Phonological Phrasing in Barcelona Spanish

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1. Introduction

1.1 Prosodic phonology

Prosody in general is used to divide information into 'chunks' demonstrating definite size and internal structure (D'Imperio et al. 2005). Prosodic Phonology (Selkirk 1984, 1986; Nespor and Vogel 1986), which considers the relationship between syntax and prosody, hierarchically organizes prosodic constituents in the fashion shown in (1).

(1) Prosodic Hierarchy [1]

IP	Intonational Phrase (Major Phrase)
PPH	Phonological Phrase (Minor Phrase)
PW	Prosodic Word
F	Foot
σ	Syllable

The various levels in (1) are defined in detail by Selkirk (1984), with the top three being the most pertinent to the present study. An IP is a unit that corresponds to a portion of a sentence associated with a characteristic intonational contour or melody. A PPH denotes any level of prosodic constituent structure that may include one or more major category words (i.e. lexical categories of Noun, Verb, Adjective, and Adverb, from Chomsky 1965). According to Truckenbrodt (1999, in press), the PPH and IP differ in that the former refers specifically to syntactic phrases (XPs), such as Noun Phrases (NPs), Verb Phrases (VPs), and Adjective Phrases (APs), while the latter deals with larger syntactic clauses. Furthermore, a PW is a phonologically relevant idea that plays a metrical role in describing main word stress.[2] In studies on Spanish intonation, it was noted as far back as Navarro Tomás (1944) that words are considered prosodically accented if they display a fundamental frequency (F0) rise though the stressed syllable. Those such as Quilis (1993) and Face (2003) note that such F0 rises are actually the strongest cues to stress in Spanish.

Therefore, in order to consider a lexical item a PW, it must contain a F0 rise through the stressed syllable.[3]

Phonological rules are applied to the prosodic constituents of the hierarchy. Previously, those such as Nespor and Vogel (1986) claimed that syntactic structure is that which dominates the distribution and division of prosodic constituents. This idea especially pertains to the top two levels of the hierarchy, the IP and PPH. Although it was mentioned in such older studies that speech rate, style, and emotion can lead to restructuring of IPs into shorter IPs, D'Imperio et al. (2005) emphasize that more recent studies (Steedman 1991; Ghini 1993; Truckenbrodt 1995, 1999; Ladd 1996; Selkirk 2000; among others) have shown that prosodic boundary placement in different languages is determined by factors other than merely syntax, namely constituent weight, symmetrical distribution of constituents, and information structure.

1.2 Phrasing in Spanish

The majority of studies on phonological phrasing decisions in Spanish and in Romance in general have been carried out in recent years.[4] The main experimental findings of those such as Elordieta et al. (2003), D'Imperio et al. (2005) and Frota et al. (in press) reveal and compare common phrasing patterns in Subject-Verb-Object (SVO) utterances across Romance. These studies, focusing mostly on Peninsular varieties of Spanish, find that (S)(VO) groupings tend to be most common. Cues to PPH boundaries are explored as well. In Spanish, high (H) boundary tones usually serve as markers of PPH boundaries. Furthermore, the F0 stretch before the boundary tends to appear as a *continuation rise*, which is a rise on the stressed syllable in nuclear position, which extends to the boundary syllable, or as a rise followed by *sustained pitch*, or a plateau up to the boundary syllable. Other cues, such as F0 reset and preboundary lengthening of a word or stressed syllable are shown to be used in Spanish as well.

There are few studies bridging OT and phrasing in Spanish. Prieto (2006) considers the rankings of a series of size and eurhythmic OT constraints that interact to explain the phonological phrasing of Peninsular Spanish declaratives in slow, normal, and rapid speech. The phrasing data given in the study, coming from recordings of sentences with various degrees of syntactic complexity, supports that well-formedness constraints dealing with the length and balance of PPHs within IPs have a crucial role in phrasing decisions. In fact, some of these well-formedness constraints rank higher than those addressing syntactic alignment and cohesion. Overall, the study suggests that a complete theory of prosodic phrasing must realize that prosody, syntax, and linguistic variation all interact in determining phrasing decisions.

