí* or *no* to each test item. As this study is being reported in English, the abbreviation *y* (for 'yes') will be used to represent the *sí* responses, and *n* (for 'no') will represent the *no* responses. A *y* response indicated that the meaning given was a possible interpretation of the utterance heard, and a *n* response indicated that it was not. As there were thirty-three subjects, and each answered every test item, the prediction was either *y*=33 or *n*=33 (i.e., *y*=0) for each item.

The predicted response and the actual number and percentage of *y* responses obtained for each item were recorded in the cells of data tables. A separate table was created for each minimal group, and each table cell represented one item or utterance-meaning correspondence. A key to the information given in each cell is provided in (3). Full tables are presented later in (8) and (10).

(3) Key to cell data

Symbols:

y or *n*	<-- predicted response
y=X	<-- actual number of *y* responses (out of 33)
%	<-- percentage of the responses that were *y*

For each of the five minimal groups, there were three variables. One was the dependent, or response, variable Y, which included the two possible responses *y* or *n*. The other two variables were the independent, or predictor, variables X1 and X2. X1 corresponded to the various possible meanings. X2 corresponded to the different intonations generated by varying only aspects of intermediate phrase structure.

Our first research question asked: do native Spanish speakers attend to phonetic cues attributable to an underlying phrase accent? In other words, in our study, did intonation affect whether or not a subject responded *y* to a meaning, or would he/she have responded *y* no matter what the intonation? Essentially, did the independent variable X2 affect the dependent variable Y? If intonation indeed had an effect, then there is strong support for intermediate phrasing marked by a phrase accent in Spanish, as intonation varied only in these terms. This would mean that the phrase accent clearly was perceived by listeners and was crucial for their acceptance, and therefore differentiation, of meaning.

To answer this question, a regression analysis was performed on the data.[1] The type of regression analysis chosen was logistic regression, based on the fact that the response variable was binary (cf. Weisberg 1985). The method of logistic regression estimates, or models, the probability (p) of an event occurring, for each possible set of values for the independent variables. In our case, the *event* was choosing *y*, or judging a meaning as possible, and the *values* for the independent variables were the various meanings and intonations, for each minimal group.

Since the objective was to determine whether or not intonation indeed had an effect on choosing *y*, the null hypothesis was: the probability that a subject chooses *y* is the same no matter what the intonation is. A test of the null hypothesis versus its alternative was done in two steps. The first step consisted of using logistic regression to fit two different models to the data for comparison--one model that took intonation into account (Model 2) and one that did not (Model 1). Considering the latter model first, it integrated only one independent variable, meaning, and was expressed by the following equation.

(4) Model 1

Y = a + b1(X1), where:
Y = the logit transformation of the p(*y*): Y = log (p(*y*) / (1-p(*y*))),[2]
a and b1 = the regression parameters to be estimated, or fitted, by means of maximum likelihood estimation (or MLE)[3], and
X1 = the independent variable *meaning*.

Model 2 considered two independent variables, meaning and intonation, as well as a term for the interaction of these variables. This model was expressed by the equation in (5).

(5) Model 2

Y = a + b1(X1) + b2(X2) + b3(X1*X2), where:
Y = as defined above in (4),
a, b1, b2, and b3 = the regression parameters to be estimated by means of MLE, and
X1 and X2 = the independent variables *meaning* and *intonation*, respectively.

After the models were fit to the data of each minimal group, the second step of the analysis was performed: a comparison of how well each of the models fit the data. The *goodness-of-fit* of each model was measured in terms of deviance, or the residual sum of squares. Since Model 2 included more parameters than Model 1, it was expected to show a smaller deviance than Model 1. However, the smaller the deviance of Model 2 in comparison to that of Model 1, the more important these extra parameters were in accounting for the data. Therefore, the change, or difference, in deviance between the two models was examined. A

large difference between the deviances of the two models would indicate that the intonation variable indeed affected the response variable.

The change in deviance obtained for each minimal group appears in the table in (6).

