

THE PROSODY PRODUCED BY SPANISH-ENGLISH BILINGUALS: A PRELIMINARY INVESTIGATION AND IMPLICATIONS FOR SENTENCE PROCESSING¹

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RESUMO

Esta investigação compara a prosódia produzida no espanhol e no inglês por falantes bilingües e falantes monolíngües, em enunciados de sentenças-alvo contendo ambigüidade decorrente do encaixamento de oração relativa. Os dados de falantes bilingües assemelham-se aos padrões monolíngües em aspectos de construção de frases e entonação, mas se diferenciam dos padrões monolíngües em outros casos. Diferenças de padrão frasal são mais provavelmente susceptíveis de limitações de performance, enquanto diferenças em padrões entonacionais são atribuíveis a repositórios de competência subjacentes. As implicações destas descobertas para a pesquisa em processamento de sentenças bilingües serão discutidas.

ABSTRACT

This investigation compares the prosody produced in Spanish and English by bilinguals and monolinguals, in utterances of target sentences containing the RC attachment ambiguity. The bilingual data approach the monolingual patterns in some aspects of both phrasing and intonation, but depart from the monolingual patterns in others. Phrasing pattern differences are most likely sourced in performance limitations, while differences in intonation patterns are attributable to underlying competence repositories. The implications of these findings for bilingual sentence processing research will be discussed.

PALAVRAS-CHAVES

prosódia, bilingüismo, Inglês, Espanhol, aposição de orações relativas

KEYWORDS

prosody, bilingualism, English, Spanish, relative clause attachment

Introduction

To what extent is the speech produced by fluent speakers of two languages different from that of their monolingual counterparts? Investigations concerned with this question have examined properties of bilingual and second language learner speech at various levels of analysis. A great deal of this work is concerned with segmental parameters, one of the most studied being the detailed acoustic properties of segments produced by speakers of two languages which have systematic differences in the two phonemic inventories (e.g., Beach, Burnham and Kitamura, 2001). Other work has focused on word-level supra-segmental phenomena, including investigations of syllable structure (e.g., Broselow, Chen and Wang, 1998; Brulard and Carr, 2003), the assignment of lexical stress (e.g., Archibald, 1995), and the realization of lexical tone (e.g., Wang, Behne, Jongman and Sereno, 2004). But conspicuously missing from this literature is a potentially important parameter, the intonation and rhythm assigned to the phrasal constituents of sentences. This paper is concerned with precisely this issue: the properties of sentence-level prosody in the speech of bilinguals, compared to those in the speech produced by their monolingual counterparts.

Understanding the extent to which bilingual sentence-level prosody diverges from the prosody produced by monolingual speakers is a necessary first step for explorations of how prosody might contribute to perceived “foreign accent”, a matter which has also received relatively little attention (see Major, 2001, for comments along these lines). Segment- and word-level properties of the speech of bilinguals which depart from the monolingual norm contribute to what naïve listeners may perceive as “foreign accent”. Yet intuition suggests that aspects of the prosody produced by bilinguals may signal divergence from the monolingual norm, plausibly being more reliable indicators of non-nativeness than segmental parameters: this is one of the motivations for the research reported here.

A second motivation has to do with how the study of bilingual prosody might contribute to developing a more complete understanding of how

bilinguals represent and process their two languages. Ostensibly, the research reported below addresses the question of whether bilinguals can possess two differentiated underlying phonologies to produce utterances in their two languages with different surfacing prosodies. By extension, we can ask whether having a non-native-like phonological system might affect not only language production but also language perception. We explore this question in the final section of this paper, which outlines some potentially important implications of the data reported here for research on sentence processing in bilinguals.

The sections that follow describe the findings from two experiments that elicited spoken utterances from English and Spanish speakers, monolingual and bilingual, using identical materials and procedure. The monolingual data (Fernández, Bradley, Igoa and Teira, in preparation)² reveal striking similarities across the two languages in the phrasing patterns produced, as well as suggestive differences between the two languages in the pitch movements made phrase finally by speakers of the two languages. The bilingual data approach the monolingual patterns in some aspects of both phrasing and pitch movement, but we will see that they depart from the monolingual patterns in others. The observed divergences from the monolingual norm in phrasing patterns and the variability in durations are attributable to performance limitations for the bilingual group, most plausibly linked to varying degrees of literacy in Spanish versus English. The bilinguals' intonation patterns, however, appear to be sourced in a phonological system that generates aspects of Spanish-monolingual-like prosody – in both languages. We turn first to an overview of the prosodic parameters of interest, along with a description of the materials and elicitation protocol employed with all participants.

1. Background

In addition to having a syntactic, semantic, and information structure, sentences have a phonological structure, which includes a supra-segmental

prosodic level. The units of this level of representation include pitch accents and boundary tones, units that are signaled by means of phrasing (durational) and intonational (pitch movement) cues and which make up the skeleton of the prosodic phrases or intonational units of a sentence. (For an extensive introduction to the study of intonational structure, see Gussenhoven, 2004.) A particular prosodic structure may be assigned to a given string of words to convey a speech act (compare *Mary left* uttered with falling intonation, to *Mary left?* uttered with rising intonation), or to put into focus an element in the sentence's information structure (compare *Mary left, not John* uttered with a pitch accent on *Mary*, and *Mary left, not laughed* uttered with a pitch accent on *left*).

But the prosodic level of a sentence is projected not just based on the sentence's communicative intent or function in a given discourse.³ A particular prosodic structure may be projected to reflect the underlying syntactic structure: prosodic breaks will occur at major syntactic boundaries, rather than elsewhere, and certain syntactic boundaries (e.g., a subject-predicate boundary) will be attractors for breaks (Selkirk, 1986), while other types of boundaries (e.g., those surrounding an adjectival phrase) may not attract breaks at all. Importantly, the prosody of an utterance could help disambiguate what might otherwise be an ambiguous string of words. As an example, consider the phrase in (1), and its Spanish translation-equivalent in (1').

1. the brother of the bridegroom who snores

1'. el hermano del novio que roncaba

If this string is uttered with no internal phrasal break, as one prosodic phrase, the more likely referent for the subject of the relative clause (RC), *who snores*, is the adjacent noun *bridegroom*. (This interpretation is generally labeled a *low attachment* interpretation; the host noun *bridegroom* is lower in the complex NP; we will refer to it as N2.). However, with a large prosodic discontinuity preceding the RC, which a speaker might signal by inserting a large pause between *bridegroom* and *who*, the

interpretation of the RC might shift so that the more likely referent for its subject might now be *brother* (a *high attachment* interpretation, since *brother* is higher in the complex NP; we will refer to this site as N1). This pattern of preferred interpretations has been observed for English (Maynell, 1999) and Spanish (Teira and Igoa, 2005), in studies that used auditory stimuli with and without prosodic phrasing breaks preceding the RC. (See also Lovrić, 2003, for similar results in Croatian.)

A number of studies that examine interpretation preferences for this construction have manipulated RC length, and have confirmed that long RCs are more likely than short RCs to attach high (e.g., Fernández, 2003). Among the existing explanations for the effect of length on the interpretation of RCs, the Implicit Prosody Hypothesis (IPH; Fodor, 1998, 2002) makes the claim that the prosody projected implicitly, during silent reading, is the source. Short RCs are very unlikely to be phrased as independent prosodic constituents, since they violate minimum size constraints (such as a constraint that the minimal prosodic phrase is binary; Selkirk, 2000). Short RCs are thus preferably interpreted as referring to the more local constituent, given the sentence processor's general preference to attach new constituents locally, following a principle such as Late Closure (Frazier, 1978) or Recency (Gibson, Pearlmutter, Canseco-González and Hickok, 1996). Long RCs, in contrast, can be phrased separately from the rest of the sentence, and separate phrasing licenses them to attach to a non-local host (Fodor, 1998, 2002).

