# Rating Accented Speech on Continua: Nativeness in Speech Production in Highly Proficient Bilinguals

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## 1. Introduction

The level of proficiency of a bilingual, in her second language, is generally understood as a relative and continuous phenomenon, which varies from one individual to the next (Birdsong, 2006), depends on a great number of factors (Piske et al., 2001) and affects both production (Flege et al., 1995, 1999; Fowler et al., 2008; Oyama, 1976; Piske et al., 2002) and perception (Flege & MacKay, 2004; Pallier et al., 1997; Sebastián-Gallés & Soto-Faraco, 1999). Thus, claims of the degree of influence of the first language (L1) on the second (L2) or vice versa, which are relevant to the field of phonetics and laboratory phonology, need to be carefully assessed in each case, for each individual, before any generalization can be drawn. The latter fact implies that reliable methods to asses speech performance in bilinguals are needed, and that precise methods to investigate linguistic proficiency are available.

Many different methodologies have been used to assess proficiency in bilingual populations, such as self-ratings of ability to read, write, speak and understand the L1 and L2, global ratings of 'fluency', scores obtained on vocabulary tests administered in both languages, linguistic background information, word order judgments, relative speed in carrying out commands, speed in picture-naming tasks, speed of pronunciation (or relative duration of sentences) in reading tasks and delayed repetition tasks (see Flege et al. (2002), and references therein, for a review of methods). Flege et al. (2002) used three indirect measures to assess proficiency in a group of seventy two (72) Italian-English bilinguals residing in Ottawa, Canada: (1) self-rated verbal ability in both the L1 and the L2 (ability to understand and speak), (2) self-rated written ability in both languages (ability to read and write) and (3) duration of sentences elicited through a delayed repetition technique (on the assumption that sentence durations reflect linguistic activation and possibly motor control). Sentence durations were computed as the intra-speaker ratio between sentences in English and sentences in Italian. An important goal of Flege et al. (2002) was to study the potential relationship between indirect measures of linguistic proficiency and linguistic experience or background, such as age of acquisition or first exposure to the L2, length of L2 use or length of residence in an L2-speaking country, frequency of use of the L1 vs. the L2, communicative function of the L2 (e.g. the purposes and settings), etc. The findings in Flege et al. (2002) revealed strong positive correlations between sentence durations and the results of both the verbal and written self-ratings. Also, strong correlations were found between age of first exposure to the L2 and the proficiency measures (sentence durations and self-rated ratios) and between percentage of L1 use and the proficiency ratios. In sum, "the bilinguals who were most likely to self-rate their abilities to be greater in Italian than English and to produce shorter Italian than English sentences were those who arrived in Canada as young adults and used Italian often. Conversely, the bilinguals who were most likely to self-rate their abilities to be greater in English than Italian and to produce longer Italian than English sentences were those who arrived in Canada as children and used Italian seldom" (Flege et al., 2002). Flege et al. (2002) also used "foreign" accent ratings as an indirect measure of linguistic proficiency in the Italian-English bilingual sample recruited in Ottawa. Their findings indicated strong correlations between indirect proficiency parameters (sentence duration, self-rated verbal and written abilities) and detectable "foreign" accent, which suggest that "foreign" accent ratings may be good general predictors of linguistic proficiency (Southwood & Flege, 1999). Even though linguistic dominance may ultimately only be revealed by the results of psycholinguistic and/or neurolinguistic tests (Birdsong, 2006), it seems that some assumptions may be derived from linguistic history and analyses of speech performance (Flege et al., 2002). The present paper is concerned with measuring speech proficiency in bilinguals with the indirect implication that doing so may be informative in revealing the patterns of linguistic dominance

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in these speakers, at least when combined with other tests (Birdsong, 2006). Here, we will focus on "foreign" accent rating tests.