Another study uniting phonological phrasing and OT in Spanish is Rao (2006). Inspired by Prieto's (2006) use of syntactic branching in Peninsular Spanish, this

investigation analyzes experimental data of phonological phrasing in rapid speech in the Spanish of Lima, Perú. Employing many of the prosodic and syntactic alignment constraints used by Prieto (2006) leads to a different constraint ranking, which reveals that satisfying prosodic well-formedness with regard to length and balance of PPHs is a much higher priority than is complying with the similar alignment of prosodic and syntactic boundaries (to an even greater degree than in Prieto's study). The phrasing differences between this study and that of Prieto motivate the introduction of a prosodic constraint prohibiting a rightward increase in length of PPHs within a given IP.

The present study expands on the work of Prieto (2006) and Rao (2006) by seeking to explain phonological phrasing in the dialect of Barcelona, Spain, using OT. It presents the phrasing decisions found in recordings of SVO sentences containing different degrees of syntactic branching of the subject NP and the direct object NP belonging to a higher VP. A constraint hierarchy emerges that fully accounts for the observed phrasing patterns with reference to solely prosodic constraints. The ranking proves that adopting modified versions of Ghini's (1993) prosodic principles for Italian into OT allows for a thorough explanation of the data without reference to syntactic constraints.

The remainder of the paper is organized as follows: Section 2 describes the methods used for data elicitation; Section 3 presents the frequencies of phrasing patterns and theoretically explains these results using OT; and Section 4 provides concluding remarks.

2. Methods

Inspired by the methodology of Prieto (2006), the 18 participants in the present study each read 65 sentences at a normal speech rate. This rate is what they consider to be appropriate, for example, when reading a text aloud to a friend. The 65 sentences consist of 13 sets of five sentences each. Each set contains sentences with simple SVO utterances or those with various degrees of syntactic branching on the subject NP or the direct object NP. Branching is achieved through APs or prepositional phrases (PPs). Unfortunately, due to recording difficulties, there are fewer tokens of subject NP branching, and thus fewer cases of this type of sentence will be included in the present OT analysis. Although sentences were created in groups according to structural similarities, they were randomized when presented to the participants. Four of the sets are constructed of simple SVO utterances, three sets show branching of the subject NP, and six sets demonstrate branching of the direct object NP. An additional factor considered is whether stressability of the determiner (meaning an additional PW) in the direct object NP affects the parsing of phrases in simple SVO utterances and those with direct object NP branching. Quilis (1993) served as an invaluable resource in distinguishing those determiners that are stressable from those that are not. Each determiner is equally divided among the sets of simple

SVO utterances and those with direct object NP branching. Examples of utterances with direct object branching are shown in (2).

(2) Branching of the direct object NP
   a. *Javier escribió una/muchas carta(s)*
      'Javier wrote a/many letter(s)'
   b. *Javier escribió una/muchas carta(s) larga(s)*
      'Javier wrote a/many long letter(s)'
   c. *Javier escribió una/muchas carta(s) larga(s) a sus amigos*
      'Javier wrote a/many long letter(s) to his friends'
   d. *Javier escribió una/muchas carta(s) larga(s) a sus amigos griegos*
      'Javier wrote a/many long letter(s) to his Greek friends'
   e. *Javier escribió una/muchas carta(s) larga(s) a sus amigos griegos de Atenas*
      'Javier wrote a/many long letter(s) to his Greek friends from Athens'

With respect to the speakers involved, due to the fact that Barcelona is a city in which Spanish and Catalan are in constant contact, it was important to carefully select participants for the study. Since the focus is on the dialect of Spanish spoken in this region, only speakers who are dominant in Spanish or who consider themselves as very balanced bilinguals were eligible to participate. A language history questionnaire helped screen for speakers who fit this requirement. Participants carried out the reading task in a phonetics laboratory at the *Universitat Autònoma de Barcelona.* They were recorded using the PitchWorks software package, a microphone, and a laptop computer.

The data analysis first involved confirmation that all stressable words are indeed accented and thus considered PWs. This is the case, as would be expected according to Face's (2003) description of lab speech in which he states that deaccenting is rare in this speech style. The phonetic cues documented in previous studies served as indicators of PPH boundaries. The most common cues observed in the present data are continuation rises, large decreases in pitch range, pre-boundary lengthening of the stressed syllable, and pauses. Figures 1 and 2 show examples of phrase boundaries. The vertical lines in each figure show where boundaries occur and the symbol 'ϕ' is used to indicate these boundaries in written form.

