BILINGUAL SPEECH RHYTHM: SPANISH-AFRIKAANS IN PATAGONIA

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ABSTRACT

Our study examines the extent to which Afrikaans-Spanish bilingual speakers show L1-L2 interactions in the rhythmic properties of their two languages. Eight Afrikaans-Spanish bilingual speakers who live in Patagonia, Argentina read aloud sentences in Afrikaans (their L1) and Spanish (their L2), and ten Afrikaans and eight Spanish monolingual control speakers read aloud sentences in their respective native languages. Measurements of consonantal and vocalic intervals were taken using Praat. Our results suggest that there are L2 to L1 transfer effects for vowel metrics but not for consonant metrics. We argue that this difference derives from the fact that Afrikaans phonology controls vowel duration, whereas neither Spanish nor Afrikaans use phonemic consonant length. This shows that the extent of rhythmic influence between languages can depend on segment-specific aspects of the two phonological grammars under study.

Keywords: rhythm, language contact, Spanish, Afrikaans, prosodic transfer

1. INTRODUCTION

A recurrent finding in the research on bilingual speech is that bilingual speakers exhibit bidirectional effects in their phonology: L1 sound patterns affect L2 production, and vice versa [11, 12, 13]. These studies, among many others in the literature on bilingual pronunciation, indicate that L1 phonological categories are gradually restructured with increased L2 experience. Current models of second language speech learning predict such bidirectional influences because L1 and L2 sounds are posited to co-exist in a shared phonetic space in the bilingual grammar [3, 12].

At the suprasegmental level, there is evidence for bidirectional effects in bilingual speech [16, 21], but the body of research is more limited in comparison to the research at the segmental level. Regarding L2 rhythm, research has shown that there are clear L1 to L2 effects such that bilingual speakers produce intermediate rhythm values in their L2 [6, 8, 20, 22], but to our knowledge there is no research on the extent of L2 to L1 influence in such situations. Although evidence for bidirectional influence between L1 and L2 in terms of speech rhythm is currently lacking, we hypothesize that bidirectional influence should also be present at this level. In order to investigate this hypothesis, we examine the rhythmic properties of the speech of bilingual Spanish-Afrikaans speakers who live in Patagonia, Argentina. Since our speakers are bilingual in languages that are rhythmically different (Afrikaans is prototypically stress-timed and Spanish syllable-timed), they present an ideal test case for potential L1-L2 interactions in terms of speech rhythm.

Rhythm refers to the relative timing of strong and weak prosodic units in speech [15, 17, 19]. Experimental research has failed to provide evidence for isochrony, which is the notion that syllables are of equal duration in syllable-timed languages but not in stress-timed languages. Since it is known that so-called stress-timed languages are more variable in their timing relationships across sequences of consonants and vowels, acoustic metrics have been proposed to quantify consonantal and vocalic variability, and these metrics have been used to classify languages rhythmically. These metrics include %V, ΔC, the pairwise variability index (PVI), and Varco metrics [10, 14, 15]. Arvaniti [2] shows that cross-linguistic differences captured by such metrics can be influenced by a variety of factors, including speaking situation, the syllable structure of test sentences, and individual speakers. For our purposes, these metrics capture differences in vowel reduction, vowel length contrasts, and final lengthening between and within languages [9]. Since we know that Spanish and Afrikaans differ in these respects, we used these rhythm metrics to explore variation for bilingual speakers of both languages.

2. METHOD

2.1. Speakers

We collected speech data from 26 speakers: eight Afrikaans-Spanish bilinguals (from Argentina); eight monolingual Spanish controls (from Argentina); and ten monolingual Afrikaans controls (from South Africa). The age range for all speakers was 38-81 years old, and the mean age was 66.7 years old. (Virtually all South Africans speak some English, thus our Afrikaans control speakers are not monolinguals, strictly speaking. The speakers, however, live in an Afrikaans-dominant region of South Africa so that they would have limited exposure to English. Moreover, Afrikaans and English are rhythmically similar [8] so that English should not rhythmically impact their Afrikaans.)

The Afrikaans-Spanish bilingual community that we investigate represents a unique situation of language contact between Afrikaans and Spanish. Several hundred Afrikaans speakers settled in Patagonia, Argentina, early in the 20th century. After several decades in which Afrikaans was virtually the only language spoken in this community, Spanish has gradually become dominant in the second half of the 20th century. Currently, Afrikaans is spoken by the oldest generation only (typically over 60 years). Afrikaans is the L1 of these speakers and was their dominant language until early adulthood. For the past three or four decades of their lives, however, these speakers have been Spanish-dominant.