The use of "foreign" accent ratings to assess linguistic proficiency in bilinguals seems to be widespread. Particularly, a large number of papers by Flege and his colleagues report on "foreign" accent rating experiments (Flege et al., 2002, 1995; Piske et al., 2001; Southwood & Flege, 1999). In these experiments, a group of bilingual talkers that differ along a wide array of attributes provide speech data (usually gathered in the laboratory) that are later rated by a panel of native, monolingual listeners of one of the two languages of the bilingual talkers, or both (Yeni-Komshian et al., 2000). The listeners face a computer screen displaying a five-, seven- or nine-point scale. They are instructed to select a number on the rating scale that best reflects their judgement regarding how each sentence is pronounced. The endpoint labels of the scale go from "no accent" (e.g. number 9) to "very strong accent" (number 1) (Flege et al., 1995; Piske et al., 2001). This research paradigm has proven to be very useful in revealing the many factors (and their relative weight) that affect L2 speech performance and seem to provide a good method to assess the overall degree of nativeness in bilingual speech production without the need to carry out direct acoustic analyses of L2 speech. Crucially, however, the informativeness of "foreign" accent rating tests relies on the following assumption: the raters (listeners) are very sensitive to "deviant" speech (e.g. speech that differs from the one commonly used in their speech community). Presumably, monolingual listeners are used because, since they have not been previously exposed to the native language of the "foreign" speakers, they have not developed any "tolerance" to non-native, "deviant" speech. In this type of research, the following two procedures seem to be standard: (1) monolingual raters (listeners) are used, and (2) speakers whose native language is "foreign" to the target community have their speech rated. For instance, Korean-English bilinguals have their English rated in North America, by monolingual speakers of English, and their Korean rated in Korea, by monolingual speakers of Korean (Yeni-Komshian et al., 2000). The question arises, however, as to whether "foreign" accent rating tasks are able to provide any type of information in cases where the two languages spoken by the bilingual speakers (whose speech is to be rated) are also the languages of the community. Are bilingual raters able to discriminate between native and non-native speakers who speak the two (or more) languages used in the speech community? Do bilingual speakers who have been exposed to their non-native language during childhood and have had ample opportunities to acquire their second language still display a noticeable non-native accent?

In the present study, the productions of highly proficient, early bilinguals who grew up and reside in a bilingual society are rated by some other highly proficient, early bilinguals who grew up and reside in the same community. Our participants started learning their L2 before turning 6 years of age. They all live in the Western Mediterranean island of Majorca, Spain, where Catalan and Spanish are official and used in all spheres of communication. Data from the official census of 2003 show that Catalan and Spanish share the linguistic market to very similar degrees (Villaverde, 2005). The speakers that participated in the experiments reported in the present study differed in their levels of language dominance, i.e. Catalan-dominant vs. Spanish-dominant, as determined by the language to which they were first exposed in childhood and the one that they self-reportedly use more frequently in their daily lives. In addition, all the speakers that participated in the production experiments reported here were educated through the same bilingual schooling system, which assumes that they have had ample opportunities to learn the speech patterns of their non-native language (Pallier et al., 1997).

Finally, a somewhat novel methodology is introduced that presents a significant improvement over most "foreign" accent rating experiments carried out in the previous literature. A Praat script is provided (see Appendix) that may be freely used to implement the task.

## 2. Method

### *2.1. Participants*

A language background questionnaire (LBQ) was administered to 40 Catalan-Spanish bilingual participants residing in the island of Majorca. The LBQ was based on the one used in Flege & MacKay (2004). The participants were asked questions regarding demographic information such as gender, age (year of birth), time spend outside of Majorca, and place of birth. Additionally, they were asked

