/u/-FRONTING IN ENGLISH SPEAKERS' L1 BUT NOT IN THEIR L2

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ABSTRACT

This paper presents an acoustic analysis of the three corner vowels in the Diapix Foreign Language corpus (DIAPIX-FL) which contains material from English and Spanish native speakers from both their L1 and L2. We investigated how L1 vowel characteristics influence the production of L2 vowels, and to what extent a current sound change in one of the languages is reflected in the other. We find that /u/-fronting in English occurs for both native and non-native speakers, although the degree of /u/-fronting is much larger for the English group. English speakers appear to create a separate category for the L2 /u/ rather than use their L1 sound. Spanish speakers show some adjustment to their English /u/ and /a/ realisations. These findings suggest that despite limited exposure to the L2 sounds, learners are aware of realisational differences between the languages and implement them to different degrees even for non-standard variants.

Keywords: /u/-fronting, L1, L2, non-native

1. INTRODUCTION

The influence of the L1 phonetic system on L2 speech is well established [14, 21, 8, 9, 2, 3, 15, 13]. For instance, an L2 sound which is quite similar to an L1 category is likely to be perceived as equivalent to the L1 category and therefore it is particularly difficult for learners to separate the two, both in perception and in production [8, 13].

The current study investigates the extent to which speakers adapt their vowels from L1 to L2 norms or alternatively to what degree speakers adhere to L1 vowel characteristics during L2 vowel production. The DIAPIX-FL corpus [23] provides a dataset to explore this issue. In [23] several suprasegmental and acoustic parameters were found to distinguish speakers when speaking in their L1 versus their L2. At a segmental level, given that the speakers of the DIAPIX-FL corpus are upper-intermediate learners (CEFR level of B2 or C1) in a non-immersion setting, we would expect to find noticeable L1 interference in their consonant and vowel realisations, particularly for sounds which are similar in the two languages. In order to test this hypothesis, in the present paper we analyse the production of three corner vowels in the two languages by speakers both in their L1 and in their L2. For brevity we denote the three corner vowels /æ, iː, uː/ using the symbols /a, i, u/ throughout this paper. In particular, we were interested in the realisation of L2 /u/, given the current disparity in the characteristics of this vowel in British English and Spanish as detailed below.

Spanish /i, u/ are described as having similar F1 values but are clearly differentiated in F2. Gil Fernández [10] describes Spanish /u/ as more retracted and lower than cardinal /u/, in agreement with the very low F2 values mentioned by Quilis and Esgueva [17]. The latter mention F2 values for /i/ between 2300 Hz and 2800 Hz for male and female speakers respectively whereas /u/ has F2s around 670 Hz for males and 630 Hz for females. The analysis of Martínez and Fernández [16] also shows a radical differentiation according to F2 values for the two vowels, somewhat less extreme due to their higher F2 values for /u/, but still nowhere near /i/, with males producing a mean F2 of 2200 Hz for /i/ and 877 Hz for /u/, with corresponding values of 2700 and 940 Hz for females.

Traditional descriptions of English /i, u/ match the above F2 differences. Wells' 1962 study [22] of male RP speakers found high F2 values for /i/ (2373 Hz) and much lower values for /u/ (939 Hz). Hawkins and Midgley's comparable data (i.e., those corresponding to their older male speaker groups) [12] were compatible with these values (F2 /i/ = 2283 Hz ; /u/ = 994 Hz). Deterding [6] presents formants for both female and male SSBE speakers recorded in the 1980s, finding an average female F2 of 2652 Hz for /i/ and 1437 Hz for /u/, with values of 2249 Hz and 1191 Hz for males. Generally, F2 values for /i/ are very comparable to Spanish, while the F2 values for /u/ are slightly higher in English than in Spanish.

Nowadays, however, /u/ is fronted in many varieties of English. For younger speakers of Standard Southern British English (SSBE) /u/ is phonetically fronted and the coarticulatory influence of consonants on /u/ is less than in older speakers [11]. A higher F2 in /u/ produced by younger speakers has been measured [12]. In Scottish English there is an even stronger basis for “back” /u/ to be reconsidered as central or front [19, 20, 18].

