The production of Spanish vowels by early and late Spanish-English bilinguals

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Abstract

We examine the production of the Spanish vowels [a,e,i] by two groups of Spanish-English bilinguals plus a control group from the same dialectal area. The bilinguals differed in their age of onset of acquisition of English; the early bilinguals acquired English before puberty and the late bilinguals after puberty. Participants read a list of words containing the target sounds controlled by position, stress and phonetic context. Formant values (F1 and F2) were measured at 3 points in each vowel, to investigate diphthongization. We hypothesized that early bilinguals' production of vowels would exhibit (i) fronting, (ii) diphthongization and (iii) reduction, following the English norm. Hypotheses (i) and (ii) were confirmed. We discuss the influence of age of arrival on bilinguals' performance.

Key words: Spanish-English bilingual, Spanish vowel, acoustic analysis, attrition.

Introduction

Bi-directional influences have been documented at all linguistic levels, including phonetics and phonology (Antoniou *et al.* 2011), and Spanish-English bilinguals are not an exception (e.g. Bradlow 1995). The debate centers on whether maturational constraints and age of onset of acquisition (AOA) are responsible for such influences. If maturational approaches are correct (Abrahamsson & Hyltenstam 2009), early bilinguals (heritage speakers) are expected to behave as late bilinguals (long term immigrants), since both acquired Spanish before puberty. However, if AOA affects the perception and production of sounds, then early bilinguals exposed to English from birth, and with limited exposure to Spanish, will have difficulties producing native-like Spanish contrasts due to reduced Spanish input and intense contact with English.

If age of onset of bilingualism affects the production of sounds, we hypothesized that early bilinguals will: (i) produce front vowels with a more fronted tongue position (following the English norm) relative to the tongue position for the Spanish vowels (Bradlow 1995); (ii) Exhibit a higher degree of diphthongization. iii) Have greater differences in duration between stressed and unstressed vowels. On the other hand, late bilinguals who acquired the L2 past puberty should behave closer to the attested monolingual patterns (MacKay *et al.* 2001).

Method

To determine the relative role of maturational constraints and AOA, we studied two groups of bilinguals who spoke Spanish from birth but differed in their age of onset of acquisition of English. Whereas the early bilinguals were exposed to English during early childhood and received formal education in English, the late bilinguals were exposed to English after puberty and were educated in Spanish. A total of twenty-four participants (n=24) participated in the study: 12 early bilinguals (mean AOA=2.5; mean length of residence= 21.2), 6 late bilinguals (mean AOA=24.3; mean length of residence=14.5) from El Paso, Texas, and a group of 6 monolinguals from Chihuahua – Mexico.

We examined the production of Spanish vowels [a], [e], [i] preceded by either voiceless or voiced stops in stressed and unstressed syllables. Subjects read real words (n=112) in a carrier phrase *Digo X para ti* ('I say X for you'). The acoustic dimensions analysed were vowel formants (normalized using the Nearey 1 method), measured at different time points (25, 50 and 75%) into the vowel to detect diphthongization, and relative duration of the unstressed vs. stressed vowels.

The degree of diphthongization was measured by using the formula:

$$D = \sqrt{(F1_{25} - F1_{75})^2 + (F2_{25} - F2_{75})^2}$$

Where $F1_{25}$ and $F2_{25}$ are the values of F1 and F2 measured 25% into the vowel, and $F1_{75}$ and $F2_{75}$ are the values of F1 and F2 measured 75% into the vowel. The different groups were compared using one-way ANOVAs.

Results

Hypothesis i) was confirmed for /i/. Early bilinguals have a significantly higher normalized F2 (thus more fronted /i/) than late bilingual and monolingual speakers (Table 1 and Figure 1). This effect was not found in /a/ or /e/, where groups are clustered together. However, the lack of variation in /a/ and /e/ should be taken with caution, since the normalization method could have erased important variation in these vowels.

Hypothesis (ii) was confirmed for /a/ and /i/. Early bilinguals more frequently diphthongize /a/, while late bilinguals do the same with /i/ (Table 2). Stress does not seem to affect this trend.

Table 1. Normalized F2 values for [a], [e] and [i] measured at vowel midpoint.

	[a]		[e]		[i]	
	mean	SD	mean	SD	Mean	SD
Early biling.	0.93	0.06	1.07	0.06	1.16	0.11
Late biling.	0.94	0.05	1.07	0.07	1.14	0.13
Monolingual	0.94	0.06	1.07	0.06	1.12	0.10
p-value	0.001		0.82		<0.001	

Table 2. Change in normalized F1-F2 distance from 25% to 75% of the vowel duration.

	[a]		[e]		[i]	
	mean	SD	mean	SD	Mean	SD
Early biling.	1.23	1.12	1.05	1.24	1.29	1.53
Late biling.	1.17	1.03	1.04	1.02	1.82	2.09
Monolingual	1.06	0.85	0.83	0.64	1.00	1.08
p-value	0.03		0.07		<0.001	

Hypothesis (iii) was rejected. Early bilinguals' relative duration of unstressed vs stressed vowels is similar to those of monolinguals. Yet, late bilinguals produce significantly larger differences between stressed and unstressed vowels.

Our results suggest that reduced Spanish input and intense contact with English affect the production of vowels. Bilingual speakers produced /i/ with a more fronted articulation and /e/ and /a/ with a higher degree of diphthongization compared to monolinguals. It is possible that bilinguals have established a common phonetic category for Spanish /i/ and English /i/, which is shown by its shift towards the front. However, since /e/ and /a/ could be mapped to different English vowels (/e, ɪ, ɛ/ and /æ, ɒ, ʌ, ɛ/, respectively) (Morrison 2003), it is possible that new phonetic categories were created for the English vowels, leaving the Spanish ones unaffected. Late bilinguals' reduced difference in the duration of stressed and unstressed vowels compared to monolinguals and early bilinguals was unexpected. Yet, research has shown that increased use of L2 is associated with inhibition of L1 (Linck et al., 2009), which may result in movement away from the native norm.

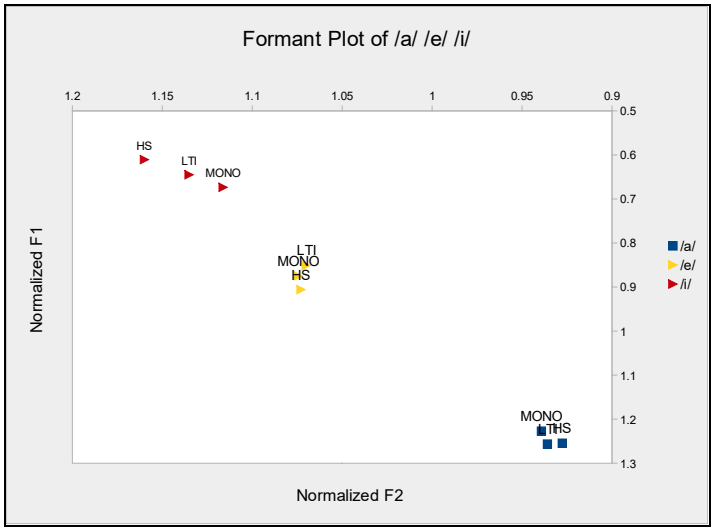

Figure 1. Scatterplot of /a, e, i/ for all three groups.

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