**Table 1:** Sentences read aloud by the 20 Catalan-Spanish bilingual talkers

| Language | Sentence | Target vowel | Translation |
|---|---|---|---|
| Catalan | *Pren molta de t**i**l.la* | /i/ | 'S/he drinks a lot of lime tea' |
| | *Encèn sa t**e**le* | /e/ | 'S/he turns on the TV' |
| | *Dibuixa una c**è**l.lula* | /ɛ/ | 'S/he draws a cell' |
| | *És bona t**e**la* | /ə/ | 'This is good fabric' |
| | *Obri sa s**a**la* | /a/ | 'S/he opens the living room' |
| | *Viu tota s**o**la* | /ɔ/ | 'She lives alone' |
| | *Crida a(n) en T**o**lo* | /o/ | 'S/he calls Tolo (name)' |
| | *Així ho tit**u**la* | /u/ | 'He gives it this title' |
| Spanish | *No toma t**i**la* | /i/ | 'S/he does not drink lime tea' |
| | *Enciende la t**e**le* | /e/ | 'S/he turns on the TV' |
| | *Dibuja una c**é**lula* | /e/ | 'S/he draws a cell' |
| | *Es buena t**e**la* | /e/ | 'This is good fabric' |
| | *Abre la s**a**la* | /a/ | 'S/he opens the living room' |
| | *Vive muy s**o**la* | /o/ | 'She lives alone' |
| | *No llames a T**o**lo* | /o/ | 'Do not call Tolo (name)' |
| | *Así lo tit**u**la* | /u/ | 'He gives it this title' |

the following language-background questions: (1) Which language do you consider to be your native language? (2) Which language did you use to speak at home, as a child, with your family? (3) Which language do you use mostly in your daily life? (4) Rate the percentage of use of Spanish/Catalan in your daily life: (i) with family, (ii) with friends, (iii) at work/school, (iv) when shopping, (v) with strangers.

The 40 participants were classified in two groups: (1) Catalan-dominant (i.e. they answered "Catalan" to the first three questions and had higher percentages of use of Catalan than Spanish in all of the communicative settings), and (2) Spanish-dominant (i.e. they answered "Spanish" to the first three questions and had significantly higher percentages of use of Spanish than Catalan in all the communicative settings). The 20 participants in each L1 group were randomly divided into two groups: (1) a group of talkers, and (2) a group of listeners. Therefore, an equal number of bilinguals participated as talkers or listeners in each L1 group, i.e. 10 talkers and 10 listeners in the Catalan-dominant group and 10 talkers and 10 listeners in the Spanish-dominant group. All of the 20 talkers produced speech materials in both their L1 and their L2, Spanish and Catalan.

### *2.1.1. Recordings*

The recorded speech materials were based on read-aloud speech. The twenty bilingual speakers were recorded while reading the Catalan and Spanish sentences included in Table 1, out of which only the last word in each sentence was excised and used for the perceptual rating test.

The target words were selected according to the following criteria. First, all the target words were required to have an intervocalic lateral. This is so because it is known that Majorcan Catalan and Spanish laterals are phonetically different: Majorcan Catalan laterals are strongly 'dark' (or [u]-like) while Spanish laterals are 'clear' (or [i]-like) (Recasens, 2004; Recasens & Espinosa, 2005). Second, the vowel preceding the alveolar lateral was also targeted. The materials were first designed in Catalan and then translated and adapted into Spanish, using cognates. Each one of the eight vowels of the Majorcan Catalan phonological system was represented: /i, e, ɛ, a, o, ɔ, u, ə/. Since the vowel system of Spanish has only five phonemes (/i, e, a, o, u/), some vowels were repeated in the Spanish cognates that were used. For instance, the Spanish vowel /e/ was represented in three different words, all corresponding to Catalan /e/, /ɛ/ and /ə/, while the Spanish vowel /o/ was also represented in two instances, both corresponding to Catalan /o/ and /ɔ/. Our intention was to maximize the acoustic difference between the Spanish and Catalan materials while minimizing the length of the exposure (i.e. most words were bi-syllabic).