The RC attachment ambiguity illustrated in (1) is interpreted differently by speakers of different languages: speakers of English are more likely to attach the RC low to *bridegroom*, while speakers of Spanish will prefer high attachment to *brother* (Cuetos and Mitchell, 1988). This cross-linguistic difference has been documented in a number of studies examining the attachment preferences of English and Spanish monolinguals (for review, see Fernández, 2003). Also relevant is the finding that Spanish-English bilinguals have attachment preferences that are similar in both of their languages, and that match those of monolinguals of their dominant language (Fernández, 2003) or their first

language (Dussias, 2001; see also Maia and Maia, 2005, who examine the attachment preferences of Portuguese-English bilinguals). These cross-linguistic and cross-language-history differences have been explained variously in the literature; according to the IPH their source would lie in the prosody projected implicitly by speakers of different languages (Spanish versus English) or speakers of different language histories (Spanish-dominant versus English-dominant bilinguals). Spanish monolinguals and Spanish-dominant bilinguals might be more likely to project a prosodic phrasing break before RC, regardless of RC's length, compared to English monolinguals and English-dominant bilinguals. This holds under the assumption that bilinguals employ a single phonology (that of their dominant language or of their first language) to generate the prosody they apply to utterances in both of their languages. We come back to this point later.

The cross-linguistic and cross-language-history differences reported in the literature are clearest with materials that place the target construction as a post-verbal object (2a). In fact, the preference in Spanish for high attachment, with materials as (2'a) has been shown to disappear – i.e., shift to a preference for low attachment – when the construction is a pre-verbal subject, as in (2'b) (Hemforth, S. Fernández, Clifton, Frazier, Konieczny and Walter, 2002).

- 2. a. The guest impressed the brother of the bridegroom who snores.
- b. The brother of the bridegroom who snores impressed the guest.

- 2'. a. El invitado impresionó al hermano del novio que roncaba.
- b. El hermano del novio que roncaba impresionó al invitado.

Fernández, Bradley, Igoa and Teira (in preparation) offer a prosodic explanation for this effect of placement: in Spanish, sentences in which the target construction is a post-verbal object (2'a) contain a major prosodic discontinuity (in the form of a rising boundary tone) before RC, while sentences in which the target is a pre-verbal subject (2'b) do not,

since in these the major prosodic discontinuity comes at the end of RC, at the subject-predicate break. Thus in (2'a), the RC is phrased separately from the complex NP, a prosody that encourages high attachment, while in (2'b) the RC is phrased together with the complex NP, a prosody that discourages high attachment.

Any prosody-based explanation for interpretive preferences in RC attachment, such as the IPH, has to assume that a prosodic structure is projected implicitly, even during silent reading, a structure taking on the default values generated by the underlying phonology. The only way to obtain empirical evidence of these hypothesized default values is indirect, by examining the overt prosody produced by speakers in natural speech, making a second assumption that the most frequently produced prosody is the one taking on the default values of the system. Thus elicitation protocols need to be designed to minimize behavior that varies based on, among other things, interpretation of the construction and discourse-induced focus. Furthermore, data analysis protocols and the ensuing interpretations of experimental outcomes need to distinguish between those aspects of prosody that are discrete and structured, and thereby can be considered as part of the internalized phonology, and those that are gradient and lacking internal structure, and are therefore not grammaticalized. Bolinger (1964) described intonation as a “half-tamed savage”, a linguistic level that is “around the edge of language”, and it is not very difficult at all to illustrate how frequently sentence-level prosody breaks away from the systematicity expected of a component of a language’s grammar. Yes/no questions, for example, are by default uttered in both English and Spanish with rising intonation, but this is a prosody that is far from being obligatory in either language, since the same string could be uttered with falling intonation, or with an overly decorated prosody that features capricious rises and falls. There is also variability, both between and within speakers, in the range of pitch movements. Furthermore, the timing or duration of a given constituent could undergo unprecedented lengthening if the speaker hesitates or stumbles in the middle.

Variability in the prosody produced by speakers presents complex challenges, if our objective is to characterize the prosody speakers produce most of the time. A phonological system, couched within the linguistic competence of an individual (monolingual or bilingual), generates structures that get garbled as they pass through the performance system. In this respect, we must consider whether performance limits bilinguals and monolinguals differently – for example, because bilinguals are unfamiliar with lexical items, or because they are insecure when speaking the non-dominant language, or for whatever other reason. If performance limitations mask the principles that operate in the bilingual's competence repositories, we could be making mistaken observations about what bilinguals know and do not know about the phonology of one or both of their languages.

2. Materials and Procedure

Seeking evidence of possible differences in the prosody produced by bilinguals and monolinguals, we will examine data from two experiments eliciting utterances from speakers of the two types, performing in English and/or Spanish. This section describes the materials and the elicitation protocol, both of which were identical for the monolingual and bilingual participants.

The elicitation protocol asked participants to read a stimulus triplet, illustrated in (3a) and (3b) below, and to immediately go on to combine the three sentences into a complex sentence containing the target construction, as in (2b) or (2b) above.

3. a. The guest impressed the brother of the bridegroom.
Which bridegroom? The bridegroom who (often unknowingly) snores.
- b. The brother of the bridegroom impressed the guest.
Which bridegroom? The bridegroom who (often unknowingly) snores.

- 3'. a. El invitado impresionó al hermano del novio.
 ¿Qué novio? El novio que (a menudo inconscientemente) roncaba.
 b. El hermano del novio impresionó al invitado.
 ¿Qué novio? El novio que (a menudo inconscientemente) roncaba.

The materials⁴ included two manipulations of interest. The relative clause in the target sentence was either short (e.g., *who snores*) or long (e.g., *who often unknowingly snores*); this added length was included to increase the likelihood of a prosodic phrasal break somewhere in the sentence. The variable of RC Length was crossed with a manipulation of Placement, such that the target construction, *the brother of the bridegroom who snores*, functioned in the matrix clause either as the post-verbal direct object (2a), or as the pre-verbal subject (2b). A likely location for a phrasal boundary in the target sentence in (2a) is the boundary before the RC. For (2b), in contrast, intuition suggests that a phrasal boundary after the RC is more natural than a phrasal boundary before it. In fact, we would be surprised to find utterances of (2b) where only one major prosodic phrase boundary was projected before RC (e.g., *The brother of the bridegroom || who snores impressed the guest*) because such a prosody seems to be ungrammatical.

In contrast, we might not be surprised to find utterances of (2a) or (2b) with N2 and RC grouped as one prosodic phrase (e.g., *The guest impressed the brother || of the bridegroom who snores* or *The brother || of the bridegroom who snores || impressed the guest*). Such a phrasing is, after all, a prosody that disambiguates RC attachment to N2, precisely the syntactic configuration prompted by the elicitation protocol. This disambiguation – achieved via the stimulus context sentences – is in place to ensure that the participants interpret the construction uniformly. The choice of forcing attachment low, to N2, is not random: forcing attachment high, to N1, would promote the likelihood of prosodic phrasal breaks occurring at the left edge of the RC, given the syntactic configuration of the constituents. With a low attachment, there is no syntactic trigger for a break before RC, so we can attribute variation in pre-RC breaks to

the application of phonological principles varying with the manipulations in the materials.