In order to assess language dominance, our bilingual speakers completed the Bilingual Language Profile (BLP) [4]. The BLP uses self-reported data on language use, identity, and attitudes to achieve a bilingual score for a given speaker. For our version of the BLP, scores range from +180 (Spanish-dominant) to -180 (Afrikaans-dominant). The average BLP score for our bilingual speakers was +48.7, indicating weak Spanish dominance.

2.2. Speech materials

All speakers participated in a sentence reading task. The bilinguals read sentences in Spanish and Afrikaans, and the monolinguals read sentences in their respective native languages. Following [2, 18], we created three conditions per language to test for the effects of syllable structure on rhythm: CV sentences (with “simpler” CV syllables), CVC sentences (with “complex” CVC syllables), and uncontrolled sentences (from Afrikaans or Spanish novels). We created five sentences for each condition, and speakers read each sentence three times, yielding 45 sentences per speaker for each language. We predicted the CV sentences to show rhythmic patterns more prototypical of syllable-timed languages, and the CVC sentences to show more stress-timed like patterns. Since the uncontrolled sentences represent utterances typical of each language, we expected these sentences to show more stress-timed patterns for Afrikaans, and more syllable-timed patterns for Spanish.

2.3. Acoustic analysis

Measurements of consonantal and vocalic intervals were taken using Praat [5]. We quantified the timing differences between Afrikaans and Spanish based on four metrics: %V, ΔC, NPVI-V, and RPVI-C. %V is the proportion of the duration of each utterance that is vocalic. ΔC quantifies the standard deviation of the consonant interval duration across an utterance. NPVI-V is a measure of the variability in duration of consecutive vocalic intervals, and RPVI-C is the corresponding measure for consonant intervals. Following [1, 7], we used the speech rate normalized NPVI-V measure for vowels, but the unnormalized RPVI-C measure for consonants.

2.4. Statistical analysis

We fitted four linear mixed-effects models (LMEMs) including random effects of SPEAKER and SENTENCE within SPEAKER. Each LMEM corresponded to one of the four metrics in the analysis: %V; ΔC; NPVI-V; and RPVI-C. The LMEMs also included fixed effects of SENTENCETYPE (CV, CVC, uncontrolled), GROUP (Spanish monolinguals, Spanish bilinguals, Afrikaans monolinguals, Afrikaans bilinguals), and the interaction combinations between them. All models were fitted using the MIXED procedure in SPSS, and degrees of freedom for approximate F-statistics for the fixed effects were computed using a Satterthwaite approximation. Post-hoc comparisons with Bonferroni corrections were performed on the effects that were found to be significant. In the following sections, we report results for statistically significant effects only.

3. RESULTS

For the fixed factor SENTENCETYPE, post-hoc comparisons between all levels (CV vs. CVC; CV vs. uncontrolled; CVC vs. uncontrolled) returned significant results. We therefore omit the results for this factor here and focus on the effects of GROUP.

In Figure 1 we plot the %V data. First, in the uncontrolled sentences, Spanish monolinguals had higher %V values than Afrikaans monolinguals (as expected). Second, the differences between CV and CVC sentences show how syllable structure can influence rhythm metrics. The low values for Afrikaans CV sentences result from these sentences containing more short vowels than the other Afrikaans sentence types. Third, and most important, the bilingual speakers generally displayed Spanish-like values in Spanish and Afrikaans-like values in Afrikaans. The LMEM for %V returned significant effects for the fixed factors SENTENCETYPE ($F(2, 373.335)=4.463$, $p=.012$), GROUP ($F(3, 32.962)=20.510$, $p\leq.001$), and the SENTENCETYPE-BY-GROUP interaction ($F(6, 373.228)=15.332$, $p\leq.001$). Significant comparisons between levels of

GROUP are summarized in Table 1 (***: p≤.001; **: p≤.01; *: p≤.05; n.s.: not significant).

Figure 1: Mean %V values.

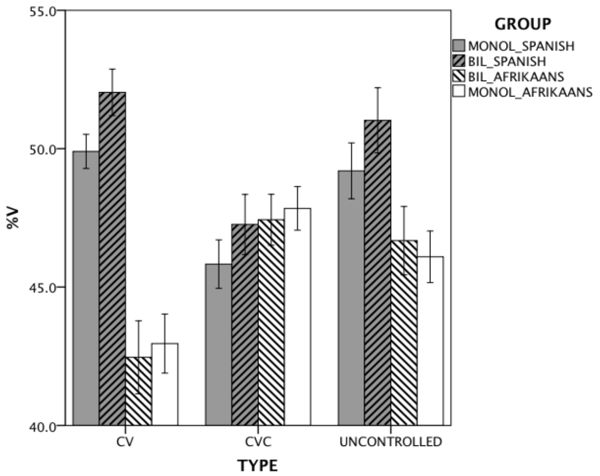

Table 1: Pairwise comparison results for %V.