The eight words produced in the L1 and the eight produced in the L2 of every speaker were put into two separate sound files, one for each language. In each sound file a brief period of silence (0.5 s) was pasted after each word. In other words, all the Spanish files contained the following materials: *tila* + silence + *tele* + silence + *célula* + silence + *sala* + silence + *sola* + silence + *Tolo* + silence + *titula* + silence + *tela*. The Catalan files contained the following materials: *til.la* + silence + *tele* + silence + *cèl.lula* + silence + *sala* + silence + *sola* + silence + *Tolo* + silence + *titula* + silence + *tela*. Each file contained all the words produced by only one talker in only one language. Since there were a total of twenty talkers, ten Catalan-dominant and ten Spanish-dominant, a total of twenty Spanish and twenty Catalan files were constructed. Ten of the Catalan files were produced by Catalan-dominant speakers (L1) and the other ten by Spanish-dominant speakers (L2), while ten of the Spanish files were produced by Spanish-dominant speakers (L1) and the other ten by Catalan-dominant speakers (L2).

### *2.1.2. Procedure*

The 20 listeners heard speech samples produced exclusively in their L1, i.e. Catalan-dominant listeners heard words in Catalan (50% native and 50% non-native), while Spanish-dominant listeners heard words in Spanish (50% native and 50% non-native).

The stimuli were presented over headphones at a comfortable, self-selected volume. A laptop computer was responsible for the randomization and presentation of the sound files and for the recording of the listeners' responses. The perceptual rating experiment was designed and run using Praat software (Boersma, 2001). The participants introduced their responses into the laptop computer by using a mouse. Subjects were allowed to listen to each file as many times as they deemed necessary before introducing their response. Once they felt they were ready for the next file, they clicked on a screen button on the top left of the screen, which saved their response, played the next file and generated the following answer display. Each sound file was played twice, in two different blocks. Every block was randomized before each interaction. This was done so each listener would rate each sound file (and thus each speaker) twice.

The listeners were asked to rate the level of overall native vs. non-native accent of the speakers. A vertical bar appeared on the computer screen after each sound file was played. The participants were asked to move the bar towards the left if they believed that the speaker they were listening to had a native accent and to the right if they believed that the speaker had a non-native accent. Mid-point positions reflected indecision. This procedure is based on the Visual Analog Scale, which is widely used in clinical research to assess an attribute that is believed to range across a continuum of values and cannot be directly measured, such as pain or mood (Chen, 2005). Even though this procedure uses a linear scale (a metathetic continuum), it differs from other procedures using Likert-type, equal-interval scales, in that it does not use linear partitioning but a linear continuum (Southwood & Flege, 1999). The data points or responses are proportion numbers; that is, between 0 and 1. The number 0 represents a "native" accent while the number 1 represents a "non-native" accent.

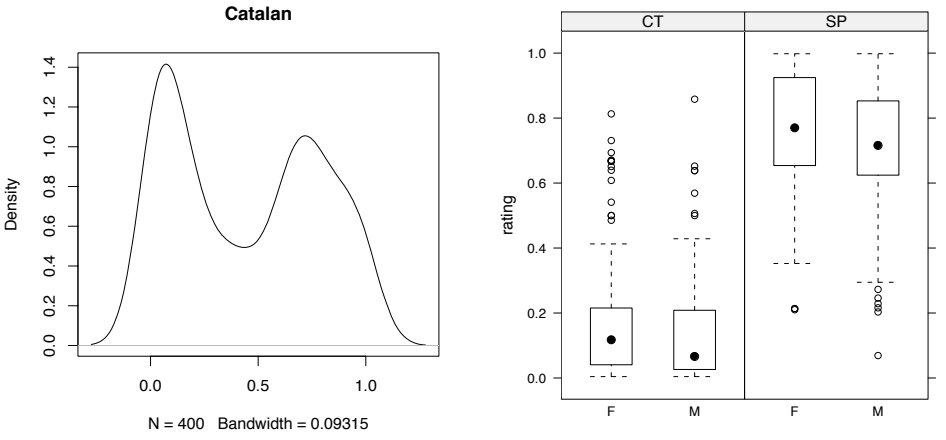
The present procedure presents a significant improvement over Likert-type scales or linear partitioning most importantly due to the fact that they offer the possibility to use standard parametric statistical tests, i.e. ANOVA. Parametric statistical tests may be used because the data are continuous (and not divided into 7 or 9 discrete equal intervals) and normality may be checked prior to analysis. The use of parametric tests on non-continuous data is problematic (Johnson, 2008).