The target materials consisted of $N=8 \times 4$ basic items, the four versions crossing the variables RC Length (short or long), and Placement (post-verbal object, pre-verbal subject). The experimental session began with a short sequence ($N=4$) of illustration and practice items of the same form as the targets. The sequence of targets was presented following the practice items, in a fixed pseudo-random order and interspersed among filler items ($N=8$) of similar characteristics. Participants were permitted to take brief breaks (one or two minutes) after they completed the first third and second third of the experimental trials. Most participants completed the experimental session in 20 to 30 minutes.

Bilingual participants performed the task first in their non-dominant language (as informally assessed when the investigator met them), and returned two weeks later for a second session, during which the materials were presented in their dominant language. Bilinguals were instructed in the language of the task, and if they initiated a code-switch, the investigator promptly switched back to the language of the task. This posed no problems for any of the bilingual participants, who were all fluent speakers of both languages, though of slightly variable degrees of proficiency in each; we will come back to the issue of proficiency below.

It was not concealed from the bilinguals that the experiment was about bilingualism. However, the participants were not aware that the experiment was about prosody. They were merely asked to produce “natural-sounding” speech, speaking as if they were chatting with a friend, and they were told that their speech would be analyzed acoustically. Importantly, participants were not asked to produce the sentences in a way that disambiguated the attachment of the relative clause. In fact, they were not alerted to the presence of the ambiguous string at all. Since the procedure disambiguated attachment consistently to the same site (N2), it is very likely that the participants never even noticed that the surface strings they were producing were in fact ambiguous.

3. Monolingual Patterns

The monolingual data (see full report in Fernández, Bradley, Igoa and Teira, in preparation) come from utterances elicited from N=8 native speakers each of English (recruited in New York City) and Spanish (recruited in Madrid, Spain). As already mentioned, this dataset reveals both similarities (in phrasing patterns) and differences (in intonation patterns at phrasal boundaries) between the two languages.

Figure 1 displays mean durations for N2 (*bridegroom*) and the RC-final verb (*snores*), for both monolingual speaker groups. Durations for these two regions were measured using onset and offset acoustic landmarks that were readily identifiable across participants.

Examining the N2 data, displayed in the top portion of the figure, we observe a clear effect of RC Length: N2 is on average 97 ms longer before long RCs ($F_1(1,14) = 46.70, p < .001, F_2(1,14) = 46.05, p < .001$). But this effect is reliably modulated by Placement ($F_1(1,14) = 5.77, p < .05, F_2(1,14) = 12.37, p < .005$). The RC Length effect is greater (a difference of 123 ms.) when the construction is placed post-verbally, smaller (68 ms) when it is pre-verbal. Importantly, the pattern holds for both English and Spanish; there was no main effect of Language ($F_1, F_2 < 1$), and this factor did not interact with either of the other two factors, RC Length ($F_1, F_2 < 1$) or Placement ($F_1, F_2 < 1$).

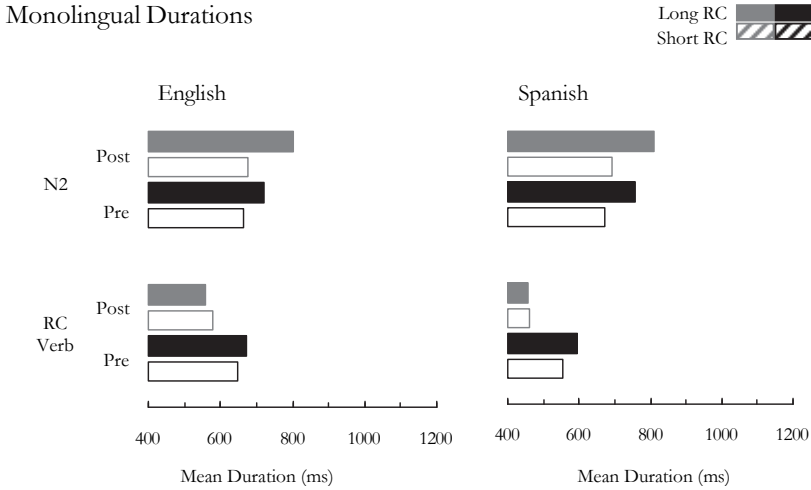


Figure 1: Mean durations (ms) for N2 and RC Verb regions, in utterances produced by English and Spanish monolinguals, as a function Placement (post-/pre-verbal) and RC Length (short/long). Durations for utterances in English and Spanish are displayed separately in the left and right panels of the figure, respectively.

In the RC verb durations, displayed in the bottom portion of Figure 1, we again observe an interaction of RC Length and Placement ($F_1(1,14) = 6.38$, $p < .05$, $F_2(1,14) = 5.90$, $p < .05$), but the interaction here is qualitatively different than in the N2 duration data. An RC Length effect is present (35 ms) with pre-verbal materials, absent (-10 ms) with post-verbal materials, and the overall duration of the RC verb is 105 ms longer pre- than post-verbally (main effect of Placement: $F_1(1,14) = 17.31$, $p < .001$, $F_2(1,14) = 52.38$, $p < .001$). In the pre-verbal materials, the relative clause verb is sentence-medial and occurs at the subject-predicate boundary, where added length in the sentence can increase the likelihood of a break. The length effect is absent with post-verbal materials, where the RC verb region is sentence final and therefore cannot undergo final lengthening modulated by the length of the utterance.

In the monolingual RC verb durations, neither RC Length nor Placement interact with Language ($F_1, F_2 < 1$), but the main effect of Language is itself reliable ($F_1(1,14) = 7.89$, $p < .02$; $F_2(1,14) = 6.68$, $p < .05$):

durations of the verb in the relative clause are longer in English than they are in Spanish, by 97 ms on average. This effect emerges in spite of the fact that the English verbs used are on average shorter (1 syllable) than those in Spanish (3 syllables).

The pitch movement data at the two sites of interest, N2 and RC Verb, are displayed in Figure 2, as mean rises over 200 ms. Average pitch was extracted over the whole of the N2 and RC Verb regions, in bins of 50 ms. The mean rise (slope) measures displayed in Figure 2 (and used to perform the Analyses of Variance) were calculated only on the last five bins, off-set locked and partitioning the final 250 ms of phonation. This approach to examining boundary tones is a conservative estimate of the boundary tones produced, since pitch movements could well span across more than the duration between the five measurement points used in the slope calculations. (See Katz, Beach, Jenouri and Verma, 1996, for a similar instrumental approach to examining pitch movements in English.)

Monolingual Pitch Movements

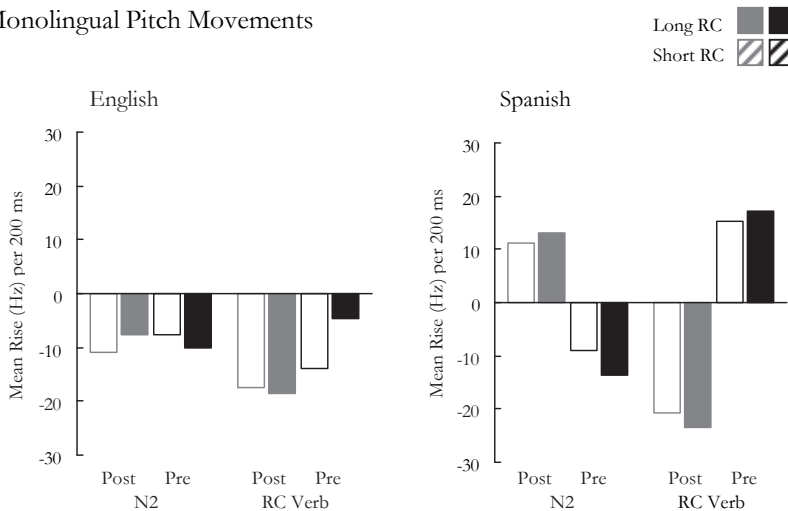


Figure 2: Mean pitch rise (Hz) per 200 ms for N2 and RC Verb regions, in utterances produced by English and Spanish monolinguals, as a function Placement (post-/pre-verbal) and RC Length (short/long). Pitch movement data for utterances in English and Spanish are displayed separately in the left and right panels of the figure, respectively.

