

# When over-reliance on duration does not mean perceiving duration differences

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## 1 Introduction

Previous research has shown that native speakers of English rely mainly on spectral differences in the identification of the tense-lax contrast /i:/-/ɪ/, although this contrast also presents a salient difference in duration (Cruttenden 2001: 109). However, Spanish monolinguals and Spanish/Catalan bilinguals have been found to rely mainly on temporal cues in the categorization of /i:/-/ɪ/ (Bohn 1995; Cebrian 2007, 2006; Escudero & Boersma 2004; Mora & Fullana 2007). With regard to the voicing contrast /s/-/z/, English listeners' identification is based mainly on the ratio between the duration of the preceding vowel and the duration of the following fricative consonant (Flege & Hillenbrand 1986). Spanish/Catalan learners of English have been shown to make use of both vowel and fricative duration in the production of this contrast, but to a lesser extent than native English listeners (Fullana & Mora 2007). The present study aims at investigating the extent to which Spanish/Catalan learners of English rely on duration as a phonetic cue in these two different phonetic contexts. The ultimate objective of this study is to propose teaching tools that may help learners inhibit or enhance their sensitivity to duration cues in different phonetic contexts. This study is preliminary work to the evaluation of the effect of the proposed teaching strategies.

## 2 Research questions and hypotheses

*To what extent do Spanish/Catalan learners of English rely on duration as a perceptual cue? We hypothesize that Spanish/Catalan learners of English will rely on duration to a greater extent than native listeners in the categorization of /i:/ and /ɪ/, but that will not rely on this phonetic cue to the same extent as native listeners in the categorization of /s/ and /z/ in word-final position. The reason for this is the different degree of perceptual salience of duration in the two contexts. In the /i:/-/ɪ/ context spectral cues are not perceived by Spanish/Catalan learners because of perceptual assimilation of both these sounds to the Spanish/Catalan /i/. In the /i:s/-/i:z/ context, Spanish/Catalan learners probably attend to voicing cues in the categorization of these contrasts. This is due to the fact that in Catalan and Spanish closure voicing is distinctive in non-word-final position.*

## 3 Method

### 3.1. Participants

The participants in this study were 38 Spanish/Catalan bilinguals, advanced learners of English taking a degree in English Studies at the University of Barcelona, and 13 native speakers of Southern British English.

### 3.2. Stimuli

The effect of vowel duration manipulation on Spanish/Catalan learners' perception of the tense-lax contrast /i:/-/ɪ/ was examined through a perceptual identification task using stimuli drawn from *feet-fit* vowel duration continua. The effect of vowel and fricative duration manipulation on the learners' perception of the voicing contrast /i:s/-/i:z/ in word-final position was assessed in the same way using stimuli drawn from *peace-peas* vowel/fricative duration continua. All the words were recorded in a sound-proof booth by a native speaker of Southern British English, and were repeated ten times each in the carrier-phrase "I'll say \_\_\_\_". Vowel duration in *feet and fit* and both vowel and fricative

duration in *peace* and *peas* were measured with Praat (Boersma & Weenink 2007). In order to select the tokens that were finally manipulated, the mean duration of all the segments was calculated. The items whose duration was closest to the mean were chosen for duration manipulation. The stimuli were normalised for peak amplitude and pitch movement (F0). 8 continua of 8 equidistant steps were created using Praat (see Table 1).

Continua	Word	Sound/s manipulated	Duration (ms)
C1	<i>feet</i>	/i:/	shortening
C2	<i>fit</i>	/ɪ/	lengthening
C3	<i>peace_v</i>	/i:/	lengthening
C4	<i>peas_v</i>	/i:/	shortening
C5	<i>peace_f</i>	/s/	shortening
C6	<i>peas_f</i>	/z/	lengthening
C7	<i>peace_s</i>	/i:/+/s/	leng.+ short.
C8	<i>peas_s</i>	/i:/+/z/	short. + leng.

Table 1. 8 continua of 8 equidistant steps.

### 3.3. Materials and Procedures

The perception test was designed using DMDX display software. It consisted of an identification (ID) task made up of 640 randomized trials (8 continua x 8 stimuli per continuum x 10 repetitions). The test consisted of four lexical-decision tasks in which participants were presented with a stimulus and were asked to choose between two items (*feet* or *fit* and *peace* or *peas*). The stimuli were presented both aurally and by showing the written word displayed on the screen. In addition, a picture of each item was included to minimise possible orthographic effects. Each item was presented within 1.5 seconds; if the subjects failed to answer the next item was presented within 5 seconds. In addition response latencies were registered. Instructions to perform the task were given on the computer screen; participants were asked to respond as quickly and as accurately as possible, and the tokens were heard via headphones that allowed for volume adjustment.

### 4 Data analysis and results

The mean scores and response latencies obtained from subjects' responses in the 4 sections of the lexical decision task were submitted to an ANOVA with Stimulus as a within-subject variable and L1 (English-Spanish/Catalan) as the between-subjects factor. The effect of duration manipulation on subjects' responses (independently for the two language groups) along the 8 continua was assessed through a series of repeated measures ANOVAs.