In this paper, we compare the three corner vowels produced in task-based dialogues by 10 English and 10 Spanish female speakers. The English speakers recorded are of a generation in which /u/-fronting is likely to be present. However, as with any on-going sound change, these speakers are also familiar with non-fronted realisations of this vowel, so that their perceptual categories will include both fronted and non-fronted /u/ realisations.

We addressed the following research questions: (1) Do English speakers apply a current sound change to an L2 vowel which is similar to the canonical vowel in their L1? (2) Do Spanish speakers of English reflect recent sound changes despite limited contact with native speakers?

2. METHOD

2.1. The DIAPIX-FL corpus

A subset of the DIAPIX-FL corpus [23] was chosen to support an acoustic analysis of vowels. The original DIAPIX task [1] was designed to elicit conversational speech from pairs of speakers attempting to spot differences in simple pictures. DIAPIX-FL uses the same picture-based task to collect speech from participants speaking in their L1 or in an L2. Use of pictures as prompts permits the same level of task difficulty for both languages. [23] describes the elicitation and analysis of a corpus collected using DIAPIX-FL for two cohorts of speakers, one group of native English learners of Spanish, the other a group of native Spanish learners of English, both studying the language at university level. In separate sessions each group undertook the DIAPIX-FL task in both their native and non-native language. In this way the corpus is balanced with respect to both native language and language-being-spoken, enabling the separation of L1 factors from factors related to second language speech.

2.2. Vowel labelling

The analysis of /u/-fronting in the current study is based on material produced by the 10 English and 10 Spanish female speakers in the corpus. As in [23] a one-minute sample of speech (excluding silences) from each talker speaking in each of English and Spanish was analysed, leading to a total sample of 40 minutes of speech.

Table 1: Top five most frequently occurring words in Spanish and English for native (N) and non-native (NN) speakers.

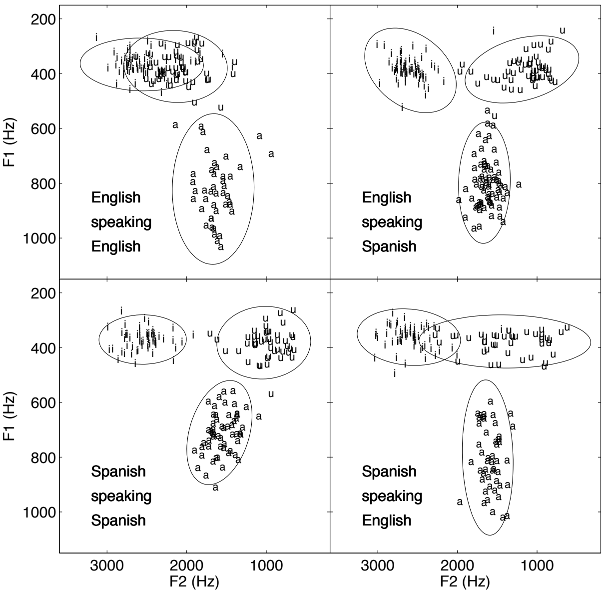
Sp/En	N/NN	/i/	/u/	/a/
Sp	N	sí	azul	está
		chica	una	abajo
		chico	justo	lado
		y	dibujo	más
		asi	cubo	debajo
En	NN	sí	azul	está
		dice	una	para
		y	mujer	la
		chica	un	nada
		chico	sus	ventana
Sp	NN	three	two	man
		green	blue	rackets
		see	to	bags
		he	shooting	has
		tree	shoes	can
En	N	green	two	bags
		three	blue	bag
		tree	shoes	black
		pea	whose	shack
		people	shoot	standing

Vowel midpoints were labelled by two native speakers of the respective languages. Instructions to the labellers were to mark midpoints of the three vowels: /a/, /i/, and /u/, to find at least 3 examples of each vowel per speaker/language, to aim for stressed syllables, to locate clear examples of the vowel (e.g., not conversationally reduced) and to avoid following /r/. Table 1 gives examples of the most frequent words that occurred in the dialogues containing one of the three vowels. Frequencies of the first three formants at vowel midpoints were estimated using PRAAT [4]. A proficient bilingual speaker with a background in acoustic-phonetics checked both the location of all vowel midpoints and the reliability of the formant estimates for speech material in both languages. Some 674 vowels instances were marked, corresponding to a mean of 5.62 tokens per vowel per talker per language condition.

