

The contribution of prosody to foreign accent: A study of Spanish as a foreign language

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ABSTRACT: The aim of this study is to analyze the contribution of prosody on the perception of foreign accent by Brazilian learners of Spanish. The data were collected from 15 participants and a control group of 5 native Spanish speakers. A perceptual test was performed with two different speech styles (reading and storytelling) and with delexicalized and natural speech. The speech production was judged by 24 native Spanish subjects. First, they had to determine the nationality of the speaker by listening to the delexicalized excerpts in Spanish (storytelling). After that, the listeners used a continuous scale to rate the excerpts (reading and storytelling) for the degree of foreign accent in Spanish. The results suggest that it is possible to identify foreign accent only with the prosodic information provided in the delexicalized stimuli, i.e., f_0 , duration, and overall intensity. In addition, the perceptual test allowed us to assess the degree of foreign accent of each subject while revealing the great variability of their production. Finally, concerning the external data, the following factors predicted foreign accent among the learners: gender, length of residence in Spain, formal language instruction in Brazil, age of arrival in Spain, and reported use of Brazilian Portuguese in Spain. These results confirm the crucial role of naturalistic learning of a foreign language, as shown by previous studies.

Keywords: foreign accent; prosody; delexicalization; L2 Spanish; task type.

RESUMEN: *La contribución de la prosodia al acento extranjero: Un estudio sobre el español como lengua extranjera.* – El objetivo de este estudio es analizar la contribución de la prosodia para la percepción del acento extranjero en aprendices brasileños de español. Se recogieron datos de 15 sujetos y un grupo control compuesto por 5 hablantes nativos de español y se realizó un test de percepción a partir de estímulos en dos estilos habla distintos (lectura y narración) y habla delexicalizada y sin modificación. Participaron en el experimento de percepción 24 jueces hablantes nativos de español. Primeramente, tuvieron que determinar la nacionalidad del hablante al escuchar los fragmentos delexicalizados en español (narración). A continuación, los oyentes utilizaron una escala continua para puntuar el acento extranjero en los fragmentos de lectura y narración sin modificación. Los resultados sugieren que es posible identificar el acento extranjero solo con la información prosódica que hay en los estímulos delexicalizados, es decir, la f_0 , la duración y la intensidad global. Además de eso, el test de percepción nos permitió evaluar el grado de acento extranjero de cada sujeto y al mismo tiempo reveló la gran variabilidad de sus producciones. Por fin, respecto a los datos externos, los siguientes factores predijeron el acento extranjero entre los aprendices: género, tiempo de residencia en España, enseñanza formal, edad de llegada al país extranjero y uso del portugués de Brasil en España. Estos resultados confirman la gran importancia del aprendizaje natural de la lengua extranjera.

Palabras clave: acento extranjero; prosodia; delexicalización; español L2; tipo de tarea.

1. INTRODUCTION

When people learn a second (L2) or a foreign language after puberty, they usually present some *foreign accent* (Flege, 1993; Major, 2001; Munro, Derwing, & Morton, 2006). The foreign accent can be defined as the quantitative difference between two phonological systems in which one is the native language (L1) and the other is the foreign language (L2; Boula de Mareuil & Vieru-Dimulescu, 2006).

According to Jilka (2000), foreign accent is a deviation from a standard pronunciation of a certain language and whose characteristics are reminiscent from another language, i.e., the native language of the speaker. Despite working with the idea of error, Jilka presents an interesting definition for foreign accent. According to him, foreign accent should be investigated from the perspective of native speakers, and not defined as deviations from articulatory or acoustic productions. Therefore, only perceived deviations could be considered effectively as an example of foreign accent.

Although the characterization of foreign accent is related to differences in both segmental and prosodic levels, most of the research on foreign accented speech focuses on segmental aspects (Flege, 1984, 1993; Flege & Hillenbrand, 1984; Munro, 1995; Piske, Mackay, & Flege, 2001; Vaissière & Boula de Mareuil, 2004). In addition, the models related to L2 acquisition focus exclusively on the perceptual analysis of the segmental level. The *Speech Learning Model* (SLM) proposed by Flege and his colleagues, for example, “aims to account for age-related limits on the ability to produce L2 vowels and consonants in a native-like fashion” (Flege, 1995, p. 237). The model also claims that only accurate perceptual “targets” can guide the accurate production of L2 sounds even though it recognizes that not all L2 production errors are related to perception.