Examining Figure 2 we observe clear differences between the two languages, in the form of an interaction of Placement and Language, both in the N2 data ($F_1(1,14) = 16.56$, $p < .002$, $F_2(1,14) = 14.43$, $p < .002$) and in the RC Verb data ($F_1(1,14) = 6.05$, $p < .05$, $F_2(1,14) = 14.72$, $p < .002$). English monolinguals produce falling boundary tones at both N2 and the RC verb (-11.4 Hz/200 ms, on average) for both placements of the target construction. In contrast, Spanish monolinguals produce boundary tones, both at N2 and at the RC verb, that vary systematically by placement. With post-verbal placement materials, pitch rises (12.3 Hz/200 ms) sentence medially at N2 and falls (-22.1 Hz/200 ms) sentence finally at the RC verb. With pre-verbal placement materials, pitch falls (-11.3 Hz/200 ms) at N2, in anticipation of the rise (16.2 Hz/200 ms) at the RC verb. In the monolingual pitch movements observed at the N2 and the RC verb sites, the main effect of RC Length is not reliable ($F_1, F_2 < 1$) and does not interact with either Placement ($p > .10$) or Language ($F_1, F_2 < 1$).

To summarize, the monolingual duration data reveal between-language similarities: speakers of both languages lengthen N2 before long RCs, more so when the construction is post-verbal, and lengthen the RC verb in long RCs when the construction is pre-verbal. These patterns indicate that the preferred location for a major phrasal boundary is after the RC in post-verbal materials, and before the RC in pre-verbal materials. In contrast, the two languages differ markedly in the pitch movement patterns produced. English speakers produce very similar boundary tones everywhere, while Spanish speakers produce boundary tones that vary systematically depending on the sentence type: post-verbal materials have a rise at N2 and a fall at the sentence-final RC verb, pre-verbal materials have a fall at N2 and a rise at the sentence-medial RC verb.

The phrasing and intonation patterns revealed by this dataset interarticulate well with the interpretation preferences observed in the behavioral data on Spanish/English RC attachment (Fernández, Bradley, Igoa and Teira, in preparation):

- RC length: The greater likelihood of phrasal boundaries before long RCs observed in the duration data corresponds with the behavioral finding that long RCs are preferably attached high; according to the IPH, this is so because long RCs are phrased separately from the complex NP.
- Placement: The finding that the intonation boundary in Spanish rises post-verbally and falls pre-verbally is consistent with the behavioral evidence that in Spanish the high attachment preference with post-verbal materials disappears with pre-verbal materials.
- Cross-linguistic differences: In post-verbal materials, the pre-RC boundary is characterized by a fall in English and a rise in Spanish, suggesting a higher category of break (a more prominent break) in Spanish than in English. This effect could be linked to the cross-linguistic differences in the interpretation of RC.

We can now proceed with the findings of the second experiment, which employed the same materials and protocol, only with bilingual participants.

4. Language History of the Bilingual Participants

The data were provided by N=12 Spanish-English bilinguals, recruited in New York City, all undergraduate students at Queens College. Bilingual participants completed an extensive language history questionnaire examining a broad range of language history parameters.⁵ Participants' responses to proficiency self-assessment questions were used to categorize them into three sub-groups: English-dominant, Spanish-dominant, or balanced. Table 1 provides summary data on the bilinguals' self-assessed proficiency, as estimated from responses to seven questions on the questionnaire, all posed separately for each language. The first four questions asked participants to rate their ability in English and Spanish when listening, speaking, reading and writing (responses for these questions were made on a five-point scale, where 1 =

“very poor” and 5 = “very good”). Two additional questions asked the participants to rate whether they thought they could pass as monolingual speakers, again separately for English and Spanish, in a telephone conversation and in a face-to-face conversation (also on a five-point scale, where 1 = “always” and 5 = “never”). A seventh question asked participants to rate their degree of accent, separately for English and Spanish (on a five-point scale, where 1 = “no accent” and 5 = “very strong accent”). The table lists the differential scores (Spanish minus English self-ratings): a negative score indicates that responses for English were lower in the scale (indicating English-dominance), a positive score indicates that responses for Spanish were lower in the scale (indicating Spanish-dominance).

Language-History Sub-Groups	Proficiency Differentials (Spanish – English) [†]									Mean Age of Acquisition [‡]	
	LI	SP	RD	WR	Mean	PH	F2F	AC	Mean	EN	SP
English-Dominant	0.0	-0.5	-1.0	-1.0	-0.6	-1.0	-1.5	-0.5	-1.0	3	0
“Balanced”	0.0	-0.3	0.0	-0.3	-0.1	0.0	-0.3	-0.3	-0.3	8	0
Spanish-Dominant	0.5	1.0	0.5	0.3	0.6	2.0	1.8	2.3	2.0	13	0
Mean	0.2	0.1	-0.2	-0.3	0.0	0.3	0.0	0.5	0.2	8	0

[†] Proficiency differentials are expressed as mean difference, Spanish (SP) – English (EN), in self-ratings for ability in listening (LI), speaking (SP), reading (RD), writing (WR); mean difference in self-ratings for likelihood of passing as a monolingual on the telephone (PH), face to face (F2F); mean difference in self-ratings for degree of accent (AC).

[‡] Mean age of acquisition is expressed in years.

Table 1: Mean self-assessed proficiency differential scores and mean age of acquisition for bilingual participants, across three language-dominance sub-groups.

Overall, the participants rate their abilities in the two languages very similarly (the proficiency differentials are closer to zero than they are to four), but consistent differences are observed between the English- and

Spanish-dominant sub-groups. Preliminary analyses of the data took into account a variable of language dominance, based on the sub-groups identified Table 1. However, clear differences between the three sub-groups failed to emerge in these preliminary analyses, thus the bulk of the bilingual data will be presented collapsing across the three language-dominance groups.

Table 1 also lists the mean age of acquisition for the three groups, in each of their languages, a datum that reflects the demographics of the Spanish-English bilingual population in New York City, where Spanish is almost always learned from birth at home and in informal settings, while English may be learned very early, or in elementary school, or as late as high school. Thus order of acquisition will not predict language dominance in New York City bilinguals. Rather, other variables (e.g., age of exposure to English, amount of formal education received in each language) will be more accurate predictors.

The bilingual participants all speak American English and speak at least one variety of Pan-American Spanish: 2 acquired Spanish in the continental US, 2 in Colombia, 2 in the Dominican Republic, 1 in Ecuador, 1 in El Salvador, 2 in Peru, 1 in Puerto Rico, and 1 in Venezuela. It is possible that the dialectal variation in the Spanish spoken by the bilinguals has introduced unwanted noise in the data; this is a problem to leave for future research, because the sample is too small and has representatives from too many potentially different dialects. Nonetheless, we will see that in spite of any existing dialectal differences between the speakers, the phrasing and intonational patterns they produce are consistent enough across speakers to yield significance (or lack thereof) in the participant-based analyses reported.