The Stimulus x L1 interaction was non-significant for all continua. Duration manipulation (as measured by the Step 1 minus Step 10 differential "duration effect score") had a significantly greater effect on non-native speakers' (NNSs) identification scores than on native speakers' (NSs) (see figures 1, 2, 3, 4, 5, 6, 7, and 8 for mean % ID and the "duration effect score" column in Table 2). The Identification scores obtained were submitted to a series of ANOVAs with stimulus as the within-subjects factor. The results revealed significant differences in the effect of duration manipulation within groups (see Table 2). For NNSs further Bonferroni-adjusted multiple comparisons revealed significant differences among steps along the continua at a 5-step distance (i.e. 80 ms.). Although duration manipulation did not have a significant effect within the NSs group, response latencies increased in all continua (except in C3 *peace\_v*). These results suggest that for NNSs vowel categorization was affected by a duration manipulation of 80 ms, whereas

for NSs changes in response latencies suggested that difficulty in the lexical decision task increased as a result of duration manipulation.

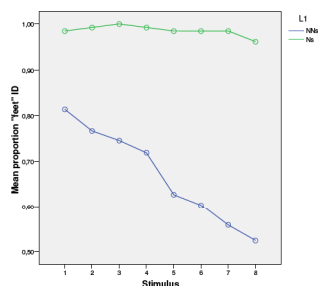


Fig. 1. *feet*

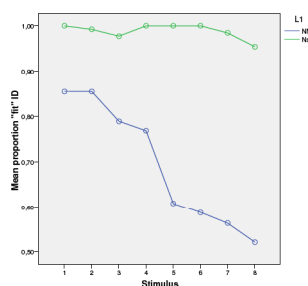


Fig. 2. *fit*

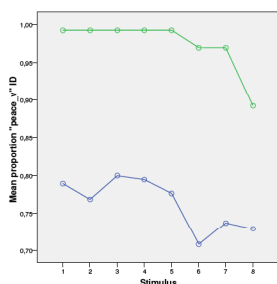


Fig. 3. *peace\_v*

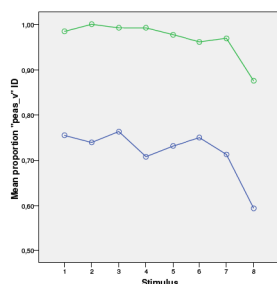


Fig.4. *peas\_v*

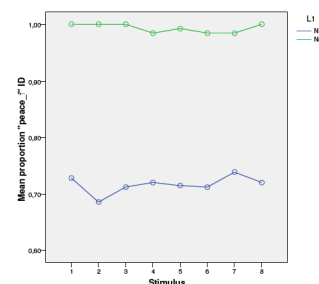


Fig. 5. *peace\_f*

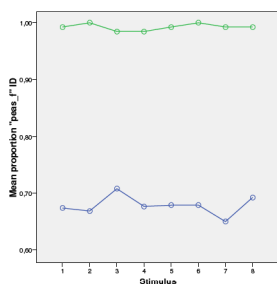


Fig. 6. *peas\_f*

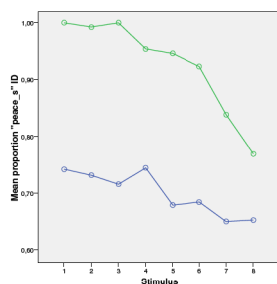


Fig.7. *peace\_s*

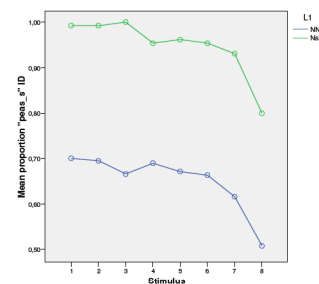


Fig. 8. *peas\_s*

Continua	NSs' DES	NNSs' DES	NSs	NNSs
C1 <i>feet</i>	0.02	0.29	$F(7, 6) = 1,79, p = .246$	$F(7, 31) = 5.54, p = <.001$
C2 <i>fit</i>	0.05	0.33	$F(4, 9) = 1.70, p = .232$	$F(7, 31) = 4.93, p = .001$
C3 <i>peace_v</i>	0.10	0.06	$F(6, 7) = 1.58, p = .279$	$F(7, 31) = 2.39, p = .044$
C4 <i>peas_v</i>	0.11	0.16	$F(7, 6) = 2.13, p = .188$	$F(7, 31) = 2.74, p = .024$
C5 <i>peace_f</i>	0.00	0.01	$F(4, 9) = 1.0, p = .456$	$F(7, 31) = 0.94, p = .485$
C6 <i>peas_f</i>	0.00	-0.02	$F(3, 10) = 1.0, p = .432$	$F(7, 31) = 9.91, p = .456$
C7 <i>peace_s</i>	0.23	0.09	$F(6, 7) = 3.07, p = .084$	$F(7, 31) = 1.73, p = .137$
C8 <i>peas_s</i>	0.19	0.19	$F(6, 7) = 2.86, p = .097$	$F(7, 31) = 1.04, p = .424$

Table 2. Mean "Duration Effect Scores" (DES) and results of within-subjects ANOVAs.