## 3. Results

### *3.1. Catalan-dominant listeners*

The distributions of responses were first checked for normality with the use of q-q plots (Johnson, 2008) and later investigated by displaying density plots. With a cursory examination of the density plot shown in Figure 1 it can be seen that the distribution is largely bi-modal. This suggests that the listeners had little difficulty in discriminating between Catalan-dominant (L1) and Spanish-dominant (L2) speakers of Catalan.

The data were then submitted to a Repeated Measures ANOVA with language background of the speakers (L1 vs. L2 speakers of Catalan) and gender of the speakers as factors, one for each dependent




(a) Density plot (b) Box plot

**Figure 1:** Density and box plots of the responses by ten Catalan-dominant listeners to Catalan speech data produced by ten Catalan-dominant (L1 [CT]) and ten Spanish-dominant speakers (L2 [SP]), further divided by the talker's gender (M [male] vs. F [female]).

variable. Both factors were within-subjects factors, which were calculated over listener as the error term. The RM-ANOVA revealed strong effects of language background of the speakers, but no effect of their gender and no significant interaction: language background of the speakers [F(1,360) = 123.15; $p$ <.001], gender of the speakers [F(1,360) = 4.25; $p$ = .06], and interaction [F(1,360) = 0.02; *ns*].

The distributions of responses as a function of the two factors used in the inferential statistics are displayed in a box plot in Figure 1. The box plot shows that the speech produced by the Catalan-dominant (L1) vs. Spanish-dominant (L2) speakers provoked very different responses in the listeners. The Catalan-dominant (L1) speakers were clearly rated as native while L2 speakers were rated as 'non-native'. This was so for both males and females. The distributions of the responses to all speech data as a function of individual listener are displayed in Figure 2. The box plots show that the differences in the native-accent ratings obtained between L1 (CT) and L2 (SP) speakers of Catalan are systematic across listeners.

### *3.2. Spanish-dominant listeners*

Once again, the responses or ratings by the Spanish-dominant listeners were first checked for normality through the inspection of q-q plots (Johnson, 2008) and later investigated by displaying a density plot, which is shown in Figure 3. In the density plot, it can be seen that the distribution is bi-modal and that the two modes concentrate around the two extremes. This suggests that Spanish-dominant listeners had little difficulty in discriminating between Spanish-dominant (L1) and Catalan-dominant (L2) speakers of Spanish.

The data were then submitted to a Repeated Measures ANOVA with language background of the speakers (L1 vs. L2 speakers of Spanish) and gender of the speakers as factors. The RM-ANOVA revealed strong effects of language background of the speakers, but no effect of gender and a significant interaction: language background of the speakers [F(1,360) = 289.26; $p$ <.001], gender of the speakers [F(1,360) = 0.02; *ns*], and interaction [F(1,360) = 8.27; $p$ = .01].

The distributions of responses as a function of the two factors used in the inferential statistics are displayed in a box plot in Figure 3. The box plot shows that the speech produced by Spanish-dominant (L1) vs. Catalan-dominant (L2) speakers provoked very different responses from the listeners. The Spanish-dominant (L1) speakers were clearly rated as native while the Catalan-dominant (L2) speakers were rated as 'non-native'. This was so for both males and females. Interestingly, the RM-ANOVA revealed an interaction between the factors gender and language background. On the one hand, the