(6) Results of the *goodness-of-fit* comparison of the models, in terms of change in deviance

Minimal group of F0 contours	**Change in deviance**	Degrees of freedom (df)	Percentile value (p-value)
1	**133.26**	4	0.000
2	**188.15**	16	0.000
3	**241.61**	12	0.000
4	**200.86**	12	0.000
5	**94.75**	6	0.000

The changes in deviance then were compared to the Chi-Square (χ^2) distribution with the corresponding degrees of freedom (calculated by subtracting the number of meaning variants from the number of cells) to obtain the p-values, listed in the rightmost column of the table. The p-values, *all* being 0.000, are interpreted as follows: the probability of obtaining the values shown for the change in deviance (i.e., of obtaining such a large decrease in deviance from Model 1 to Model 2), assuming that the added parameters in Model 2 were *not* important, is *zero*. In other words, the added parameters in Model 2 *were* important, and the null hypothesis must be rejected: the intonation variable did indeed have an effect on the response variable.

These results indicate that subjects clearly perceived the phrase accent variations in the utterances heard and used the information to make judgements about the acceptance and differentiation of meaning. This occurred *for each minimal group*, in other words, in a number of different syntactic and semantic contexts. Thus, the phrase accent T- clearly is a distinct category in the tonal inventory of Spanish that marks the intermediate phrase, a prosodic unit in the intonational structure of the language.

4. Some individual minimal-group tables and analyses

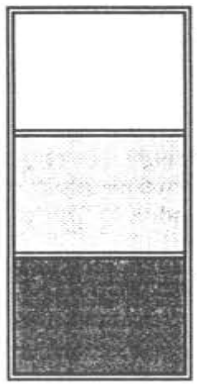
Detailed information about the *meaning* of intermediate phrasing in Spanish can be obtained by examining the minimal-group tables more closely on an individual basis. In this section, two of these tables will be presented and discussed.

As stated earlier, each table cell indicates the predicted response and the actual number and percentage of *y* responses obtained for each utterance-meaning correspondence. In addition, each cell is coded by a particular shade to evaluate categorically the subjects' responses to the correspondence. Three categories were established, indicated by a light, medium, or dark shading. Based on our sample, if a correspondence was accepted by subjects 33 1/3% or less of the time, it was given a light shading. If a correspondence was accepted by subjects more than 33 1/3% up to 66 2/3% of the time, it was given a medium shading. If a correspondence was accepted by subjects more than 66 2/3% of the time, it was given a dark shading.

In the dark category, the percentage of subjects who responded *y* is significantly *greater* (statistically) than 50% (= chance, or randomness), at a $p \leq .05$. In other words, in this category, there is only a 5% chance that, using the *entire* population of Peninsular Spanish speakers-- as our data is based only on a small sample of them--, the *y* responses would be *only 50%* or *less*, and not the higher percentage actually obtained from the sample. Similarly, in the light category, the percentage of subjects who responded *y* is significantly *less* (statistically) than 50%, at a $p \leq .05$. In other words, there is only a 5% chance that, using the entire population, the *y* responses would result to be *50%* or *more*, and not the lower percentage actually obtained from the sample. While we can draw strong conclusions about the acceptability of a correspondence marked dark or light (= clearly *acceptable* or *not acceptable*, respectively), we cannot be sure about the acceptability of one with medium shading, since the *y* responses were too close to 50%, or chance, to confidently say. Thus, the phrase accent variants are clearly crucial to meaning in the cases marked light or dark. The above information and the shadings used are shown in (7).

(7) Key to cell shading

Shades: If the percentage of *y* responses falls within the range of:



<-- 33 1/3% (~33%) or less: is a strong *n* to a correspondence; % who responded *y* is significantly *less* (statistically) than 50% (= chance), at a $p \leq .05$.

<-- more than 33 1/3% up to 66 2/3% (~67%): is a weak response to a correspondence; % who responded *y* is too close to 50% for a confident reading.

<-- more than 66 2/3% (~67%): is a strong *y* to a correspondence; % who responded *y* is significantly *greater* (statistically) than 50%, at a $p \leq .05$.