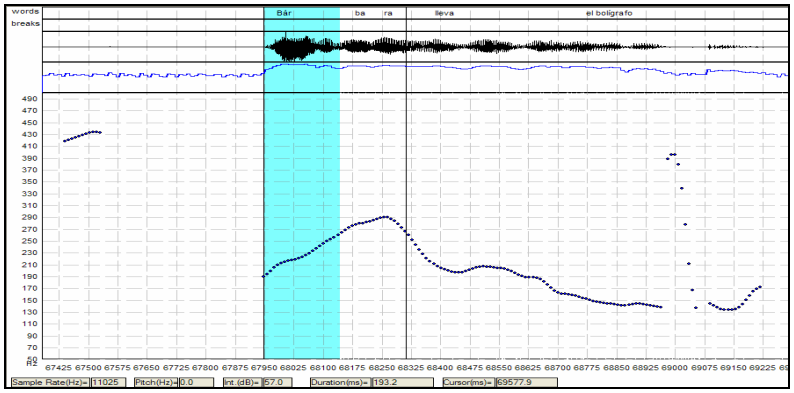

Figure 1: The phrasing of the simple SVO sentence *Bárbara lleva el bolígrafo* ('Barbara carries the pen'). The phrasing pattern observed is (Bárbara)ϕ(lleva el bolígrafo)ϕ. The highlighted portion represents the duration of the stressed syllable *Bar.*, of the subject *Bárbara*.

In Figure 1, there is a continuation rise ending on the final syllable of *Bárbara*, followed by a large decrease in pitch range, both of which are indicators of a PPH boundary. The F0 measurement of the first peak realized in the first PPH on *Bárbara* is 292.2 Hertz (Hz), while the second peak drops to 209.5 Hz. Although the trend of *downstepping* (i.e. peak decay) is often seen within PPHs in Spanish declaratives, Prieto et al. (1995, 1996), Face (2001, 2003) and Hualde (2003), among others, have described this pattern as a gradual decrease in F0 peak height rather than the drastic decrease seen here. Further evidence of a phrase boundary after the subject of the utterance in Figure 1 is that the stressed syllable, *Bar.*, is noticeably longer here than it is in a case in which the word *Bárbara* is not directly followed by a phrase boundary. In this example, the duration of the stressed syllable is 193.2 milliseconds (ms), which is much longer than the 138.3 ms duration of this same syllable found in the sentence *La Bárbara rubia lleva el bolígrafo* ('The blond Barbara carries the pen'), in which the phrase boundary is located after the AP *rubia*. This contrast is seen when comparing Figures 1 and 2.

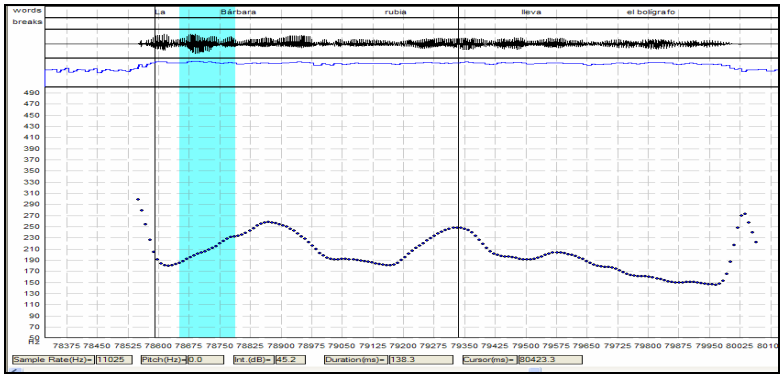

Figure 2**:** The phrasing of the sentence *La Bárbara rubia lleva el bolígrafo* (‘The blond Barbara carries the pen’). The phrasing pattern observed is (La Bárbara rubia)ϕ(lleva el bolígrafo)ϕ.