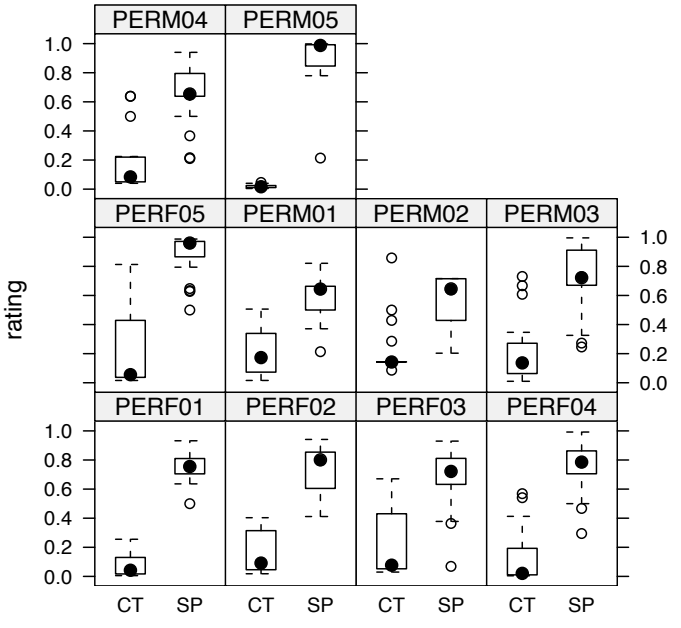
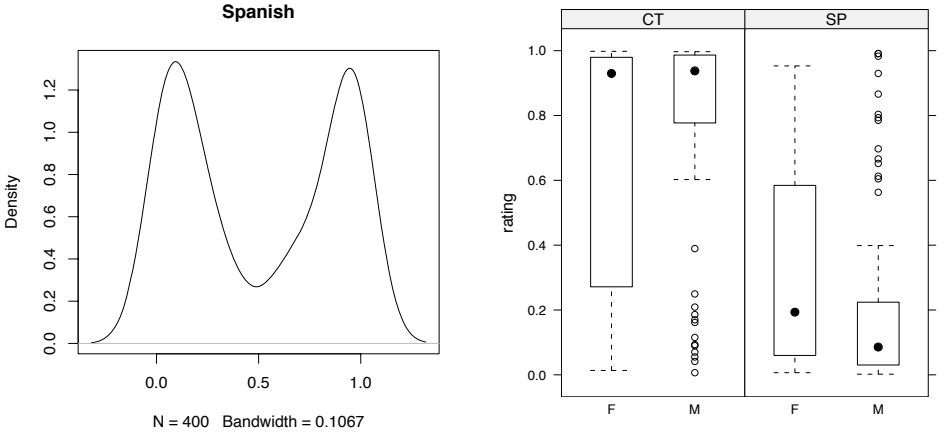



**Figure 2:** Boxplots of the responses by ten Catalan-dominant listeners, as a function of individual listener, to Catalan speech data produced by ten Catalan-dominant (L1 [CT]) and ten Spanish-dominant bilingual speakers (L2 [SP]).




(a) Density plot

(b) Box plot

**Figure 3:** Density and box plots of the responses by ten Spanish-dominant listeners to Spanish speech data produced by ten Spanish-dominant (L1 [SP]) and ten Catalan-dominant speakers (L2 [CT]), further broken down by talker's gender (M [male] vs. F [female]).