The experimental design and results for minimal group 1 are shown in (8).

(8) Minimal group 1

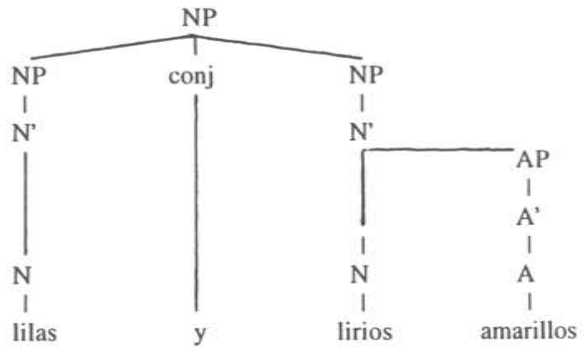
lilas y lirios amarillos; literally, 'lilies and irises yellow'

		MEANING	
		A irises= yellow	B both flower types= yellow
TUNE	a [[w]$_{H-}$ [w w]$_{L-}$]$_{L\%}$	y=3 9%	n y=3 9%
	b [[w w]$_{H-}$ [w]$_{L-}$]$_{L\%}$	n y=8 24%	y=3 9%
	c [[w w w]$_{L-}$]$_{L\%}$	y y=8 24%	y=3 9%
			=6

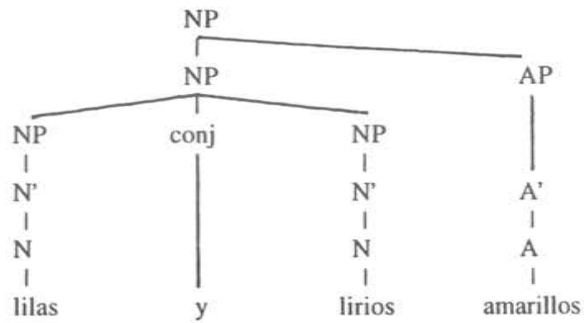
In the above table, as well as in the one to follow, the possible meanings considered appear in columns and are labeled with capital letters. The tunes examined appear in rows and are labeled with small case letters. Under the label for each tune, the intermediate and intonation phrase structure posited for the utterance is indicated, with w= a prosodic word, H= a high tone, and L= a low tone. The tone appearing outside of all bracketing is the boundary tone marking the right edge of the intonation phrase, while all other tones are phrase accents marking the right edges of intermediate phrases. This labeling makes it easy to see how the placement of the phrase accent (i.e., the grouping of prosodic words into intermediate phrases) and the use of H- vs. L- vary over each tune.

Returning now to the particulars of (8), the text *lilas y lirios amarillos* used for minimal group 1 is syntactically ambiguous because of the conjunction *y*, which allows the scope of modification of the adjective phrase (AP) *amarillos* to extend beyond the adjacent noun to the first one as well. Two possible interpretations, or readings, are created from this ambiguity. In one reading (labeled A), the AP *amarillos* refers to only the adjacent noun *lirios*. In other words, the AP has a narrow scope of modification. In reading B, on the other hand, *amarillos* refers to both noun phrases (NPs) or flower types, and the AP has a wide scope of modification. The syntactic tree configurations corresponding to these possible meanings are shown in (9). In these and subsequent syntactic figures, we follow standard assumptions about phrase structure held within X-bar theory (where X"= XP), as presented, for example, in Haegeman (1991).

(9) a. Meaning A: *amarillos*= narrow-scoped



b. Meaning B: *amarillos*= wide-scoped



Three different intonation patterns, or tunes, mapped onto the segmental sequence, or text, were tested for meaning correspondence. Tune 'a' contains a H- phrase accent after *lilas* that sets the word off from the remainder of the utterance. Thus, the prediction was that subjects would accept only reading A, interpreting that *amarillos* refers to *lirios* only. Tune 'b' has a H- after the word *lirios* that sets *amarillos* off from both nouns preceding it. Thus, only meaning B was predicted as acceptable. Tune 'c,' however, contains no non-final phrase accent to disambiguate its meaning. Thus, it was predicted that subjects would judge both readings as possible.