5. Bilingual Patterns

We now turn to the bilingual dataset, examining durations first and pitch movements later on. Duration measurements were taken from the utterances recorded by the bilinguals by following the same procedure

as with the monolingual recordings. Figure 3 displays the duration measures, at N2 and RC verb, for the bilinguals.

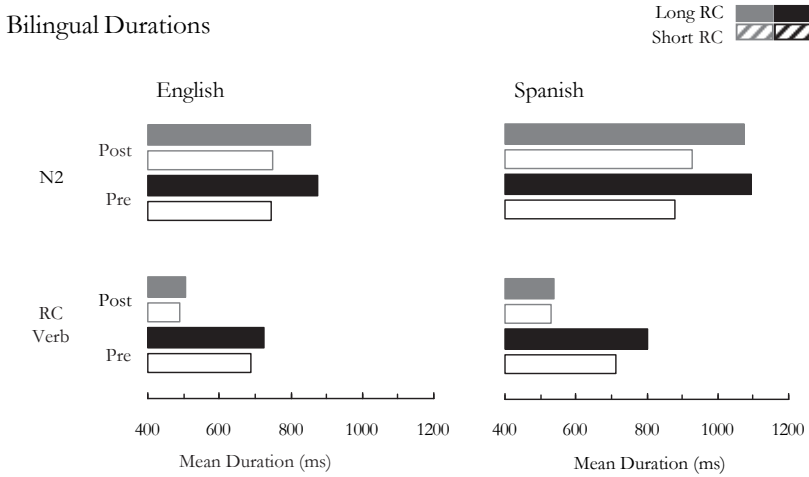


Figure 3: Mean durations (ms) for N2 and RC Verb regions, in utterances produced by English and Spanish bilinguals, as a function Placement (post-/pre-verbal) and RC Length (short/long). Durations for utterances in English and Spanish are displayed separately in the left and right panels of the figure, respectively.

Recall that the monolingual duration data for N2 revealed that the factors of Placement and RC Length interact, the effect of RC Length (i.e., increased N2 durations before long RCs) being larger with post- than pre-verbal materials (refer to the top portion of Figure 1). In the bilingual N2 duration data, displayed in the top portion of Figure 3, a reliable effect of RC Length is observed ($F_1(1,11) = 40.86$, $p < .001$, $F_2(1,14) = 21.86$, $p < .001$), but the Placement and Length interaction is absent ($F_1(1,11) = 2.37$, $p > .15$, $F_2 < 1$). In fact, the effect of RC Length (an overall difference of 149 ms, long-short) is numerically greater in the pre-verbal materials (171 ms) than in the post-verbal materials (125 ms), precisely the opposite of the pattern observed with the monolinguals.

N2 is on average 187 ms longer in Spanish than in English; this effect is reliable in the participant-based analysis ($F_1(1,11) = 10.50$, $p < .01$;

$F_2(1,14) = 4.10, p = .063$). That N2 durations are longer in Spanish might well be linked to intrinsic differences in the length of the N2 region across the two languages (3 syllables in English, compared to 5 syllables in Spanish), but recall that a main effect of Language did not emerge in the monolingual data. We come back to this issue shortly.

The RC Verb data pattern for the bilinguals, displayed in the bottom portion of Figure 3, is remarkably similar to that for the monolinguals (refer to the bottom portion of Figure 1). In the bilingual durations we observe a main effect of Placement ($F_1(1,11) = 94.12, p < .001, F_2(1,14) = 179.39, p < .001$), RC verbs being 216 ms longer in pre-verbal than post-verbal materials. We also observe a main effect of RC Length ($F_1(1,11) = 20.26, p < .001, F_2(1,14) = 18.12, p < .001$), RC verbs being 37 ms longer in long-RC than short-RC materials. These two main effects, though, interact reliably ($F_1(1,11) = 9.16, p < .02, F_2(1,14) = 8.98, p < .01$): when the RC verb appears sentence-medially, in pre-verbal materials, the length effect is sizeable (63 ms), but when the RC verb appears sentence-finally, in post-verbal materials, the length effect is negligible (14 ms).

In the RC Verb data, the main effect of Language is absent ($F_1(1,11) = 1.86, p > .20, F_2(1,14) = 1.42, p > .25$) and does not interact with either Placement ($F_1, F_2 < 1$) or RC Length ($F_1, F_2 < 1$). However, the three-way interaction merits a closer look ($F_1(1,11) = 2.11, p = .175, F_2(1,14) = 2.97, p = .107$). For every Spanish-English comparison, RC verb durations are longer in Spanish than in English, but pairwise analyses indicate that this difference only approaches marginal significance for pre-verbal long materials, where the average difference is 69 ms ($F_1(1,11) = 2.56, p = .138; F_2(1,14) = 3.09, p = .101$); elsewhere, the difference is not reliable (all p 's $> .10$).

The duration data just presented shows that the phrasing patterns produced by the bilinguals approach being native-like more with post-verbal than with pre-verbal materials. Post-verbally, RC length increases the likelihood of a pre-RC phrasal break, just as in the monolingual data. Pre-verbally, however, added length increases the likelihood of

breaks not only after RC (where they occur in the monolingual data) but also before RC. Going beyond these patterns, let us now turn to two sources of evidence that illustrate how the phrasings produced by the bilinguals are more variable than those produced by the monolinguals.

There are two types of phrasing patterns present in the bilingual dataset which are almost entirely absent in the monolingual dataset. The first type involves utterances of pre-verbal materials with a break before RC, an arguably ungrammatical prosody. One example appears in Figure 4. This break pattern could be an important source for the reduced interaction of Placement and Length in the bilingual N2 durations that emerged so clearly in the monolingual N2 durations.

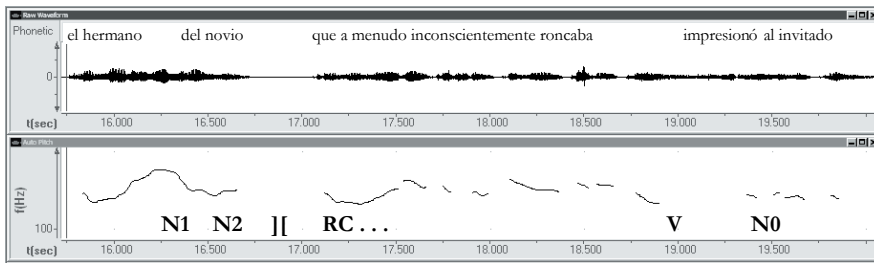


Figure 4: Waveform and pitch track for utterance of pre-verbal long target in Spanish. A major prosodic boundary occurs between N2 and the left edge of RC. A minor prosodic boundary occurs at the subject-predicate boundary. The speaker (“BA1”) belongs to the “balanced” sub-group.

A second type of phrasing frequent in the bilingual dataset, but essentially absent in the monolingual dataset, is one where N2 and RC are phrased together, with a preceding break. One example appears in Figure 5. This phrasing disambiguates attachment to N2, precisely the interpretation prompted by the stimulus sentences. We could speculate that bilinguals are more likely than monolinguals to produce utterances that disambiguate, by whatever means available (including prosody). Bilinguals might be less tolerant of ambiguity, or might be more aware of the effect of ambiguity on the interlocutor perhaps because they are more “cooperative” speakers, in the Gricean sense.⁶ This is a speculation that

deserves empirical attention. For our purposes, though, the presence of such disambiguating phrasings for target sentences is yet another source for variability in the bilingual dataset.