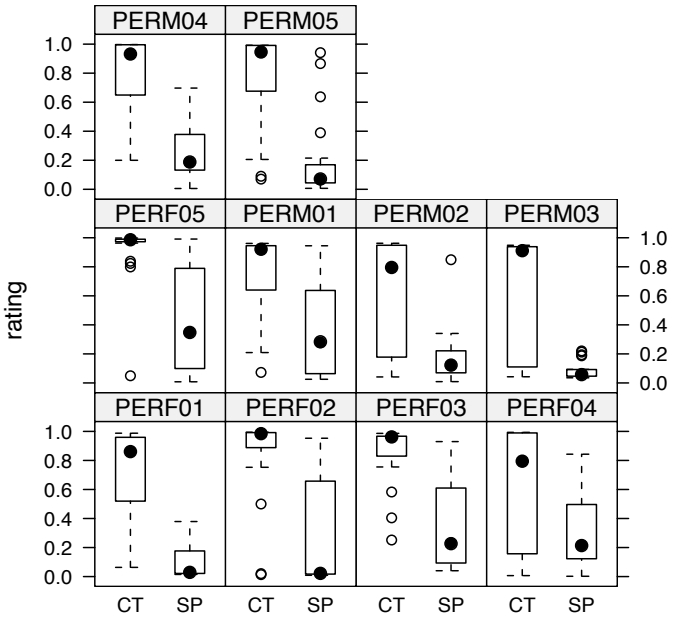



**Figure 4:** Boxplots of the responses by ten Spanish-dominant listeners, as a function of individual listener, to speech data produced by ten Spanish-dominant (L1 [SP]) and ten Catalan-dominant bilingual speakers (L2 [CT]).

distribution of the ratings given to the Spanish-dominant females is wider than that of the Spanish-dominant males, thus suggesting that some speech files produced by the Spanish-dominant (L1) females seemed less-clearly native than those of the males, at least to some listeners. On the other hand, the distribution of the ratings given to the Catalan-dominant females is also wider than that of the Catalan-dominant males, thus suggesting that some speech files produced by the Catalan-dominant (L2) females seemed less-clearly non-native than those produced by the males, at least to some listeners. In sum, this shows that Spanish-dominant listeners had a slightly higher difficulty in discriminating between Catalan-dominant and Spanish-dominant females than between Catalan-dominant and Spanish-dominant males (Simonet, 2008).

Finally, the distributions of the responses to all speech data as a function of individual listener are displayed in Figure 2. Once again, the box plots show that the differences in the native-accent ratings obtained between L1 (CT) and L2 (SP) speakers of Spanish are systematic across listeners.

## 4. Discussion

The present study of overall native vs. non-native accent of both Catalan-dominant and Spanish-dominant speakers in both Catalan and Spanish has arrived at the following main conclusions:

- Catalan-dominant listeners have no difficulty in robustly discriminating between Catalan-dominant and Spanish-dominant bilinguals speaking Catalan.
- Spanish-dominant listeners can robustly discriminate between Spanish-dominant and Catalan-dominant bilinguals speaking Spanish.
- Spanish-dominant listeners had a slightly higher difficulty discriminating between Catalan-dominant and Spanish-dominant *females* than between Catalan-dominant and Spanish-dominant *males* when the talkers were speaking Spanish.

The literature on bilingual speech performance has shown that the chronological difference between the ages of first exposure to the first and second languages in bilinguals has a long-lasting effect on speech

proficiency in bilinguals. For instance, Pallier et al. (1997), Sebastián-Gallés & Soto-Faraco (1999) and Bosch et al. (2000) found that a group of adult Spanish-dominant, Spanish-Catalan bilinguals residing in Barcelona had difficulties perceiving the /e/-/ɛ/ Catalan contrast, absent in Spanish. These Spanish-dominant bilinguals were classified as such because they grew up in Spanish-speaking homes. However, they were all exposed to Catalan (L2) at most by age 6, which is the age of mandatory bilingual schooling in Barcelona. According to the authors, the Spanish-dominant bilinguals in these studies were highly proficient in their two languages and did not have a noticeable Spanish accent in their Catalan. The findings in these studies lead the authors to claim that even early and frequent exposure to the second language may be insufficient to permit the learning of non-native speech behavior.