All of these predictions were borne out, except in the case of the tune 'c'-meaning A correspondence: only 8 of the 33 subjects (24%) deemed reading A possible for tune 'c,' a clear rejection of the correspondence. Subjects clearly accepted reading B, however, at a rate of 94%. In other words, the tune predicted to be ambiguous was not so at all but rather took on a 'default' meaning: in the case of a conjunction of two NPs and an AP, the AP modifies both NPs in the absence of information (e.g., tone) indicating otherwise.

Can these results be given a more generalized interpretation? Let's return to the syntactic tree configurations in (9) for a possible answer. If we compare the

two trees, we see that only the one in (9b) corresponding to the default meaning involves the coordination of NPs that are parallel, or symmetrical, in structure: each dominates only a simple noun (N). In the tree in (9a), on the other hand, the conjoined NPs are not symmetrical: one NP dominates only a N while the other dominates both a N and an AP. As the former tree represents the default, our data may reveal a preference for *symmetry in the modification of coordinated phrases*, in this case leading to equal modification of coordinated NPs by an AP and thus a wide-scoped interpretation of the AP.

A cursory look at similar constructions in English, with prenominally placed adjectives, further supports the notion of a preference for symmetry in coordinate modification. The phrases 1) *red balloons and streamers* (where both the balloons and the streamers are understood to be red, and therefore the conjoined NPs are parallelly modified) and 2) *red balloons and yellow streamers* (again, where there is parallelism between the conjuncts) are more common and natural, for example, than 3) *balloons and yellow streamers* (where the conjuncts are not parallelly modified). Even in this last phrase, the notion of parallelism then is imposed *semantically*, as we automatically interpret that the undefined balloons must *not* be yellow like the defined streamers. The balloons must be *different* from the streamers, for example, multicolored.

The notion of *sameness* in coordination is not a new one. Two *syntactic* constraints that have been formulated are Chomsky's Generalization (Chomsky 1957:36) and a revised version of it sometimes referred to as Wasow's Generalization (Sag et. al. 1985), although both address *sameness* of a nature that is different from our case. Chomsky's Generalization observes that conjuncts must belong to the same syntactic category, thus accounting for the ungrammaticality of a sentence like **John wrote a letter and to Fred*, where a NP is conjoined with a prepositional phrase (PP) (NP ≠ PP). Wasow's Generalization explains exceptions to Chomsky's Generalization, namely, sentences like *He's a Republican and proud of it*, where conjuncts of distinct categories (here, a NP and an AP) are perfectly grammatical. This revised generalization basically states that each conjunct in a coordinate phrase, located in some position in a syntactic representation, must have syntactic feature values that would allow it to occur alone in that position. Thus, any XP (NP, AP, PP, or VP) that can be used predicatively, i.e., as the complement of a copula verb like *be*, carries a feature such as [+PRD] that allows it to agree with the V and exist in a coordinate phrase with some other XP specified as [+PRD] (Radford 1988:155).

Neither of these syntactic constraints on sameness in coordination, however, encompasses the notion of symmetry in the modification of conjuncts, which would seem to require formalization as a *preference* rather than as a *constraint* anyway. Furthermore, it is not clear whether this preference would be best attributed to the syntax or semantics of coordinated structures, or to both, as our earlier examples from English seem to point to the semantics. Munn (1993), for instance, proposes that unlike category coordination be limited not through syntactic constraint but rather one on the preservation of semantic identity. Regardless of whether it is expressed in terms of syntax or semantics, the notion of *symmetry* in coordination is a crucial one, and extrapolating from it, we might expect conjoined categories that are symmetrical in their modification to be more

desirable in the grammar than those that are not. Of course, it is beyond the scope of this paper to propose any thorough formalization of this notion. For now, it is presented simply as a possible explanation for the results in (8).