2.3. Participants

Participants were aged between 18-22 at the time of recording. Eight of the 10 English speakers lived in their place of birth (4 S. England, 1 N. England, 3 Scotland) before moving to Edinburgh in the previous 1-2 years. Two speakers spent part of their life in France and Singapore respectively. All of the na-

Figure 1: English (top) and Spanish (bottom) speakers' /a/, /u/ and /i/ F1 - F2 plots when speaking natively (left) and non-natively (right).



tive English speakers are of an age that /u/-fronting is a likely characteristic of their vowel production. Spanish participants were either Spanish monolinguals or Spanish-Basque bilinguals. All grew up and lived in the Spanish Basque country. Northern Spanish and Basque have identical vowel systems.

3. RESULTS

Fig. 1 shows F1/F2 values for each vowel instance from both groups of speakers while speaking in their L1 or L2. Ellipses represent 95% confidence intervals for each vowel. Table 2 lists the mean formant values for F1, F2 and F3 averaged across all tokens and speakers for each vowel in each condition. In the case of F1 and F2 these values correspond to the centres of the ellipses in Fig. 1.

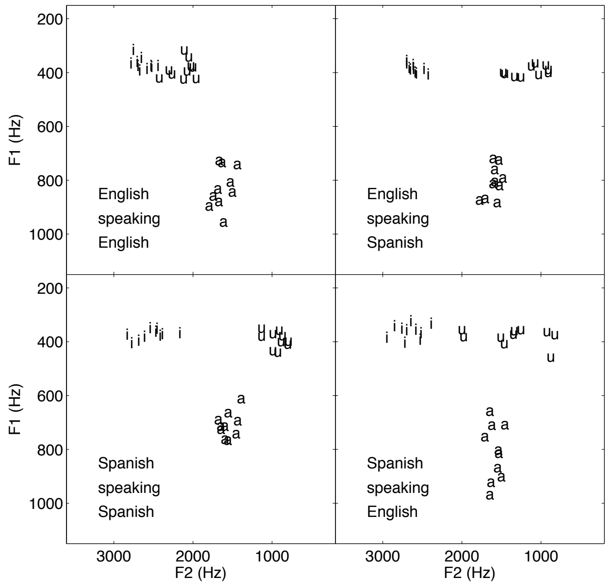
Table 2: Mean formant frequencies

Vowel	Formant	En		Sp	
		N	NN	N	NN
	F1	821	798	710	801
/a/	F2	1667	1661	1589	1619
	F3	2807	2874	2725	2717
	F1	367	388	373	362
/i/	F2	2564	2589	2553	2609
	F3	3133	3163	3091	3166
	F1	374	385	382	377
/u/	F2	2140	1189	1032	1403
	F3	2809	2824	2718	2769

It is immediately clear that English talkers speaking in their L1 show widespread /u/-fronting: F1 and F2 values for tokens of /u/ and /i/ are heavily-overlapped. However, when speaking in their L2 the same talkers maintain almost complete separation at the token level. F1/F2 values for /u/ vowels from Spanish speakers when producing English show considerable variation, with some overlapping into the region occupied by /i/.

Some further interesting trends can be seen in Fig. 1. Speaking Spanish whether natively or not results in more compact groups. Speaking English natively or non-natively produces a clear F1 spread for /a/. A similarly large F1 spread for /a/ in English was also found in [5].

Figure 2: Per-talker median formant frequencies.



Vowel locations plotted in Fig. 1 do not identify contributions made by individual speakers, and hence cannot be used to distinguish across-speaker variation from across-token variation. Fig. 2 plots median F1/F2 values per speaker, clarifying some of the trends identified above concerning compactness, dispersion and overlap of vowel clusters. In particular, Spanish /u/ and /a/ productions show considerable variation across individuals. In the case of /u/, it is notable that two Spanish speakers produce more fronted values for this vowel when speaking English. Similarly there is substantial variation in F1 values for /a/ for this group when speaking English. However, much of the diversity of English /a/ production by the English speakers is due to across-token variability. It is intriguing to note that while individual exemplars of English /i/ and /u/ produced by English speakers show considerable overlap (Fig. 1), median per-speaker F1/F2 values remain separated (Fig. 2).