There is also the *Native Language Magnet model* proposed by Kuhl (1994, 2000), which tries to explain the transition from the infant’s universal phonetic capacity to language-specific phonetic discrimination, i.e., it tries to answer how language experience “maps” the changes in the perception of sounds.

The sounds that were once discernible are pulled towards the developing magnet, making them less discernible. Thus, the model can explain why, for example, Japanese listeners show difficulty in producing American English /r/ and /l/. The model predicts that the magnet effect for their category prototype, which is neither American /r/ nor /l/, will attract both sounds, making them difficult for native Japanese speakers to discriminate (Kuhl, 1994).

There are also two more models of L2 perception and production. The *Perceptual Assimilation Model* (PAM; Best, 1995) and the *Second Language Linguistic Perception model* (L2LP; Escudero, 2005). Inspired by Articulatory Phonology (Goldstein & Browman, 1986), the PAM model states that in crosslinguistic speech perception the non-native segments tend to be perceived according to

their similarities to, as well as the discrepancies from, the native segmental constellations which are in close proximity to them in native phonological space. For instance, if the native language of a listener does not have dental stop but does have bilabial, alveolar, and velar stops, the tongue tip constriction of the dental stop is closer in native phonological space to the alveolar place than to other places of articulation. This constriction occurs as the articulation involved is the same and the place of constriction is more similar than those of bilabial or velar stops.

According to Best (1995), this assimilation is demonstrated by tests that measure identification (labeling), classification or categorization (including goodness ratings) of non-native phones. The listener can assimilate a sound as a native category (good, acceptable or deviant exemplar), as uncategorizable (not a clear exemplar of any native category), or as nonspeech sound.

Finally, the L2LP model aims at modeling L2 speech perception. For this, it states the *optimal perception hypothesis*, according to which “learners will initially perceive L2 sounds in a manner resembling the production of these same sounds in their L1 environment” (Escudero, 2005, p. 2). The model presents the result of L1 acquisition as the initial state of L2 learning, predicting that acoustical differences and similarities between the phonemes of two languages will shape development.

Although all acquisition models presented so far consider native speakers’ perception of the foreign accent in their analysis, none of them focus directly on the acquisition of L2 prosody, which suggests that this field has not been sufficiently studied.

In recent years, however, there have been attempts to demonstrate the importance of segmental and prosodic factors in affecting foreign accent. Vieru-Dimulescu and Boula de Mareuil (2005) tried to quantify the contribution of prosody (timing and melody) on the perception of a foreign accent by modifying natural speech in Spanish and Italian. They showed that listeners were slightly more influenced by prosody than by the voice and possible segmental errors. However, they could not quantify the exact contribution of prosody on the perception of foreign accent.

Flege (1988), however, analyzing the pauses in native speakers of Mandarin and Thai speaking English, found that the lack of pauses in their productions did not affect the degree of foreign accent. On the other hand, the studies by Anderson-Hsieh and Koehler (1988), Munro (1995), Jilka (2000) and Holm (2008) demonstrated that some prosodic aspects such as speech rate, stress patterns, rhythm, phrasing, intonation and duration contribute to the perception of foreign accent.

Comparatively few studies have investigated the contribution of prosody on the perception of foreign accented speech. Moreover, most studies analyze only English as a foreign language and no studies of Spanish spoken by Brazilians were found. These were the reasons that led us to conduct a perception experiment to assess the contribution of prosody on the perception of foreign accent and to evaluate the degree of foreign accent in Spanish produc-

tion by Brazilian Portuguese (BP) speakers in two different speech styles (reading and storytelling).

In this paper, we assume in part Jilka's (2000) definition of foreign accent, which only considers segmental and prosodic deviations perceived by native listeners.

We expect to find a larger prosodic transfer of BP to Spanish L2 in subjects that were evaluated as having a larger degree of foreign accent and we expect to verify whether a more controlled style (reading) compared to less controlled style (storytelling) could affect the degree of foreign accent.