In addition to the shorter duration of the stressed syllable of the word *Bárbara* in comparison to Figure 1, Figure 2 presents further evidence of a phrase boundary occurring after *rubia*. The first two peaks are manifested in a similar pitch range, with the first peak being at 260 Hz and the second at 250.4 Hz. The second peak, associated with the word *rubia*, is followed by an increased drop in F0 to 205.7 Hz, which is the height of the third peak, associated with the word *lleva.* The gradual decrease in F0 peak height between the first two peaks, which are within the same PPH, is expected due to downstep, however, the exaggerated drop to a much lower pitch range after the F0 rise to the second peak is indicative of a PPH boundary. The stressed syllable, *ru.*, of the word *rubia* is 188.7 ms in length, which is a longer observed duration compared to other sentences in the data in which this word is not before a PPH boundary.

3. Phrasing Results and OT Analysis

This section presents a series of OT tableaux that evaluate phonological phrasing patterns produced by speakers. Within each tableau, the pattern that is recorded at the highest frequency is considered optimal. Any other candidate with a frequency within 15% of the most frequent attains co-optimal status. This cut-off point was determined by charting the observed frequencies for all patterns produced in all utterances. When the top two or three patterns are within 15% of the most frequent, they clearly distinguished themselves from the remaining patterns, and therefore are deemed as co-optimal. Only phrasing patterns produced by speakers at a reasonable rate (about 10% or more) are included in the tableaux. It is assumed that all other possibilities are discarded by high ranking constraints that may not be mentioned in this analysis. Finally, of the sentences with branching of the direct object NP, only those with

stressable determiners are presented here due to limitations on space. It should be noted that the constraint ranking proposed is capable of explaining the phrasing trends observed in recordings of utterances that are not included.

When describing phrasing candidates, *prosodic weight* of PPHs is used synonymously with *length* of PPHs. Prosodic conditions such as weight balance and symmetry of PPHs increase *eurhythmicity*, which is the creation of regular, balanced stress periods (Prieto 2006).

The list of relevant constraints is provided in (3). The formal use of Ghini's (1993) principles was not applied to previous studies on Spanish phrasing, all of which contain utterances with less syntactic branching than those in the present study. The adaptation of these principles presented here heavily relies on the distribution of PWs in adjacent PPHs. This idea of adjacency is not explicitly stressed in Ghini's proposal. Therefore, the use of constraints (3a), (3b), and (3c) represents an innovative approach to phonological phrasing in OT, and, as will be seen, appears to allow for a more thorough explanation of sentences with more extensive syntactic branching. In sum, one of the main purposes of this OT analysis is to motivate the use of a larger set of prosodic constraints in accounting for phrasing data coming from a broad range of syntactically complex utterances. The absence of syntactic constraints is noteworthy, since such constraints are found to influence phrasing, at least to some degree, in most previous work on this topic.

(3) Relevant Prosodic and Syntactic Constraints [5]

a. WEIGHT BALANCE (WB) (adapted from Ghini 1993)
Given a phonological phrase, PPH, the number of PWs in PPH+1 or PPH-1 must be equal to the number of PWs in PPH. Within an IP, PPHs within each substring of three must have the same number of PWs (all PPHs dominated by the same IP node).

b. SYMMETRY (SYMM) (adapted from Ghini 1993)
   i. Odd number of PPHs in an IP: Given a pivot, P, which is a medial PPH, the number of PWs in P+1, +2,…+n must be equal to the number of PWs in P-1, -2,…-n (all PPHs dominated by the same IP node).
   ii. Even number of PPHs in an IP: Given a pivot P, which is a point between the two medial PPHs, the number of PWs in P+1, +2,…+n must be equal to the number of PWs in P-1, -2,…-n (all PPHs dominated by the same IP node).

c. INCREASING UNITS (IU) (adapted from Ghini 1993)
Given a phonological phrase, PPH, the number of PWs in PPH+1 must be greater than the total PWs in PPH (all PPHs dominated by the same IP node).

d. MIN-BIN (Prieto 2006, based on McCarthy and Prince 1993, Ghini 1993)
PPHs should consist of minimally two PWs.

The constraint ranking accounting for the experimental results is given in (4).

(4) Hierarchy of constraints
WB, IU >> MIN-BIN, SYMM

This arrangement of constraints variably ranks WB and IU and assumes that they are superior to MIN-BIN and SYMM in determining phrasing decisions. When the top two constraints are unable to decide between candidates, the task is passed down to the inferior strata, which is capable of choosing candidates that correspond with high frequencies.

3.1 Simple SVO utterances

Table 1 contains phrasing candidates produced for simple SVO utterances with an unstressable determiner in the direct object NP. Such utterances have three total PWs.