Returning to (8), the *lack* of symmetry in conjunct modification innate to meaning A (i.e., the narrow-scoped interpretation) has been offered to explain the clear rejection of the tune 'c'-meaning A correspondence. Tune 'c,' which contained no non-final phrase accent, was assigned only a symmetrically modified conjunct structure and thus only a wide-scoped interpretation (meaning B), contrary to our expectations. The only case where the asymmetrical meaning A *was* deemed possible was in its pairing with tune 'a,' with a H- phrase accent after *lilas*. Thus, the results indicate that a narrow-scoped interpretation arising from an asymmetrically modified coordinate structure may be recoverable only when a phrase accent appears between the conjuncts, thereby intonationally isolating one conjunct from any modifier adjacent to the other one. Without the phrase accent, a default meaning (in this case, a wide-scoped one) is assigned, the default being that which arises from a symmetrically modified conjunct structure.

What is interesting about these results for the intonational phonology of Spanish is that tunes 'b' and 'c' are allophonic. The presence of H- after *lirios* is redundant, as the symmetrical conjunct structure and wide-scoped interpretation it demarcates are understood by default anyway. Both tunes 'b' and 'c' contrast with tune 'a,' which shows a H- after *lilas* to indicate an asymmetrically modified conjunct structure and narrow-scoped interpretation. Whatever the role of syntax and/or semantics in these results (especially those for tune 'c'), the role of the phonology is clear. The only factor differing between tunes 'a' and 'b' and thus responsible for their contrastive meaning is the H- phrase accent. Viewing these results in composite, more now can be said about the use of this tone in intonation phrase-medial position to disambiguate the syntax of a conjunction: T- is only contrastive and therefore crucial (and not simply stylistic) where a marked, asymmetrically modified structure is involved. These facts represent a first step in describing allophony among F0 contours in Spanish that vary in terms of their intermediate phrase structure.

We turn now to minimal group 2. Like group 1, it involves a text that is ambiguous due to the conjunction *y*. Unlike group 1, the text used contains two adjectives, one in prenominal and one in postnominal position, both capable of modifying both nouns in terms of their agreement in number and gender. The experimental design and results for group 2 are presented in (10).

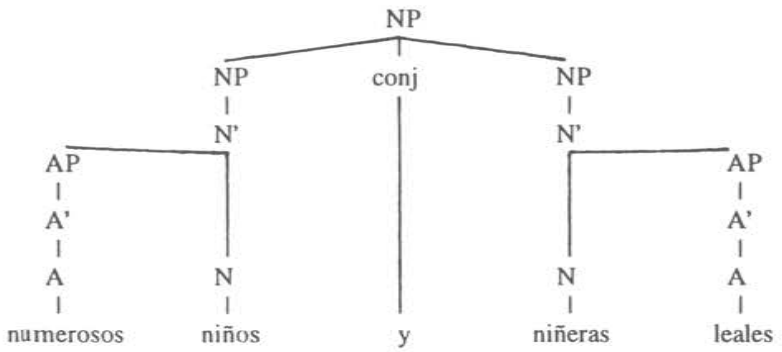
(10) Minimal group 2

numerosos niños y niñeras leales;
literally, 'numerous children and nursemaids loyal'

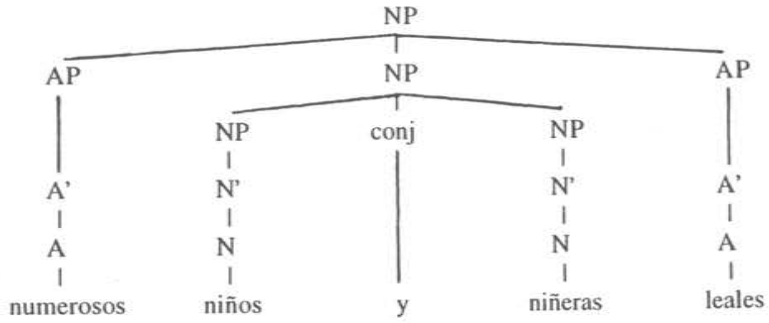
TUNE	MEANING A: num.= child.; loyal= nurse.	MEANING B: num.= both; loyal= both	MEANING C: num.= both; loyal= nurse.	MEANING D: num.= child.; loyal= both
a [[w w]H- [w w]L-]L%	y y=21 64%	n y=4 12%	n y=4 12%	n y=6 18%
b [[w]H- [w w]H- [w]L-]L%	n y=2 6%	y y=17 52%	n y=2 6%	n y=4 12%
c [[w]H- [w w w]L-]L%	n y=8 24%	n y=7 21%	y y=14 42%	n y=7 21%
d [[w w w]H- [w]L-]L%	n y=2 6%	y y=17 52%	n y=9 27%	y y=13 39%
e [[w w w w]L-]L%	y y=21 64%	y y=17 52%	y y=7 21%	y y=9 27%
				=20