In a study that investigates the contribution of prosody on the perception of foreign accented speech, the first step is to separate prosodic from segmental information in the speech signal in order to examine only the prosody in speech. For this, we decided to use a delexicalization procedure.

Delexicalization is a procedure that renders the lexical content of an utterance unintelligible while leaving the speech melody and temporal structure intact (Sonntag & Portele, 1998). In this study, we decided to use the delexicalization procedure known as PURR (*Prosody Unveiling Restricted Representation*) proposed by Sonntag and Portele (1998).

Besides the analysis of the contribution of prosody on the foreign accent, we also observed some external variables that can affect foreign accent, namely: gender, length of residence (months) in Spain, formal education in Brazil (months), age upon arrival in Spain (months), and use of L1 (hours/day). According to the literature, these are some of the variables that play an important role in foreign accent (Flege, Munro, & MacKay, 1995; Flege, Yeni-Komshian, & Liu, 1999; Piske, Mackay, & Flege, 2001; Purcell & Suter, 1980; Suter, 1976; Thompson, 1991). We decided to take into account these variables in order to check if they were related to foreign accent also in Brazilian learners of Spanish L2, since most studies only focus on English learners.

The present experiment aims at answering four questions: (i) is it possible to identify foreign accent from prosodic information only? (ii) will a group of naïve listeners evaluate the foreign accent in a consistent manner in such a way that it is possible to determine accurately the degree of foreign accent? (iii) is there a significant difference in the judgment of foreign accent in reading versus storytelling? and (iv) which external factors are important in determining foreign accent?

2. METHOD

2.1. Speakers

We collected the data from 15 native speakers of BP (10 women and 5 men) and five speakers of Spanish (3 women and 2 men). None of them were paid for their contribution. Participants received only an allowance of 10 € for transport to the phonetics laboratory.

The Brazilian speakers were from São Paulo State, graduated, aged between 27 and 48 years old (mean age:

35) and they learned Spanish after the age of 18. All lived in Madrid at the time of the recordings. The length of residence in Madrid ranged from nine months to 16 years (mean length of residence: 6 years). Ten Brazilian speakers studied Spanish in Brazil before traveling to Spain. All Brazilian speakers considered themselves fluent in Spanish (see Appendix A for more detailed information).

Three Spanish speakers were from Madrid, one from Segovia and another one from Ciudad Real (both cities are close to Madrid), graduated, aged between 22 and 33 years old (mean age: 28). None of them had studied Portuguese as a foreign language. Neither the Brazilian nor the Spanish speakers reported any hearing and/or phonological problems (see Appendix B).

2.2. Speech materials

Participants were recorded in two different sessions. The first recording took place in a soundproof room of the phonetics laboratory of the CCHS-CSIC (*Centro de Ciencias Humanas y Sociales*) in Madrid. We recorded directly onto computer using Adobe Audition software (Version 1.0). The audio files were sampled at a 44,1 Hz rate and saved in wav format in one channel. We used an AKG C444 microphone headset. In the first session, we collected the data of 13 subjects. The second recording took place in the subject's house. We recorded directly on the computer using Praat software (Version 6.0.25). The audio files were sampled at a 44,1 Hz rate and saved in wav format in one channel. For the domestic recordings, we used a Behringer B-2 PRO microphone and a Scarlett 2i2 Focusrite sound card. We collected the data of seven subjects in this manner.

Subjects were asked to produce two types of speech: reading and storytelling. For the first, the subjects read a simplified excerpt from the story of *Don Quixote* (Aguilar, 2004, pp. 15–17) adapted for children.

The decision to use Cervantes' work was because it is a classic of universal literature and so the story is familiar to both Spaniards and Brazilians. In addition, the choice of an adaptation for children rather than the original story was made so that the understanding and reading of the text occurred as naturally as possible in the two languages. The original excerpt from Aguilar (2004) was simplified by the authors so that it would contain shorter sentences and would be easier to read.