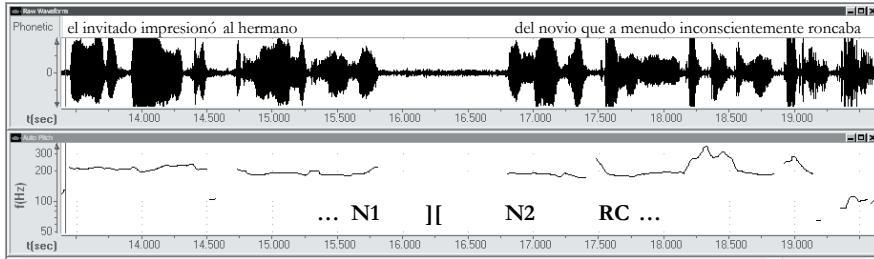


Figure 5: Waveform and pitch track for utterance of post-verbal long target in Spanish. A major prosodic boundary occurs between N1 and N2. The speaker (“BA2”) belongs to the “balanced” sub-group.

In addition to being more variable in the set of possible phrasing patterns for the materials, the bilingual data also exhibit a range of variation in durations that differs substantially from the corresponding range for monolinguals. Table 2 lists mean durations and standard deviations (pooling N2 and RC verb measurements) for monolingual and bilingual participants; also provided are mean durations and standard deviations for the three bilingual sub-groups. We observe similarity between the two monolingual groups: the grand means and standard deviations for the two are very similar. In contrast, the grand means and standard deviations for the bilinguals are all greater than for the monolinguals, and the only bilingual sub-group whose mean and standard deviation resembles the monolinguals is the English-dominant bilinguals performing in English. Importantly, even the mean and standard deviation for Spanish-dominant bilinguals performing in Spanish far exceed those of their Spanish monolingual counterparts. In the discussion section we will consider fluency as the source for these differences.

Language History Sub-Groups	English		Spanish	
	Mean	SD	Mean	SD
Monolinguals (N=8 × 2)	664	180	628	194
Bilinguals (N=12)	706	241	817	339
English-Dominant (N=4)	631	176	842	320
“Balanced” (N=4)	715	272	793	370
Spanish-Dominant (N=4)	771	276	816	328

Table 2: Mean durations and standard deviations (SD) for pooled N2 and RC Verb measurements, for monolingual and bilingual participants, as a function of language of the materials.

Let us turn to the final dataset to consider, that corresponding to the pitch movements observed at the N2 and RC Verb regions in the utterances produced by the bilinguals. These data, displayed in Figure 6, were extracted and analyzed following the same procedure as with the monolingual data.

Bilingual Pitch Movements

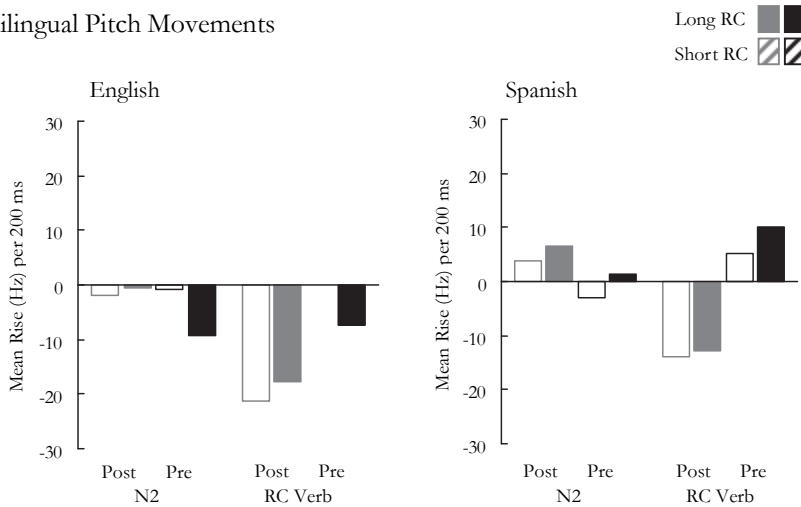


Figure 6: Mean pitch rise (Hz) per 200 ms for N2 and RC Verb regions, in utterances produced by English and Spanish bilinguals, as a function Placement (post-/pre-verbal) and RC Length (short/long). Pitch movement data for utterances in English and Spanish are displayed separately in the left and right panels of the figure, respectively.

Recall (from Figure 2) that English monolinguals produced uniform pitch movements, falling at both N2 and RC Verb, with post- and pre-verbal placement materials. In contrast, Spanish monolinguals exhibited systematic differences in pitch movement, with post-verbal materials having a rise at N2 and a fall at RC Verb, and pre-verbal materials having a fall at N2 and a rise at RC Verb. Thus an interaction of Language and Placement was observed at both regions.

The interaction of Language and Placement is fully absent in the bilingual pitch movement data, both for N2 ($F_1, F_2 < 1$) and RC Verb ($F_1 < 1$; $F_2(1,14) = 2.88, p > .10$). However, the main effect of Language is marginal in the N2 data ($F_1(1,11) = 3.45, p = .090$; $F_2(1,14) = 3.68, p = .076$) and reliable in the RC Verb data ($F_1(1,11) = 6.46, p < .05$; $F_2(1,14) = 17.47, p < .001$): at both regions, pitch is more likely to rise in Spanish (mean rise -0.3 Hz/200 ms) than in English (-7.4 Hz/200 ms). In this sense, bilinguals project language-specific prosodic contours, plausibly guided by language-specific phonological principles. But do these contours vary in patterns resembling those we observed in the monolingual pitch data?

The N2 data reveal an effect of Placement that is marginal in the participant-based analysis ($F_1(1,11) = 4.31, p = .062$; $F_2(1,14) = 9.41, p < .01$): for both languages, there are more rises with post-verbal materials (2.0 Hz/200 ms), more falls with pre-verbal materials (-3.0 Hz/200 ms). The Placement effect does not interact with RC Length ($F_1(1,11) = 1.05, p > .30$; $F_2 < 1$), and the three-way interaction is not significant ($F_1(1,11) = 1.32, p > .25$; $F_2(1,14) = 1.97, p > .15$). As in the monolingual data, the main effect of RC Length is entirely absent in the N2 pitch movement data ($F_1, F_2 < 1$).

The RC Verb data reveal a robust effect of Placement ($F_1(1,11) = 20.40, p < .001$; $F_2(1,14) = 134.64, p < .001$): for both languages there are more falls sentence-finally (-16.4 Hz/200 ms), and more rises sentence-medially (1.9 Hz/200 ms). The Placement effect does not interact with RC Length ($F_1(1,11) = 2.34, p > .15$; $F_2 < 1$), which is itself unreliable ($F_1, F_2 < 1$). The bilinguals seem to have internalized a principle through

which they use prosody to indicate the subject-predicate boundary, particularly when the subject is very heavy, by means of rising intonation. This principle, which they apply to the prosody projected for utterances in both languages, is arguably similar to the one used by Spanish monolinguals.

The bilingual pitch movements are less extreme than those of the monolinguals: the bars in Figure 6 are closer to the midline, zero-slope, than those in Figure 2. This is a phenomenon that is not clearly understood at this point: are bilinguals more monotonal than their monolingual counterparts, or are they merely far more variable in their pitch movements such that varying rises and falls cancel each other out? The grand means and standard deviations suggest that the pitch movements bilinguals produce are indeed less extreme than those produced by monolinguals (for bilinguals English mean -7.4 Hz/200 ms, SD 28.9; Spanish mean 0.5 Hz/200 ms, SD 30.6; for monolinguals English mean -11.2 Hz/200 ms, SD 41.0; Spanish mean -6.3 Hz/200 ms, SD 42.6).