Given that the text used for group 2 contains two nouns and two adjectives, it was predicted to have four possible interpretations: 1) each adjective modifies only its adjacent noun (meaning A); 2) each adjective modifies both nouns (B); 3) *numerosos* modifies both nouns, and *leales* modifies only its adjacent noun (C); and 4) *leales* modifies both nouns, and *numerosos* modifies only its adjacent noun (D). These possibilities are represented in (11).

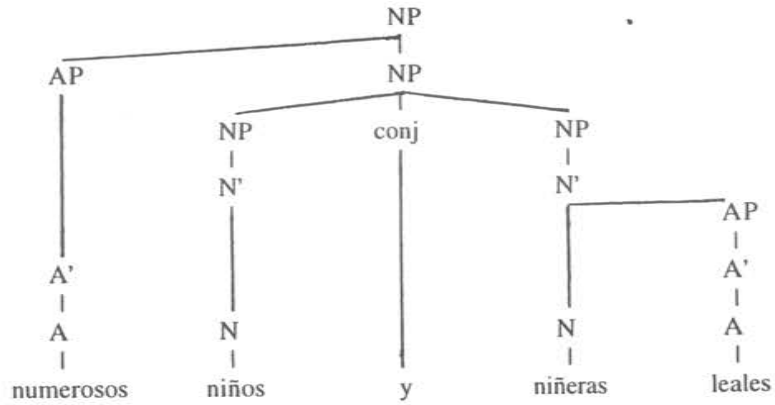
(11) a. Meaning A: *numerosos*= narrow-scoped; *leales*= narrow-scoped



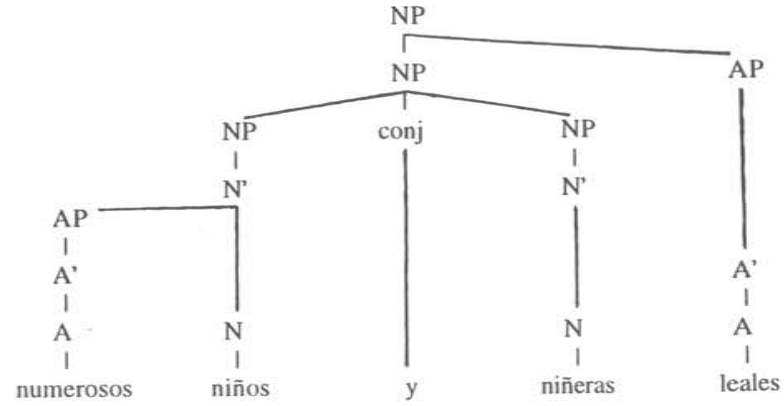
b. Meaning B: *numerosos*= wide-scoped; *leales*= wide-scoped



c. Meaning C: *numerosos*= wide-scoped; *leales*= narrow-scoped



d. Meaning D: *numerosos*= narrow-scoped; *leales*= wide-scoped



Five different intonation patterns were tested for correspondence with these meanings. Pattern 'a' contains a H- phrase accent after the first two words, *numerosos niños*. Thus, the prediction was that subjects would accept only reading A. Tune 'b' has two non-final phrase accents, a H- after *numerosos* and a H- after *niñeras*. These tones separate the adjectives from their adjacent nouns, assumingly widening their scope of modification. Thus, only meaning B was predicted as acceptable. Tune 'c' contains a H- only after the adjective *numerosos*. Thus, it was predicted that only reading C, in which only this first adjective has wide scope, would be accepted by subjects. Tune 'd' has a H- only after *niñeras*. Thus, it was predicted that only reading D, with the second adjective having wide scope, would be accepted. Tune 'e,' on the other hand, contains no non-final phrase accent. Thus, it was predicted that all four readings would be judged as possible by the subjects.