Importantly, choosing an excerpt of *Don Quixote* adapted for children was not meant to analyze speech directed at children, but simply to get a version that was closer to everyday speech. According to Sanz Marco (2005) this adaptation of *Don Quixote* is suitable for children between 8 and 9 years of age. We chose the opening of the chapter entitled *Gigantes con aspas*, which tells the classic episode of *Don Quixote* tilling at windmills.

After reading the excerpt, subjects were asked to retell the story that they had just read in their own words in order to obtain the data for the second, story-telling speech style.

Instructions were provided at the beginning of each task in Spanish for both Brazilian and Spanish speakers. The recording consisted of reading aloud the printed text (twice) and retelling the story they had just read. First, they were instructed to read silently and comment upon what they thought about the text and if it was difficult to read. All Brazilian and Spanish subjects were familiar with the story and considered the text easy to read. The Spanish subjects had no doubts about any word meaning in the text. Some Brazilian subjects, on the other hand, asked about the meaning of the word *aspas* (windmills) and *ínsula* (island), whose meaning was clarified before the reading aloud began. The selected reading excerpt we have chosen for the present experiment does not present any of these two words. Finally, they were asked to tell the story with their own words.

2.2.1. Stimuli

To answer the second and third questions presented in Section 1, we selected a small excerpt from the reading of the text and from the storytelling as the stimuli. The selected reading section was always the same for all 20 speakers, which is as follows:

¿Quieres ser mi escudero fiel? ¿Deseas acompañarme por la justicia y en nombre de Dios? - ¿Y qué hace un escudero? Preguntó el labrador, que se llamaba Sancho Panza. Sancho era un hombre de poca estatura y tenía un barrigón (Adapted from Aguilar, 2004, p. 15)

Translation: Do you want to be my faithful squire? Do you want to join me for justice and in God's name? - What does a squire do? He asked the farmer, named Sancho Panza. Sancho was a short man and had a potbelly.

We chose this reading passage as it is varied in terms of sentence modality: statement, yes-no question and wh-question, because it was present in the middle of the text where, we believe, the subjects were more involved in the story content than in the read task itself, and, in addition, it contained few segmental or syllabic structure deviations for the most part of the subjects production.

The average duration of the stimuli was 14 s with a standard deviation of 2 s. We decided against using a very long speech sample in order to avoid the appearance of segmental errors. As demonstrated by Flege (1984) it is not necessary to have very long speech samples in order to evaluate foreign accent. His study showed that phonetically untrained listeners were able to detect foreign accent in small segments, as short as 30 ms.

Since storytelling varied for each speaker, we tried to select statements for each speaker for which there was the least amount of segmental and syllabic structure deviations from native Spanish. The average duration of the

storytelling passages across speakers was 15 s with a standard deviation of 1 s (see Appendix C).

The decision to analyze two speech styles (reading and storytelling) was to verify whether a more controlled style (reading) compared to a less controlled style (storytelling) could affect the degree of foreign accent.

We expected that subjects would be rated as having a stronger foreign accent in samples from the storytelling because, as opposed to the reading task, the storytelling task would require simultaneous planning and production, which could be reflected in the pronunciation performance (Skehan, 2001; Skehan & Foster, 1997).

To answer the first question, we used delexicalized stimuli corresponding to the storytelling passages selected. We decided to use the PURR procedure (Sonntag & Portele, 1998) because the authors demonstrated that the technique was suitable for perceptual tests with naïve listeners. Sonntag and Portele showed that the perception of stimuli obtained by using the PURR technique was completely separated from segmental qualities. They showed that even stimuli with similar syntactic structures could be compared directly despite segmental differences.

The PURR method turns each fundamental period of the speech signal into a sinusoidal period of the same duration and amplitude and adds a second and third harmonic (with 1/4 and 1/16 of the original amplitude, respectively). The voiceless parts of the signals are replaced by silent pauses. Thus, the signal contains all relevant characteristics to the perception of prosody: pitch, duration, and height (Dellwo, 2010). The delexicalized stimuli is obtained by time-domain concatenative synthesis systems using the PSOLA method. It was carried out automatically in Praat (Version 6.0.25) by the use of a Praat script created by Wagner (2004).