To summarize the bilingual pitch movement patterns, differences emerged between the two languages in that more rises were observed in Spanish, and more falls in English. Thus the prosody produced by the bilinguals seems to distinguish between preferred sentence-internal boundary tones for the two languages. However, the bilinguals produced intonational patterns for the materials in this study that resemble each other across Spanish and English: for post-verbal materials rises at N2 and falls at RC verb, and for pre-verbal materials falls at N2 and rises at RC verb. Perhaps these patterns are indicative of the bilinguals using a similar set of prosodic principles to generate prosodic structure in both languages.

6. Discussion

We are now in a position to answer the critical question posed earlier: does the prosody bilinguals produce in each of their languages differ substantially from that produced by monolingual speakers of each?

The answer to this question is complex, since the two sources of data examined (durations, pitch movements) both identify similarities and differences, and as we have already suggested, the differences could be sourced either in differing performance limitations or in differing underlying competence repositories.

The duration measures demonstrate differences between bilinguals and monolinguals that are most plausibly interpreted as sourced in performance limitations for the former group rather than differences at the level of competence. The duration data show that bilinguals phrase pre-verbally placed RC attachment constructions differently than do monolinguals, and that the timing of bilingual speech is overall more variable, particularly in Spanish. It is not unreasonable to speculate that the factor driving these differences is fluency.

At the time of testing, the bilinguals were all attending an English-speaking university, and living in a city where English is the language of the mass media, government, and most social services. It is not surprising that the elicited production procedure would tax their performance more in Spanish than in English. The task involves reading aloud written stimulus sentences that possibly contain lexical material they are not used to seeing in print in the language they read less frequently, Spanish. It is probably also not a coincidence that the target sentences causing greater degrees of difficulty were those that placed the construction pre-verbally. Such target sentences do not match as closely the linear order of the elements in the stimulus triplet (compare (3b) and (3a), and their respective target sentences in (2b) and (2a)). Pre-verbal materials also place a heavy constituent early on in the sentence, and early placement of heavy constituents is generally dispreferred (see, e.g., MacDonald, 1999).

The evidence offered here, linking differences between bilingual and monolingual durations to differences between the two groups in terms of performance limitations, is rather tenuous and calls for more investigation. For example, future analyses of this or a new dataset might operationalize the notion of disfluency and seek evidence of a correlation

between variable durations and variable degrees of disfluency between speakers. Alternatively, elicitation protocols could be designed to either reduce or increase the difficulty of the verbal task, possibly by manipulating the frequency of the lexical content of the materials. Presumably, such a manipulation would have similar effects with monolingual and bilingual participants. If, instead, the disfluency witnessed in the bilingual data is linked to the fact that both languages are perhaps activated, even in a unilingual mode, it might be insightful to compare bilingual performance in tasks, as the one here, where only one language is being used in the discourse, to tasks where both languages are used within the discourse of one experimental session. We might expect disfluency to increase in a discourse that requires both languages to be activated, decrease when the discourse requires only one language to be activated.

The pitch movements produced by the bilinguals are overall different between English (more falls) and Spanish (more rises), so phonetically at least bilinguals differentiate between the two languages: preferred sentence-internal boundary tones are different for the two languages.

Fall, not only with Spanish but also with English materials. This finding suggests that one underlying set of phonological principles guides bilinguals in building the prosody for utterances like the ones examined in this investigation, in both English and Spanish. That the bilinguals use Spanish patterns in both languages is a matter that requires future investigation. Spanish patterns may predominate because Spanish is L1 for all of these speakers and prosodic principles are subject to stricter critical period effects than might be syntactic principles, for instance. Alternatively, the Spanish prosody might be marked in some sense, and bilingual speakers opt for using the more marked prosody in both languages.

7. Looking Forward

We have identified a number of parameters where the prosody produced by Spanish-English bilinguals differs from that of their

monolingual counterparts. These data could serve as a starting point for future work concerned with whether prosody is used by listeners as a signal of non-nativeness. In particular, it would be interesting to distinguish, in a “foreign accent” judgment task, between judgments of utterances that diverge from a monolingual norm in terms of their durational properties and those that diverge in terms of their intonational properties. It would be particularly useful to compare judgments performed by monolinguals and by bilinguals, to determine whether the two types of speakers are attentive to prosodic signals in similar or in different ways.

We mentioned earlier that this investigation has some potentially interesting implications for bilingual sentence processing research. As already discussed, studying the prosody produced for stimulus materials containing the RC attachment ambiguity is of interest because of the claims made by the IPH regarding the interpretations of this ambiguity in silent reading. Recall that the IPH invokes the prosody projected implicitly during silent reading to explain effects such as the increased preference to interpret long RCs as attached high, and the greater likelihood of Spanish monolinguals and Spanish-dominant bilinguals to interpret RCs as attached high. In the monolingual data discussed here we find correlates between the produced prosody and several relevant effects reported by studies that examine interpretation preferences. However, it is not as simple to interarticulate the effects found in the prosody produced by the bilingual participants of this study and the effects on interpretation found in earlier studies using bilingual participants. One fact to account for is that for bilinguals the dominant language (or the first language) drives attachment preferences in interpretation, in both languages. Indeed, we expected the bilinguals in this study to produce patterns that matched those of monolinguals of their dominant language (or their first language). We have instead uncovered an interesting paradox: the bilinguals tested here were more disfluent in Spanish, yet projected Spanish-like intonational patterns in both of their languages. Thus we have failed to find a straightforward link between what an IPH

account would predict for overt prosody, given the interpretive preferences of bilinguals, as reported in the literature.

The bilingual data reported here suggest two different types of effects to seek in future investigations tapping interpretive preferences for the RC attachment ambiguity. The first is linked to the effects found in the duration data. If bilinguals are more disfluent in overt speech, it is possible that their implicit prosody is also equally disfluent. We might then expect that prosody-driven effects – such as RC length or placement – will be attenuated in bilingual interpretation data, particularly in the bilingual's less fluently read language. One effect along these lines is already reported in Fernández (2003), where an effect of RC length was reduced in Spanish, for both English and Spanish dominant bilinguals. The explanation offered by Fernández is similar to that contemplated here, as it invokes degrees of literacy or reading fluency in the less frequently read language, Spanish.

The second effect we might expect to find in future investigations of interpretive preferences in bilinguals concerns the placement effect that has been observed in Spanish by Hemforth, S. Fernández, Clifton, Frazier, Konieczny and Walter (2002). If prosody is the source for the variation in interpretations given different placements of the target construction (post-verbal versus pre-verbal), as suggested by Fernández, Bradley, Igoa and Teira (in preparation), we would expect Spanish-English bilinguals like the ones tested here to exhibit a shift in preference not only in Spanish, but also in English, given the pitch movement patterns observed in this study.

There is one final issue to contemplate: does the explicit prosody produced by bilinguals resemble their implicitly projected prosody? We face again some version of Bolinger's (1964) half-tamed savage problem: a disfluent speaker might or might not be a disfluent silent reader, because performance limitations might no longer apply. The prosody I produce in my head, when I read in one of my very weak languages, may be as close to native-like as my imagination may permit – just as when I sing in my head, my rhythm is always in synch, my notes are

always perfectly on pitch. But of course, the inner voice one experiences during silent reading does not necessarily reflect the structure of the prosody that is projected implicitly by the internalized grammar. This means that the future study of problems such as these will have to involve devising ingenious and multi-pronged approaches.