Twelve of these twenty predictions were borne out convincingly in the data. In the case of tune 'a,' as predicted, it corresponded to meaning A only. Subjects clearly rejected the other meanings when a H- separated the conjoined NPs. In regard to tune 'b,' again, only meaning B was accepted as possible, and all other meanings were rejected.

The results obtained for tunes 'c' through 'e,' however, were not those expected. In regard to tunes 'c' and 'd,' a medium shading was obtained for the predicted correspondences of tune 'c'-meaning C and tune 'd'-meaning D. These results *are* in the *direction* of the predictions, and opposite pairings such as tune 'c'-meaning D and tune 'd'-meaning C were clearly rejected. Nevertheless, the predicted pairings are not strong enough to represent convincing correspondences, especially given the 42% and 39% rates falling in the lower end of the medium range. The meaning that *was* strongly accepted for both tunes 'c' and 'd' surprisingly was B, rendering these tunes allophonic with tune 'b.' In regard to tune 'e,' surprisingly again, subjects did not clearly accept *any* of the meanings. However, a medium shading *was* obtained for meanings A and B at the acceptance rates of 64% and 52%, respectively, both of which fall in the higher end of the medium range.

How can we account for these somewhat unexpected results? By again appealing to the notion of a preference for symmetry in the modification of conjuncts, much sense can be made of them. In (11), only the syntactic representations in (11a) and (11b), corresponding to meanings A and B, respectively, are symmetrical. For meaning A, the conjoined NPs both consist of a N and an AP. For meaning B, the conjoined NPs both consist of simply a N. These two meanings were the *only* ones given strong acceptance by subjects; the dark shading is present only in columns A and B. The other configurations in (11c) and (11d), corresponding to meanings C and D, respectively, show an asymmetrical structure, in which one conjunct NP contains a N while the other contains a N and an AP. In columns C and D, the predominant shading is the light one, indicating clear rejection. While these columns do show two cases of medium shading, the rates involved both fall in the *lower* part of the medium range. Thus, in sum, the results for minimal group 2 in (10) are well explained by the notion of a preference for symmetry in the modification of conjuncts.

Assuming 1) this preference for symmetry in the modification of conjuncts,

and 2) the absence of a disambiguating cue such as a non-final phrase accent, we would expect an equal acceptance of the symmetrical configurations in (11a) and (11b). The results for the control contour, tune 'e,' which lacks a phrase-medial T-, corroborate this prediction. Both meanings A and B received acceptance rates high in the medium range. While these rates are not in the dark range, their position high in the medium range shows a tendency much more in the direction of possible than not possible. This medium shading suggests that listeners extract meanings A and B less easily when only one intermediate phrase is used by the speaker. In regard to meanings C and D, both were judged clearly not possible for tune 'e.' Thus, the results for this control contour reveal default meanings determined by symmetry, as was true for the control contour (tune 'c') in minimal group 1.

Since by default the symmetrical meanings A and B both are possible, we would expect the insertion of a H- phrase accent to be a useful strategy for clarifying intended meaning. The results in (10) confirm this prediction. In tune 'a,' the presence of a H- after *numerosos niños* emphasizes the grouping of this AP and N into an immediate NP constituent. This grouping excludes the possibility of meaning B, which does not group these elements in this way. Only meaning A was considered possible, at a rate of 91%. The opposite results were obtained for tune 'b,' which shows two H- phrase accents, one separating each noun from its adjacent AP. The presence of these tones emphasizes the separation of these elements, thus excluding the possibility of meaning A, which requires their immediate grouping. Only meaning B was considered possible, at a rate of 97%.