	Mono_Sp	Bil_Sp	Bil_Afr	Mono_Afr
Mono_Sp		n.s.	***	***
Bil_Sp			***	***
Bil_Afr				n.s.
Mono_Afr				

As for ΔC, Figure 2 shows that CVC sentences have the highest scores of the three sentence types (as expected). We also found expected differences between the monolingual groups: Afrikaans monolinguals displayed higher ΔC values than Spanish monolinguals. The bilinguals displayed Afrikaans-like values in Afrikaans and Spanish-like values in Spanish. The LMEM included significant effects for SENTENCETYPE (F(2, 368.143)=24.272, p≤.001), GROUP (F(3, 31.721)=85.548, p≤.001), and their interaction (F(6, 367.587)=4.698, p≤.001). The comparisons for GROUP are summarized in Table 2.

Figure 2: Mean ΔC values.

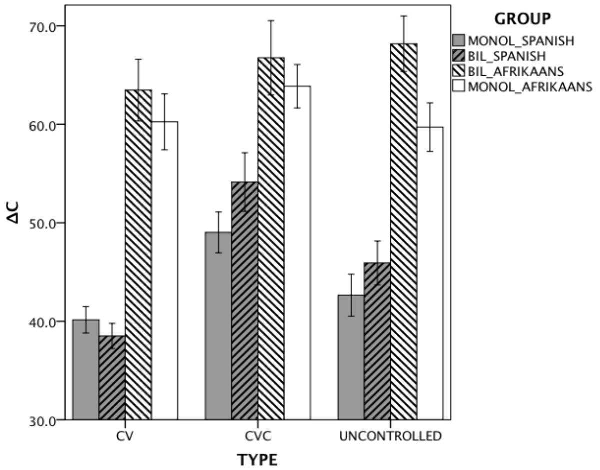

Table 2: Pairwise comparison results for ΔC.

	Mono_Sp	Bil_Sp	Bil_Afr	Mono_Afr
Mono_Sp		n.s.	***	***
Bil_Sp			***	***
Bil_Afr				n.s.
Mono_Afr				

Figure 3 illustrates the results for NPVI-V. CV sentences showed lower scores than CVC and uncontrolled sentences. The Spanish monolinguals displayed lower scores than the Afrikaans monolinguals. The bilinguals displayed Spanish-like values in Spanish and intermediate values (i.e., between Spanish and Afrikaans) in Afrikaans. The LMEM for NPVI-V returned significant effects for the fixed factors SENTENCETYPE (F(2, 374.978)=53.237, p≤.001) and GROUP (F(3, 33.320)=82.294, p≤.001). Significant comparisons between levels of GROUP are summarized in Table 3.

Figure 3: Mean NPVI-V values.

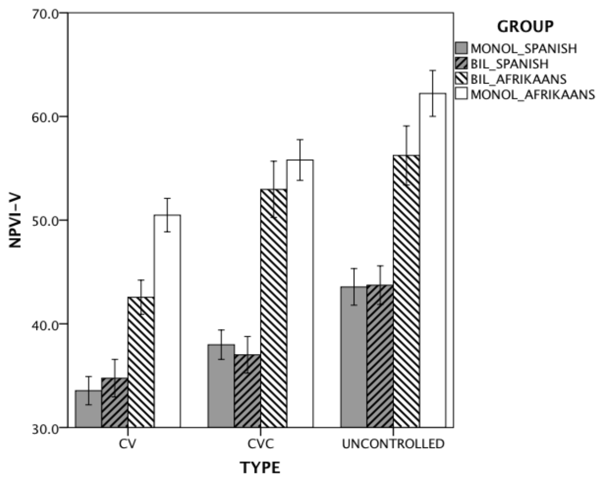

Table 3: Pairwise comparison results for NPVI-V.

	Mono_Sp	Bil_Sp	Bil_Afr	Mono_Afr
Mono_Sp		n.s.	***	***
Bil_Sp			***	***
Bil_Afr				**
Mono_Afr				

Our fourth metric was RPVI-C, plotted in Figure 4. Similar to the NPVI-V data, the CV sentences show lower scores than the CVC and uncontrolled sentences. The Spanish monolinguals also have lower scores than the Afrikaans monolinguals. The bilingual speakers displayed Spanish-like values in Spanish and Afrikaans-like values in Afrikaans. The LMEM returned significant effects for the fixed factors SENTENCETYPE (F(2, 372.767)=52.247, p≤.001) and GROUP (F(3, 31.744)=51.534, p≤.100).