Javier dona el libro	WB	IU	MIN-BIN	SYMM
a.☞(Javier)ϕ(dona el libro)ϕ	*		*	*
b. (Javier dona)ϕ(el libro)ϕ	*	*!	*	*

Table 1: Phrasing candidates for *Javier dona el libro* ('Javier donates the book') → (1 PW) ϕ(2 PW)ϕ a) 75% b) 17%

In Table 1, the dashed lines between the top pair and the second pair of constraints signal variable rankings. These variable rankings increase flexibility in evaluating candidates and the interaction of constraints ranked in such a fashion is crucial in cases of co-optimality. In terms of electing a winner, candidate (a) is optimal because it does not violate IU, since the first PPH contains one PW and the second houses two PWs. This winner corresponds with the overwhelmingly most frequent pattern produced. IU fatally punishes (b) for decreasing units from right to left, since the first PPH has two PWs and the second has one PW. WB is highest ranked in this tableau, but the one violation for each candidate fails to distinguish between the two. Due to the fact that IU is decisive, the evaluation does not need to continue to the next level of constraints, MIN-BIN and SYMM.

Table 2 presents phrasing patterns from SVO utterances with four PWs. The extra PW is gained by adding a stressable determiner to the direct object NP.

Javier dona muchos libros	WB	IU	MIN-BIN	SYMM
a. (Javier)ϕ(dona muchos libros)ϕ	*!		*	*
b. ☞ (Javier dona)ϕ(muchos libros)ϕ		*		
c. (Javier)ϕ(dona)ϕ(muchos libros)ϕ	*!	*	**	*

Table 2: Phrasing candidates for *Javier dona muchos libros* ('Javier donates many books')
→ (2 PW)ϕ(2 PW)ϕ a) 36% b) 37% c) 15%

Candidates (a) and (c) are quickly eliminated in Table 2 because they fatally violate WB. In (a) this is the case because there is an unequal amount of PWs in the first PPH and the second PPH. Although (c) balances its first two PPHs, the second and third PPHs are unbalanced. There is only one violation in (c) because only adjacent pairs of PPHs are sensitive to WB (and IU), and therefore, the imbalance between the first and third PPHs is not a violation. Candidate (b) satisfies the highest ranked constraint by equally distributing the four PWs across two PPHs. By maintaining WB, (b) incurs a violation of IU, since there is no increase in PWs in the right member of the adjacent pair of PPHs. However, IU is lower ranked here and cannot affect the optimal status of (b). This is the desired outcome based on the percentage value of (b). This winning candidate is actually the best across the board, seeing how it only has one total violation. By maintaining two PWs per PPH, it is balanced, symmetrical, and does not have any PPHs containing only one PW.

Reordering the top strata of variably ranked constraints in Table 2 yields the correct second optimal candidate, (a). Candidates (b) and (c) both fatally violate IU because they each contain adjacent pairs of PPHs that are balanced, and thus do not increase the number of PWs per PPH in the right member of the pair. This idea suggests that WB and IU have a somewhat antagonistic relationship. Therefore, a variable ranking of the two is strategically advantageous because in many cases it allows the ability to explain co-optimality of phrasing candidates demonstrating distinct patterns that favor different prosodic conditions. Candidate (a) does increase the number of PWs in the right member of the PPH pair, and therefore complies with IU. There is an increase of two PWs, which is perfectly satisfactory because there is no specification of how much of an increase needs to occur.

3.2 A case of syntactic branching of the subject NP

In Table 3, branching of the subject NP is done through the addition of an adjective. By adding this adjective, a simple SVO utterance of three PWs is stretched to total four PWs. The most frequently observed phrasing pattern is show by candidate (a), which is perfectly balanced and parsed in groups of two

PWs. The ranking of constraints accounts for why this phrasing is observed at such an overwhelmingly high percentage value.