In regard to tunes 'c' and 'd,' each showed one phrase-medial H-, separating the elements in *numerosos niños* and *niñeras leales*, respectively. The presence of a H- in only one of these sequences, however, did not render a strong acceptance of meaning C or D, each of which implies an asymmetrical modification of conjuncts. Instead, the presence of a H- in only one of these sequences sufficed to widen the scope of modification of the other AP as well. In other words, the perception of one H- between an N and its adjacent AP was enough evidence to discard meaning A and opt for the only other symmetrical possibility, meaning B. Meaning B was given strong acceptance for both tunes 'c' and 'd,' at the rates of 79% and 88%, respectively. No other meaning was given strong acceptance for either of these tunes. These results confirm a clear preference for symmetry in conjunct modification. Even when the intonational structure did not reflect symmetry, symmetry was imposed in accordance with intonational cues. This analysis is summarized in (12).

(12)

For meaning A only:

a. $[[\text{w w}]_{\text{H-}}\,[\text{w w}]_{\text{L-}}\,]_{\text{L\%}}$

For meaning B only; structure in 'c' and 'd' is sufficient, since symmetry is preferred, and these placements of single H- are enough to discard meaning A:

b. $[[\text{w}]_{\text{H-}}\,[\text{w w}]_{\text{H-}}\,[\text{w}]_{\text{L-}}\,]_{\text{L\%}}$

c. $[[\text{w}]_{\text{H-}}\,[\text{w w w}]_{\text{L-}}\,]_{\text{L\%}}$

d. $[[\text{w w w}]_{\text{H-}}\,[\text{w}]_{\text{L-}}\,]_{\text{L\%}}$

Thus, in regard to the intonational phonology of Spanish, tunes 'b,' 'c,' and 'd' are all allophonic, and the use of more than one H- to specify meaning B is redundant. These three tunes clearly contrast with tune 'a,' which also shows a single H-, albeit in a different phrasal position. Tune 'e,' because it lacks a medial H-, is ambiguous: it can be assigned either meaning A or B. Thus, tune 'e' is allophonic with all of the tunes in minimal group 2.

Based on these results, we can expand on our earlier generalization regarding the use of a phrase-medial H- to disambiguate the syntax of a conjunction. H- is only contrastive and therefore crucial: 1) where a marked, asymmetrically modified conjunct structure is involved, or 2) where more than one symmetrically modified conjunct structure is involved, and thus clarification is needed.

5. Concluding remarks

The present study set out to answer two research questions. First, do native speakers of Spanish attend to phonetic cues indicative of an underlying phrase accent (and intermediate phrasing) in the language? Second, if so, what meanings are conveyed through different intermediate phrasing choices? The composite results showed that subjects did attend to these phonetic cues to assign contrastive meaning to utterances. Thus, the phrase accent is a distinct category in the tonal inventory of Spanish, and intermediate phrasing is used contrastively in the language, as in English and Catalan. The individual results from two minimal groups addressed the contrastive use of a phrase-medial H- to disambiguate the modification of two conjoined NPs. The results indicated that the contrastive use of H- in this context depends on an interplay between intonational structure and the notion of symmetry in syntax and semantics. This interplay gives rise to interesting cases of allophony among contours varying in terms of the placement of medial H- as well as the presence vs. absence of medial H-. The meanings conveyed by different intermediate phrasing choices represent an area worthy of further investigation.

Notes

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1. A regression analysis determines how a dependent variable is affected by one or more independent variables. See Woods, et. al. (1986:226-30) for an explanation of simple linear regression (one independent variable) in language study.
2. The *logit transformation Y* of the probability of an event (in this case, a *y* response) is the natural logarithm of the ratio between the probability that the event occurs and the probability that the event does not occur (BBN Corporation 1996). The resulting scale ranges from [-infinity] to [+infinity], with 0 meaning even odds or a p(event)=.50 (Hanneman 1996).
3. MLE is an iterative estimation technique that tries to find the values for the parameters that make the data actually observed *most likely*. The *goodness of fit* of the result is measured using a Chi-Square distribution (Hanneman 1996).

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