Significant comparisons between levels of GROUP are summarized in Table 4.

Figure 4: Mean RPVI-C values.

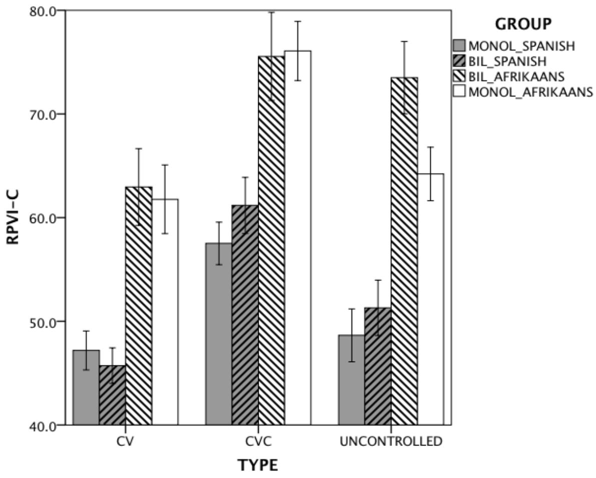

Table 4: Pairwise comparison results for RPVI-C.

	Mono_Sp	Bil_Sp	Bil_Afr	Mono_Afr
Mono_Sp		n.s.	**	**
Bil_Sp			***	**
Bil_Afr				n.s.
Mono_Afr				

4. DISCUSSION

Our results show that the Spanish and Afrikaans monolingual speakers behaved as expected: the Spanish controls generally had higher %V and lower ΔC, NPVI-V, and RPVI-C values than the Afrikaans controls. As for the bilingual speakers, their Spanish data generally patterned with the Spanish monolinguals and showed little influence from their first language, Afrikaans. The bilinguals' data for Afrikaans showed a different pattern. For the two vowel metrics, we saw two seemingly divergent trends. On the one hand, they displayed Afrikaans-like values in Afrikaans for the %V metric. On the other hand, they displayed intermediate values in Afrikaans for the NPVI-V metric. For the two consonant metrics, we observed little influence from Spanish such that the bilinguals' ΔC and RPVI-C values patterned with the Afrikaans monolinguals.

We argue that the observed discrepancy between vowel and consonant metrics results from the fact that the Afrikaans phonological grammar controls vowel duration (Afrikaans has phonemic vowel length, stress-sensitive vowel reduction, and lengthening processes), whereas neither Spanish nor Afrikaans uses phonemic consonant length. This result shows that the extent of rhythmic influence between languages can depend on other aspects of their phonological grammars. As for the differences between %V and NPVI-V, we note that NPVI-V measures variability in vocalic interval duration within utterances. Since vowel duration is actively controlled by Afrikaans phonology, NPVI-V is a better measure of the extent to which our bilingual speakers control Afrikaans phonological grammar. %V, on the other hand, is a measure of the proportion of an utterance that is vocalic, and is not sensitive to variability in the duration of vocalic intervals. Monolingual Afrikaans speakers lengthen some intervals and shorten others. Bilinguals maintain a more constant duration for vocalic intervals, with the vocalic interval duration of these speakers approaching the average duration of vocalic intervals for monolinguals. Though bilingual speakers show less variability in interval duration, the vocalic proportion of an utterance is hence roughly equal for the two speaker groups.

Contrary to our expectations, we did not find evidence for a bidirectional rhythmic influence between L1 and L2—the bilingual speakers' L1 (Afrikaans) was rhythmically influenced by their L2 (Spanish), but their L2 showed less evidence for influence from their L1. We attribute the lack of Afrikaans influence on Spanish to the fact that our speakers have been living in a Spanish-dominant environment for at least two-thirds of their lives, also confirmed by their BLP dominance scores [4]. This shows that the dominance relationship between a bilingual speaker's languages can influence the extent of influence between the two languages.

Regarding methodological implications, we note that the syllabic composition of stimuli do affect the empirical results of rhythm metrics [2, 18]. In our study there was a consistent effect of the factor SENTENCETYPE in all of our LMEMs, with especially robust data dispersions between "simpler" CV sentences and "more complex" CVC sentences. Because of this, it is critical that future research on bilingual speech rhythm control for the syllabic structure of stimulus material.

5. CONCLUSION

To conclude, our study shows the usefulness of implementing multiple rhythm metrics for understanding between-language timing differences in the phonological grammars of bilingual speakers. It also shows that the extent of between-language influence depends on factors such as the usage dominance relationship between the languages, and the finer details of the phonological grammars of the two languages (e.g., phonological processes, such as vowel reduction and lengthening, that control the durational properties of an utterance).

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