La Bárbara rubia lleva el bolígrafo	WB	IU	MIN-BIN	SYMM
a. ☞ (La Bárbara rubia)ϕ(lleva el bolígrafo)ϕ		*		
b.(La Bárbara)ϕ (rubia)ϕ(lleva el bolígrafo)	*!	*	**	*

Table 3: Phrasing candidates for *La Bárbara rubia lleva el bolígrafo* ('The blond Barbara carries the pen') → (2 PW)ϕ(2 PW)ϕ a) 82% b) 10%

Upon first glance at the constraints ranked in the upper strata, it becomes apparent that candidate (b) has no chance at optimality because it violates both WB and IU. The violation of WB is fatal. Both sets of adjacent PPHs create problems for WB and IU in (b). The first and second PPHs fail to show a rightward increase in length, while the second and third PPHs fail to prosodically balance themselves. On the other hand, (a) only violates IU, due to its stronger commitment to weight balance. Even if the top two variably ranked constraints were reversed, candidate (a) would still be optimal because IU cannot distinguish between the two candidates, and the decision would be passed down to WB. Comparing the two candidates suggests that fewer PPHs are better, since more PPHs lead to more potential violations of constraints such as WB and IU that evaluate adjacent pairs.

3.3 Syntactic branching of direct object NPs with stressable determiners

When syntactic branching of the direct object NP is considered, sentences such as that in Table 4 are formed. The addition of an adjective to the direct object NP, results in a sentence with five total PWs.

Carmen habló varios dialectos nuevos	WB	IU	MIN-BIN	SYMM
a. ☞ (Carmen habló)ϕ(varios dialectos nuevos)ϕ	*			*
b. (Carmen)ϕ(habló varios dialectos)ϕ(nuevos)ϕ	**!	*	**	
c. (Carmen)ϕ(habló varios dialectos nuevos)ϕ	*		*!	*
d. (Carmen)ϕ(habló) ϕ(varios dialectos nuevos)ϕ	*	*!	**	*

Table 4: Phrasing candidates for *Carmen habló varios dialectos nuevos* ('Carmen spoke various new dialects') → (2 PW)ϕ(3 PW)ϕ a) 36% b) 17 c) 12% d) 11%

The frequency values of candidates in Table 4 indicate that (a) should be the optimal candidate. By ranking WB atop the hierarchy of constraints, (b) is discarded because it contains two adjacent pairs of PPHs that are not balanced for prosodic weight. When comparing (b) to (a) and (c), we realize that (b) has one more PPH than (a) and (c), and that due to this trait, it is susceptible to more violations of WB and IU because it has more pairs of adjacent PPHs. Since (a), (c) and (d) are tied with one violation each of WB, they are next judged on compliance with IU. Candidate (d) is filtered out of the competition because its first two PPHs do not show an increase in PPH length. After evaluation of candidates using the top two constraints, (a) and (c) remained tied. This is the first case in which it is necessary to resort to the lower pair of variably ranked constraints to determine optimality. When considering MIN-BIN, (a) wins because it does not have any PPHs of less than two PWs in length, where as the first PPH in (c) is one PW long, which leads to a fatal violation. Switching the order of ranking of MIN-BIN and SYMM would not affect the outcome because the latter constraint is violated the same number of times by both (a) and (c). Finally, reversing the ranking of WB and IU does not affect the outcome either. If this were done, (b) and (d) would immediately be eliminated and the remainder of the evaluation would lead to the same result of (a) being optimal.

With increased syntactic branching of the VP maximal projection to a sentence with six PWs, three patterns are produced frequently enough to be considered for evaluation. These three patterns are contained in Table 5.

Carmen habló varios dialectos nuevos con sus colegas	WB	IU	MIN-BIN	SYMM
a. ☞ (Carmen habló) ϕ(varios dialectos nuevos)ϕ(con sus colegas)ϕ	**	*	*	*
b. (Carmen)ϕ(habló varios dialectos nuevos)ϕ(con sus colegas)ϕ	**	*	**!	
c. (Carmen)ϕ(habló)ϕ (varios dialectos nuevos) ϕ(con sus colegas)ϕ	**	**!	***	*

Table 5: Phrasing patterns produced of *Carmen habló varios dialectos nuevos con sus colegas* ('Carmen spoke various new dialects with her colleagues') → (2 PW)ϕ(3 PW)ϕ(1 PW)ϕ a) 47% b) 32% c) 10%

The candidates in Table 5 all violate the highest ranked constraint, WB, multiple times. This is because they each have two pairs of adjacent PPHs that do not contain equal numbers of PWs. The equal number of violations makes WB indecisive and passes the evaluation down to IU. Both (a) and (b) have one

violation of IU because of the decrease in PPH length from the second to the third PPH in each case. Candidate (c) fatally violates IU because the second PPH is not longer than the first and the fourth is not longer than the third. The fact that (c) has one more PPH than the other two candidates provides increased support for the low probability of candidates with more total PPHs of achieving optimal status. Upon moving down to MIN-BIN, the tie between (a) and (b) is broken by the second violation of this constraint by (b), whose first and last PPHs have just one PW. Only the final PPH of (a) violates this minimality constraint.