Mixed-effects ANOVAs (within-subjects: language being spoken, between-subjects: L1) were carried out for each vowel and each formant, including F3. For /u/, F2 frequency differed depending upon the language being spoken $[F(1,18) = 70.4, p < .001]$ and the L1 of the speaker cohort $[F(1,18) = 41.4, p < .001]$, with a significant interaction between the two factors caused by the fact that the degree of /u/-fronting is much larger for the English group. Neither F1 nor F3 frequency showed significant effects of these factors. For /a/, F1 is affected by the language-being-spoken $[F(1,18) = 11.4, p < .01]$; this factor also interacts with cohort L1 due to the value for the Spanish group being significantly lower when speaking natively. No effect of F2 nor F3 was observed. All three formants of /i/ show small effects of the language-being-spoken. F1 is 4-5% higher for both groups when speaking Spanish $[F(1,18) = 7.22, p < .05]$ while F2 and F3 are 5 and 3% lower respectively for Spanish speakers speaking natively $[F2 : F(1,18) = 10.3, p < .01; F3 : F(1,18) = 5.34, p < .05]$.

Two further analyses were performed to check for possible word selection and frequency effects. In the first case we were interested in whether any differences in the words employed by native and non-native speakers (e.g., due to differences in linguistic complexity) might influence the outcome. Mean formant values were recomputed based on the subset of words common to both L1 cohorts. In all but two cases formant values are identical to within 5%. For Spanish speaking natively, the F2 for /u/ is nearly 8% lower when only words in common are considered (954 vs 1032 Hz); that is, Spanish /u/ is even less fronted. For Spanish speaking non-natively, the F1 of /a/ is 6% higher (852 vs 801) for words in common. Second, we checked whether formant estimates are biased by over-representation of frequent words in the corpus. Four words [Spanish "si" and English "three", "green" and "two"] occur more frequently than once-per-talker. Reducing the number of occurrences of these words to one-per-talker (i.e., 20 in all) has negligible effects on formant estimates (largest change of just over 2%).

4. DISCUSSION

Our results indicate that for /u/ – and to some extent /a/ too – English speakers show sensitivity to the different quality of this sound in Spanish, with realisations which resemble the L2 native norms and also values found for this sound in other regional and generational L1 accents. This degree of adaptation suggests that learners are creating a separate category for the L2 back vowel rather than using their L1 realisation. Alternatively, speakers might be adapting to the L2 values in their productions based on the extent of their L1 category [7]. Further investigations with categorisation tests are needed to ascertain whether these distinct L2 vowels are separate L2 categories or realisations of the L1 categories.

Adjustment is also found in the English /u/ produced by Spanish L1 speakers, but to a lesser extent. This asymmetry could be due to the fact that English speakers' adaptation goes towards more canonical values whereas Spanish speakers find an unexpected fronted target in the L2; it may also be that these Spanish learners do not have very much exposure to native speakers of their own generation, or caused by the more arduous task of English vowel acquisition which confronts Spanish L1 learners, prompting them to disregard realisational differences.

The large spread in English /a/ was also reported by de Jong et al. [5], who investigated whether the formants of vowels undergoing diachronic sound change were better predictors of a speaker's identity than stable vowels. In their study, /a/ and /u/ are seen as changing vowels (in SSBE), whereas /i/ is seen as a relatively stable vowel. They find that non-stable vowels are better for speaker discrimination. Sounds that are undergoing diachronic sound change are likely to show more individual variation making them better for distinguishing between speakers. Our data also show a large degree of variation in F1 for English /a/. The English and Spanish speakers display some sensitivity to this with more compact F1 values in Spanish and a wider spread in English.

5. CONCLUSIONS

An acoustic analysis of the three corner vowels spoken by English and Spanish native speakers in both their L1 and L2 demonstrates that both English and Spanish speakers adapt their L2 vowel production more to L2 native norms than to their L1 norms. In particular, an on-going English vowel change is not transferred to the L2 Spanish, while L1 Spanish learners show indications of incorporating this new realisation. At the higher-intermediate level of competence analysed and despite restricted exposure to contemporary native input, we found considerably less direct L1 transfer than expected for "similar" sounds which are considered the most problematic in L2 acquisition.

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