2.3. Perceptual Experiment

2.3.1. Listeners

The listeners were 24 native speakers of peninsular Spanish (13 men and 11 women) aged between 18 and 64 years old (mean age: 31). The group consisted mainly of postgraduates (13), graduates (4) and undergraduate or high school students (7). A total of 13 out of 24 of the listeners were from the Community of Madrid and the remaining ones were from other parts of Spain (Appendix D). All of them spoke Spanish as their native language and the bilingual listeners reported that they acquired Spanish before going to school. None had hearing problems.

In order to know which languages and accents the listeners were familiar with, we asked them where they were born and if they had lived outside their hometown for more than one year.

A total of 8 out of 24 of the listeners hadn't left their hometowns, 5 listeners lived in other cities of Spain and 11 listeners lived abroad (6 lived in Brazil and in Portugal).

Studies such as Carey, Mannell, and Dunn (2011), Winke and Gass (2013), and Huang, Alegre, and Eisenberg (2016) have demonstrated that the degree of familiarity with the L1 of the speaker or with a certain type of foreign accent is a variable that can influence the evaluation of the judges. In order to check if this was the case in the present study, we asked the subjects how often they listened to Brazilians speaking Spanish and if they were familiar with the accent of Spanish spoken as L2 by Brazilian speakers. The responses are summarized in Table 1 and Table 2.

Table 1: Responses to the question: *How often do you listen to Brazilians speaking Spanish?*

Frequency	Listeners
very often	4
frequently	3
sometimes	5
hardly ever	10
never	2

Table 2: Responses to the question: *Are you used to the accent of Brazilians that speak in Spanish?*

Familiarity	Listeners
No. That's why it's so hard for me to understand	1
No. But it's not so hard for me to understand	10
Yes. But it's a little bit hard for me to understand	2
Yes. It's not a problem for me to understand	7
Yes. That's why I can understand perfectly	4

2.3.2. Procedure

The test involved two tasks: nationality identification (delexicalized stimuli) and evaluation of the degree of foreign accent in two kinds of speech samples (reading and storytelling).

First, the task consisted in listening to the delexicalized stimuli and choosing between the Spanish or Brazilian speaker options. After this, listeners heard the original reading and storytelling passages and then evaluated the degree of foreign accent in both excerpts.

In order to guarantee raters comfortable access to the test in terms of the flexibility about when and where to take it, the perception test was conducted through the Internet (SurveyGizmo, n. d.). Using the Internet has also the advantage of facilitating the presentation of sound files and the processing of results.

The people who took part in the experiment received via email the link corresponding to the experiment. Thus, they could choose the best place and time to perform the

test. The estimated time of duration of the experiment was about 30 minutes. For this reason, in the email sent, participants were told that they could stop the experiment at any time without losing the previous answers, simply by choosing the option "Save and continue your survey later". Thus, they received a new link by email to continue the task at another time.

Only 3 out of the 24 listeners performed the experiment on two different days. The mean time spent performing the experiment by the remaining 21 listeners was 39 minutes (median = 32 minutes).

We were aware of the limitations of conducting a perceptual experiment through the Internet rather than conducting it into a university lab. The most important limitations are the difficulty of controlling if the listeners read the instructions carefully, if there were significant distractions during the course of the experiment, and if the listeners were taking the experiment less seriously because nobody was watching them.

In order to overcome some of these limitations the participants were informed both by email and at the beginning of the experiment that it was very important to carry out the test with headphones and to be in a quiet place. Moreover, as a way to standardize the experimental conditions before starting the test, the listener evaluated the sound quality of her/his computer.

If they evaluated the sound quality as excellent, very good or good they could start the test normally, but if they evaluated the sound quality as fair, poor or very poor, the test stopped and the listener received a message asking him or her to write an email to the researcher reporting the incident. Just for this pre-test phase, the participants listened to a reading passage at first and then a delexicalized excerpt of the storytelling. We decided to use in the sound quality evaluation first a natural speech stimulus instead of a delexicalized one to avoid listeners to consider sound quality poor just because she/he couldn't understand what was being played. Both stimuli selected in the sound quality evaluation did not belong to the analyzed corpus.

In the test, first, the listener heard the delexicalized stimulus and then he/she chose between the Spanish or Brazilian options as shown in Figure 1.

Figure 1: First part: Delexicalized stimulus.