When MIN-BIN and SYMM are flipped in Table 5, (b) is the winning candidate, thus sharing co-optimal status with candidate (a). Ranking SYMM higher than MIN-BIN generates (b) as the winner because this candidate is symmetrical. The medial PPH has four PWs and the two flanking PPHs are balanced in that they have one PW each. With this ranking, this type of structure is preferred over one that demands the absence of PPHs that enclose individual PWs. The co-optimality of (a) and (b) is the desired outcome based on experimental findings, because (a) is the highest observed frequency and (b) is within the 15% of 47%.

The phrasing candidates of data from a sentence constructed by adding an additional adjective to the sentence from Table 5 are displayed in Table 6. This sentence has a total of seven PWs and two viable candidates.

Carmen habló varios dialectos nuevos con sus colegas españolas	WB	IU	MIN-BIN	SYMM
a. ☞ (Carmen habló) ϕ(varios dialectos nuevos)ϕ(con sus colegas españolas)ϕ	**	*		
b. (Carmen)ϕ(habló varios dialectos nuevos)ϕ(con sus colegas españolas)ϕ	**	*	*!	*

Table 6: Phrasing candidates for *Carmen habló varios dialectos nuevos con sus colegas españolas* ('Carmen spoke various new dialects with her Spanish colleagues') → (2 PW)ϕ (3 PW)ϕ(2 PW)ϕ a) 48% b) 23%

In Table 6, WB and IU are unable to distinguish between the two candidates because each violates these constraints to the same extent. In both cases, WB is violated because both adjacent pairs of PPHs in each candidate are not equal in number of PWs. IU punishes (a) and (b) one time each for decreasing PPH length from the second to the third PPH. The tie resulting from the top two constraints forces the decision down to MIN-BIN and SYMM. In terms of these two constraints, they are able to break the tie because (b) violates each one once, while (a) respects the demands of both. The first PPH of (b) has one PW, which rejects the requirement of MIN-BIN. Candidate (b) also organizes itself asymmetrically, since the PPHs on either side of the medial PPH that has four

PWs are unequal in length. Candidate (a) is satisfactory because it does not have a PPH containing just one PW, and the two PPHs surrounding the medial one create a symmetrical structure. The constraint ranking yielding (a) as optimal correctly explains its high frequency.

As the same sentence from previous tables is further expanded to eight total PWs by adding another PP, the frequencies observed point to co-optimality. The reason behind the equality of these two phrasing patterns is explicated by the constraint interaction in Table 7.

Carmen habló varios dialectos nuevos con sus colegas españolas de la universidad	WB	IU	MIN-BIN	SYMM
a. ☞ (Carmen habló)ϕ(varios dialectos nuevos) ϕ(con sus colegas españolas)ϕ(de la universidad)ϕ	***	**	*	**
b. (Carmen)ϕ(habló varios dialectos nuevos)ϕ(con sus colegas españolas)ϕ(de la universidad)ϕ	***	**	**!	*

Table 7: Phrasing candidates for *Carmen habló varios dialectos nuevos con sus colegas españolas de la universidad* ('Carmen spoke various new dialects with her Spanish colleagues from the university') → (2 PW)ϕ(3 PW)ϕ(2 PW)ϕ(1 PW)ϕ
a) 39% b) 24%

In Table 7, the highest ranked pair of constraints is unable to decide which candidate is more desirable. Both candidates (a) and (b) violate WB three times because none of the adjacent pairs of PPHs are balanced in either phrasing pattern. IU is also violated twice by both candidates. In both cases, there is a decrease in PPH length when shifting from the second to the third PPH, and also from the third to the final PPH. The decision on optimality now must be made by the lower ranked constraints. Candidate (b) disobeys MIN-BIN one more time than (a), and thus can be eliminated by this constraint. While both (a) and (b) are targeted by this constraint for their final PPHs, (b) is punished one extra time for its first PPH that individually phrases the subject, *Carmen*. The second violation by (b) is fatal, which gives (a) as optimal. This result helps explain why (a) occurs at the highest frequency. However, (b) records a frequency value within 15% of (a) and therefore merits co-optimal status.