### 5 General discussion and proposals

The results for the tense-lax contrast /i:/-/ɪ/ indicated that Spanish/Catalan learners relied on duration to a greater extent than the native speakers group. These findings are in agreement with previous research suggesting that Spanish/Catalan learners rely mainly on duration in the identification of this contrast, as opposed to native English listeners. As regards the results of the voicing contrast /i:s/-/i:z/, the findings suggest that duration manipulation of the vowel and the final fricative separately had no effect on either Spanish/Catalan learners or native English listeners' identification. However, where the duration of both segments is manipulated simultaneously, an effect can be

observed on native English listeners' perception. This supports previous research which has demonstrated that native listeners make use of the duration ratio between the preceding vowel and the fricative to categorize /s/-/z/ in word-final position. This effect was most noticeable in the simultaneous duration manipulation of C7 *peace\_s* and, to a lesser extent, in C8 *peas\_s*. On the contrary, simultaneous duration manipulation of these two continua had a considerably lesser effect on Spanish/Catalan learners' identification. These results bring forward two main problems regarding Spanish/Catalan learners of English use of duration as a phonetic cue. Firstly, learners have difficulties perceiving the tense-lax vowel contrast accurately because they over-rely on duration cues and are insensitive to vowel quality differences. Secondly, learners present perceptual deafness to allophonic vowel duration differences as a cue to voicing in (de)voiced word-final obstruents.

We propose some teaching strategies that might suppress learners' over-reliance on duration in tense-lax vowel contrasts, while enhancing their reliance on allophonic length differences as a cue to voicing in word-final position. Duration should be treated as an irrelevant contextual phenomenon in the first case, and as a useful one in the second case. With this in mind, it is our intention to implement some specific teaching strategies. These include lexical decision tasks presenting vowel contrasts (e.g., *cap-cup*; *sheep-ship*; *fool-full*) in which vowel duration is neutralised. The stimuli will be presented aurally, including a set of pictures and written words, avoiding the use of the length diacritic in tense vowels. This might de-emphasise length differences between tense-lax contrasts, and make learners focus on qualitative differences. With regard to voicing contrasts, lexical decision tasks will also include a set of aural stimuli (e.g., *rope-robe*; *ice-eyes*; *mate-made*) and a series of pictures. Additionally, the contrasts will show devoicing and length differences in word-final position through narrow phonetic transcription. This might draw the learners' attention to duration differences in these contexts.

## 6 References

- Boersma, P. & Weenink, D. (2007). Praat: doing phonetics by computer (version 4.6.15) [Computer program], <http://www.praat.org/>
- Bohn, O. S. (1995). Cross-language speech perception in adults: First language transfer doesn't tell it all. In W. Strange (Ed.), *Speech perception and linguistic experience* (pp. 279-302). York Press, Baltimore.
- Cebrian, J. (2006). Experience and the use of duration in the categorization of L2 vowels. *Journal of Phonetics*, 34, 372-387.
- Cebrian, J. (2007) Old sounds in new contrasts: L2 production of the English tense-lax vowel distinction. *Proceedings of the 16<sup>th</sup> International Congress of the Phonetics Sciences*, Saarbrücken, Germany.
- Cruttenden, A. (2001). *Gimson's Pronunciation of English* 6<sup>th</sup> ed. London: Arnold Publishers.
- Escudero, P. & Boersma, P. (2004). Bridging the gap between L2 speech perception research and phonological theory. *Studies in Second Language Acquisition*, 26, 4: 551-585.
- Flege, J. E. & Hillenbrand, J. (1986). Differential use of temporal cues to the [s-z] contrast by native and non-native speakers of English. *Journal of the Acoustical Society of America*, 79, 508-517.
- Fullana, N. & Mora, J. C. (2007). Production and perception of voicing contrasts in English word-final obstruents: assessing the effects of experience and starting age. *Proceedings of the 5<sup>th</sup> Symposium on the Acquisition of Second Language Speech, New Sounds 2007*, pp. 207-221. Federal University of Santa Catalina, Brazil.
- McAllister, R., Flege, J. E., & Piske, T. (2002). The influence of the L1 on the acquisition of Swedish vowel quantity by native speakers of Spanish, English and Estonian. *Journal of Phonetics*, 30, 229-258.
- Mora, J. C. & Fullana, N. (2007). Production and perception of English /ɪ-/ɪ/ and /ɔ/-/ɔ/ in a formal setting: Investigating the effects of experience and starting age. *Proceedings of the 16<sup>th</sup> International Congress of the Phonetic Sciences*, pp. 207-221. Saarbrücken, Germany.