References

- ARCHIBALD, J. The acquisition of stress. In: ARCHIBALD, J. (Ed.). *Phonological acquisition and phonological theory*. Hillsdale, NJ: Lawrence Erlbaum, 1995. p. 81-109.
- BEACH E. F.; BURNHAM, D.; KITAMURA, C. Bilingualism and the relationship between perception and production: Greek/English bilinguals and Thai bilabial stops. *International Journal of Bilingualism*, 5 (2-1), p. 221-225.
- BOLINGER, D. Around the edge of language: Intonation. *Harvard Educational Review*, 34, p. 282-296, 1994.
- BROSELOW, E.; CHEN, S-I.; WANG, C. The emergence of the unmarked in second language phonology. *Studies in Second Language Acquisition*, 20, p. 261-280, 1998.
- BRULARD, I.; CARR, P. French-English bilingual acquisition of phonology: One production system or two? *International Journal of Bilingualism*, 7, 2, p. 177-203, 2003.
- CRUTTENDEN, A. *Intonation*. 2nd edition. Cambridge: Cambridge University Press, 1997.
- CUETOS, F.; MITCHELL, D. C. Cross-linguistic differences in parsing: Restrictions on the use of the Late Closure strategy in Spanish. *Cognition*, 30, p. 73-105, 1988.
- DUSSIAS, P. E. Sentence parsing in fluent Spanish-English bilinguals. In: NICOL, J. L. (Ed.). *One mind two languages: Bilingual language processing*. Oxford: Blackwell, 2001. p. 159-176.

- FERNÁNDEZ, E. M. *Bilingual sentence processing: Relative clause attachment in English and Spanish*. Amsterdam: John Benjamins Publishers, 2003.
- FERNÁNDEZ, E. M.; BRADLEY, D. Exploring the prosody of the RC attachment construction in English and Spanish. Poster presented at the *17th Annual CUNY Conference on Human Sentence Processing*, 25-27, College Park, MD, march 2004.
- FERNÁNDEZ, E. M.; BRADLEY, D.; IGOA, J. M.; TEIRA, C. *Acoustic correlates of phrasing patterns in English and Spanish sentences containing the relative clause attachment construction: Effects of language, length and placement*. Manuscript, City University of New York. (in preparation)
- FERNÁNDEZ, E. M.; BRADLEY, D.; IGOA, J. M.; TEIRA, C. Prosodic phrasing in the RC-attachment ambiguity: Effects of language, RC- length, and position. Paper presented at *Architectures and Mechanisms of Language Processing (AMLaP)*, 25-27, Glasgow, Scotland, UK, august 2003. (Abstract: <http://amlap.psy.gla.ac.uk/programme/node29.html>.)
- FODOR, J. D. Learning to parse? *Journal of Psycholinguistic Research*, 27 (2), p. 285-319, 1998.
- FODOR, J. D. Psycholinguistics cannot escape prosody. In: *Proceedings of Speech Prosody*. Aix-en-Provence, France, 2002. (Full text: <<http://www.lpl.univ-aix.fr/sp2002/pdf/fodor.pdf>>)
- FRAZIER, L. *On comprehending sentences: Syntactic parsing strategies*. Unpublished doctoral dissertation, University of Connecticut, Storrs, CT, 1978.
- FRAZIER, L. Parsing modifiers: Special purpose routines in the human sentence processing mechanism? In: BALOTA, D. A.; FLORES d'ARCAIS, G. B.; RAYNER, K. (Ed.). *Comprehension processes in reading*. Hillsdale, NJ: Lawrence Erlbaum, 1990. p. 303-330.
- GIBSON, E.; PEARLMUTTER, N.; CANSECO-GONZÁLEZ, E.; HICKOK, G. Recency preference in the human sentence processing mechanism. *Cognition*, 59, p. 23-59, 1996.

- GUSSENHOVEN, C. *The phonology of tone and intonation*. Cambridge: Cambridge University Press, 2004.
- HEMFORTH, B.; FERNÁNDEZ, S.; CLIFTON, C. Jr.; FRAZIER, L.; KONIECZNY, L.; WALTER, M. *Relative clause attachment in German, English and Spanish*: Effects of position and length. Unpublished manuscript, 2002.
- KATZ, W. F.; BEACH, C. M.; JENOURI, K.; VERMA, S. Duration and fundamental frequency correlates of phrase boundaries in productions by children and adults. *Journal of the Acoustical Society of America*, 99 (5), 3179-3191, 1996.
- LOVRIĆ, N. *Implicit prosody in silent reading: Relative clause attachment in Croatian*. Unpublished Doctoral Dissertation, CUNY Graduate Center, New York, NY, 2003.
- MACDONALD, M. C. Distributional information in language comprehension, production, and acquisition: Three puzzles and a moral. In: MACWHINNEY, B. (Ed.). *The emergence of language*. Mahwah, NJ: Lawrence Erlbaum, 1999. p. 177-196.
- MAIA, M.; MAIA, J. M. A compreensão de orações relativas por falantes monolíngües e bilíngües de português e de inglês. In: MAIA, M.; FINGER, I. (Ed.). *Processamento da linguagem*. Pelotas, Brasil: Educat, 2005. p. 163-178.
- MAJOR, R. C. Preliminaries to research in second language phonology. Chapter 1. In: *Foreign accent: The ontogeny and phylogeny of second language phonology*. Mahwah, NJ: Lawrence Erlbaum, 2001.
- MAYNELL, L. Effect of pitch accent placement on resolving relative clause ambiguity in English. Poster presented at the *12th Annual CUNY Conference on Human Sentence Processing*, 18-20, New York, NY, march 1999. (Abstract: <http://cognet.mit.edu/library/conferences/paper?paper_id=4248>.)
- SELKIRK, E. On derived domains in sentence phonology. *Phonology Yearbook*, 3, p. 371-405, 1986.

SELKIRK, E. The interaction of constraints on prosodic phrasing. In: HORNE, M. (Ed.). *Prosody: theory and experiment*. Dordrecht: Kluwer Academic Publishers, 2000. p. 231-263.

SOSA, J. M. *La entonación del español: Su estructura fónica, variabilidad y dialectología*. Madrid, Spain: Cátedra, 1999.

TEIRA, C.; IGOA, J. M. On the relation between prosodic structure and syntactic decisions in spoken sentence comprehension and production. Poster presented at the *18th Annual CUNY Conference on Human Sentence Processing*, March 31-April 2, Tucson, AZ, 2005.

WANG, Y.; BEHNE, D. M.; JONGMAN, A.; SERENO, J. A. The role of linguistic experience in the hemispheric processing of lexical tone. *Applied Psycholinguistics*, 25, 3, p. 449-466, 2004.

Notes

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- 2 These data were originally reported by Fernández, Bradley, Igoa and Teira (2003), and Fernández and Bradley (2004).
- 3 Cruttenden (1997) offers a survey of communicative functions of intonation, with main reference to English. Though in less detail, Sosa (1999) also addresses this topic, focusing on Spanish.
- 4 The materials used in this investigation constitute a subset of the materials employed by Hemforth, S. Fernández, Clifton, Frazier, Konieczny and Walter (2002). Some of the items were modified to conform to the constraints of the experimental design.

- 5 Bilinguals were categorized into dominance sub-groups following a procedure partly based on that developed by Fernández (2003). A copy of the complete language history questionnaire is available at <http://qcpages.qc.cuny.edu/~efernand/QCPL/>.
- 6 Because bilinguals operate regularly with two languages, they possess an expanded communicative repertoire which include the diverse functions of code-switches, for example. With a more inclusive communicative competence, bilinguals could thus be more attuned to the needs of their interlocutors.