The present findings confirm our assumption that Catalan-Spanish bilinguals who learned only one of the two languages at home, as children, and remain frequent users of their first language, fundamentally having social networks within their language group, have a native accent in their first language and a non-native one in their second language, as judged by listeners with a very similar linguistic background. One of the main inferences we can draw from the present paper is that bilingual raters (at least if still dominant in their first language) are sensitive to speech produced, in their first language, by non-dominant bilinguals (even if these bilinguals are early learners and highly proficient). The present paper supports (with production data) the widespread assumption that speech performance in bilinguals is tremendously affected by the age of first exposure to the second language and by linguistic experience. In other words, by investigating the members of a community very similar to the one investigated in Pallier et al. (1997), Sebastián-Gallés & Soto-Faraco (1999) and Bosch et al. (2000), we reached the same conclusion: Bilingual speakers who were exposed to their second language some years after they were exposed to their first one are likely to retain a "non-native" behavior (accent, in this case) in their second language even if provided with ample opportunities to learn the speech patterns of their second language (Pallier et al., 1997). Other factors, however, may help second language learners to overcome this limitation, such as using their second language more than their first one or stopping using their first language completelly (Flege & MacKay, 2004; Pallier et al., 2003).

Finally, due to one of the interactions found between language background and gender of the speakers, we hypothesized that Catalan-dominant females may present some acoustic features that distinguish them from the Catalan-dominant males and approximate them to the Spanish-dominant speakers (Simonet, 2008). Acoustic research carried out on the productions of these speakers (using different materials) revealed the existence of a process of convergence led by females, at least with respect to three acoustic parameters that were investigated: (1) the shape of sentence-final pitch accents in read-aloud declaratives, (2) the shape of intonational contours in spontaneous absolute interrogatives, and (3) the 'darkness' of laterals consonants (Simonet, 2008). Importantly, the accent rating experiments reported here suggest that listeners are highly sensitive to variation present in speech even in situations of societal language contact.

## 5. Conclusion

In the present study, the production of highly proficient, early bilinguals who grew up and still reside in Majorca (which is as bilingual a society as Barcelona) was rated by members of the speech community, who are also bilingual. The Majorcan participants were exposed to their second language before 6 years of age, use their two languages daily and seem to be highly proficient in their two languages. Importantly, the two groups of bilinguals (Catalan-dominant and Spanish-dominant) were all educated through the same bilingual schooling system (Pallier et al., 1997). The findings of the present investigation confirm those in Pallier et al. (1997), Sebastián-Gallés & Soto-Faraco (1999) and Bosch et al. (2000) by adding the production dimension. In sum, even individuals who were exposed to their second language before the termination of any critical period for language learning (Lenneberg, 1967), who use their two languages daily and have had every opportunity to learn the speech patterns of their L2 continue to have a noticeable non-native accent, at least when rated by similar bilingual individuals residing in the same community.

Importantly, the results of the present study suggest that the methodology used here (accent rating tasks), which have been widely used in the L2 speech literature, is sensitive enough to reveal differences

in speech performance between highly proficient bilingual talkers and also when bilingual raters are recruited. This adds validity to the method as well as suggests that it could be used in subsequent bilingualism research to assess the overall level of linguistic proficiency in bilinguals (Flege et al., 2002).

## 6. Appendix

The task was entirely run from Praat (Boersma, 2001) which is a free, multi-platform software package used in speech research. Text files in Praat (TextGrids) contain time information and are time-aligned with sound files. The "Edit" option in Praat is able to display a sound file and a time-aligned TextGrid. A Praat script opened and edited each sound file, created and aligned one TextGrid per sound file (with only one tier (point tier) and one boundary (vertical bar) exactly in the middle (0.5 of the laptop display)), allowed the rater to move the bar (point boundary) and then saved the rater-modified TextGrid. The script displays a small interaction window with two options: (1) "'Stop", and (2) "Continue". The listener needs to be instructed to place the bar according to her judgment and then click on the "Continue" button so the TextGrid may be automatically saved and the next sound file and TextGrid are displayed.

The bar with which subjects were asked to interact is associated with an exact time value, which is calculated from the onset of the sound file. The dependent variable, which was extracted from the time measurements of the digital text file, was calculated as follows: (time between onset of sound file and bar) / (time between onset and offset of sound files). This provided a proportion measure (0-to-1).

The script is available for download from the author's website and may be freely used and distributed: http://sites.google.com/site/miquelsimonet/Home/AccentRating.praatscript

The script runs the experiment and creates a table of results in what is known as the "long format".

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