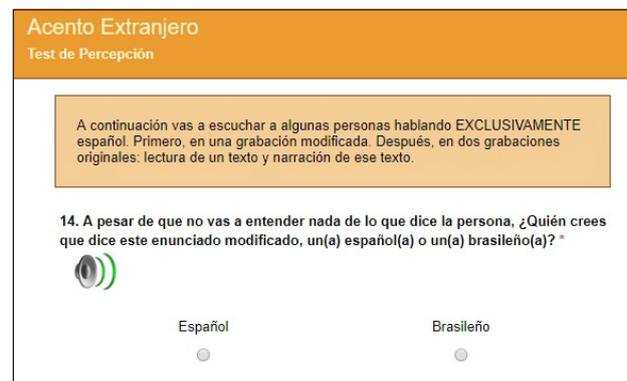
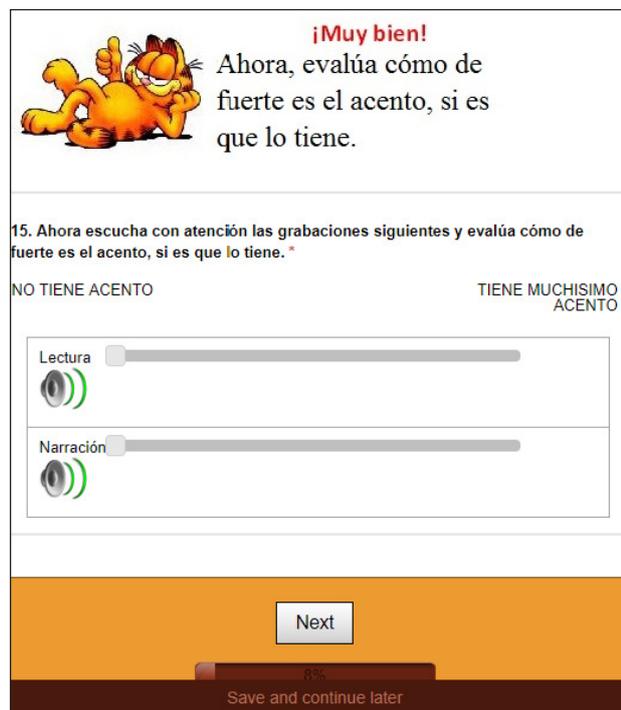


Figure 2: Second part: Unmodified stimuli (reading and storytelling).



The listeners could hear the stimulus as many times as they wanted, but from the moment they chose an option (Spanish/Brazilian), they were automatically directed to the evaluation task of the foreign accent degree and they could not go back to change their previous answers (Figure 2).

After the determination of nationality, the listener heard the unmodified reading and storytelling stimuli to evaluate the degree of foreign accent. The three stimuli: delexicalized storytelling, unmodified speech (reading), and unmodified speech (storytelling) presented to a listener were always from the same subject.

Although the order of presentation of the stimuli of each subject was always the same (delexicalized and then unmodified speech), we could control learning effects because the presentation order was random for each Brazilian and Spanish subject data.