The main structural difference between candidates (a) and (b) in Table 7 is found in the first two PPHs. The first pattern has PPHs of two and then three PWs while the second has PPHs of one and then four PWs. In this example where each candidate contains four PPHs, we are able to witness the importance of the formal definition of SYMM. In evaluating the symmetry of each candidate we must first locate the pivot, which is between the two medial PPHs, and then

evaluate pairs of PPHs that are equidistant (on the right or left) from the pivot. For example, in the pattern (1 PW)ϕ(4 PW)ϕ(2 PW)ϕ(1 PW)ϕ, represented by (b), the pairs of PPHs to be evaluated are the second and third (immediately to the left and the right of the pivot), and the first and fourth (both equidistant on the left and right from the pivot). Only the first of the aforementioned pairs is out of balance in (b), and thus we have one violation of SYMM by this candidate. In the (2 PW)ϕ(3 PW)ϕ(2 PW)ϕ(1 PW)ϕ pattern seen in (a), upon using the same baseline of judgment, it becomes apparent that there are two violations because the first and fourth PPHs are incongruent as are the second and third PPHs. Through the one less violation of this "mirror-image" type of constraint, (b) emerges as optimal over (a).

4. Conclusion

To my knowledge, there have been no previous studies analyzing phrasing in OT using only prosodic well-formedness constraints. Early work in end-based approaches assumes that syntax is the main factor influencing phonological phrasing decisions. More recent work includes prosodic conditions, however, a certain amount of reliance on syntax has remained. In extending on this study, an interesting application of OT to phrasing would be using a Rank-Ordering model of EVAL (Silva 2004; Coetzee to appear), which would present an alternate approach to accounting for phonological variability instead of the percentage cut-off value. Overall, through the inspiration of those such as Selkirk (1984, 1986, 2000), Ghini (1993), Truckenbrodt (1995, 1999), and Prieto (2006), this study hopes to serve as an experimental and theoretical advancement in the study of phrasing by revealing the possibility of utilizing solely prosodic factors in explaining the distribution of PWs in PPHs in sentences with complex syntactic organization.

5. Notes

[1] Earlier work using this hierarchy, such as that of Nespor and Vogel (1986), also included a Clitic Group level between the PW and PPH. This level has been excluded from the hierarchy in more recent studies.

[2] According to Ladd (1996), *stress* concerns perceived prominence of lexical items in an utterance, where as *accent* refers specifically to intonational F0 movement, which serves as one possible phonetic cue to the location of perceived prominence.

[3] Quilis (1993) provides a very extensive and useful list of types of *palabras acentuadas e inacentuadas* ('stressed and unstressed words'). The stressed words are those that are expected to be accented due to the presence of a F0 rise on the stressed syllable. Unstressed words are those in which such a rise is not normally anticipated. However, factors such as speech rate and emphasis can lead to the opposite trends.

[4] Other investigations of phrasing decisions in Romance include Garrido et al. (1995) for Spanish, Ghini (1993) for Italian, Frota (2000) for European Portuguese, Sandalo and Truckenbrodt (2003) for Brazilian Portuguese, and Prieto (2005) for Catalan.

[5] Constraints such as MAX-BIN (Sandalo and Truckenbrodt 2003, based on Nespor and Vogel 1986, Ghini 1993), MIN-BIN (IP) (adapted from Selkirk 2000), ALIGN-XP, R: ALIGN (XP, R; ϕ, R) (Selkirk 1986, 2000), and WRAP-XP (Truckenbrodt 1995, 1999) have been used in previous work on phrasing in Spanish and other languages. These constraints are not found to play a crucial role in determining phrasing decisions for speakers of this dialect. When candidates containing just one PPH in an IP are present, they do not violate any constraints in (4), since the idea of adjacency is not applicable. Although such PPHs are rarely present in the data, one way of eliminating them in OT tableaux is highly ranking MIN-BIN (IP), which requires that IPs be minimally binary.

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