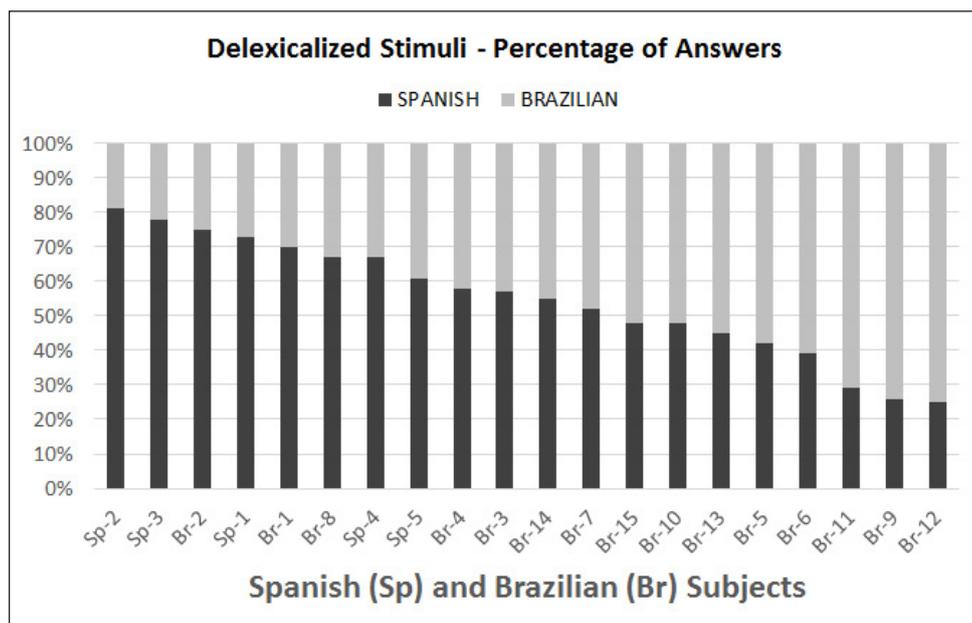
According to Figure 2, after listening to the reading and the storytelling excerpts, the listener evaluated the degree of foreign accent on a continuous scale varying between two extremes: at the left, *no foreign accent*, and, at the right, *strong foreign accent*. This continuous scale was automatically converted into a discrete scale started from 0 (no foreign accent) to 10 (very strong foreign accent) by dividing the full scale into 10 equal parts.

3. RESULTS AND DISCUSSION

In this section, we present the results obtained in the perceptual experiment. All the statistical analyses were performed using R (R Development Core Team, 2008) and we assume a significance level $p=0.05$.

In Figure 3, the percentage of the nationality identification given by the Spanish listeners to delexicalized stimuli are presented. In dark grey the percentage corresponding to the judgment of the stimuli as being produced by Spanish speakers appears, and in light grey, the percentage corresponding to the judgment of the stimuli as being produced by Brazilian speakers. Each of the speak-

Figure 3: Percentage of answers to delexicalized stimuli.



ers whose stimulus was evaluated is plotted in the horizontal axis.

The Spanish speakers Sp-2, Sp-3, and Sp-1 had their stimuli correctly evaluated by 81%, 78% and 73% of the listeners, respectively. On the other hand, the stimuli of the Spanish Sp-4 and Sp-5 were correctly evaluated by 67% and 60%, respectively.

In order to determine whether the Spanish accent was correctly identified, a binomial distribution with $\pi=0.50$ (representing a chance distribution of answers, i.e., guessing) was performed. The Spanish accent was significantly identified for the Spanish speakers Sp-1, Sp-2 and Sp-3, but not for Sp-4 or Sp-5.

With respect to the responses given to the stimuli of the Brazilians, we expected to check whether the influence of L1 on prosodic factors was so strong that prosody in Spanish L2 could reflect only the characteristics of the BP prosody. This was the case for three Brazilian subjects (Br-12, Br-9, and Br-11). They were correctly evaluated as being Brazilians by 75%, 74%, and 71% of the listeners, respectively.

On the other hand, only the stimuli of Brazilians Br-1 and Br-2 were significantly, but incorrectly, identified as being produced by Spaniards. This means that, from the prosodic point of view, it is possible that the influence of BP prosody in these two subjects production is very low.

Finally, for the 10 remaining Brazilians (Br-3, Br-4, Br-5, Br-6, Br-7, Br-8, Br-10, Br-13, Br-14, Br-15) the nationality identification was not significant.

For the analysis of foreign accent in reading and storytelling style, we calculated the Krippendorff's alpha coefficient that measures the extent of agreement among listeners. When listeners agree perfectly, $\alpha=1$, which indicates perfect reliability, and when listeners agreement is indistinguishable from chance, $\alpha=0$, which indicates the absence of reliability.

The Krippendorff's alpha coefficient was 0.54 (reading stimuli) and 0.50 (storytelling stimuli), which means there is a moderate agreement among listeners.

In Figure 4, we have the average foreign accent of reading (dark grey) and storytelling (light grey) speech samples for all listeners.

We can see that the Spanish speakers Sp-1, Sp-2 and Sp-3 had foreign accent averages very close to zero and the Spanish speakers Sp-4 and Sp-5 had averages around one.

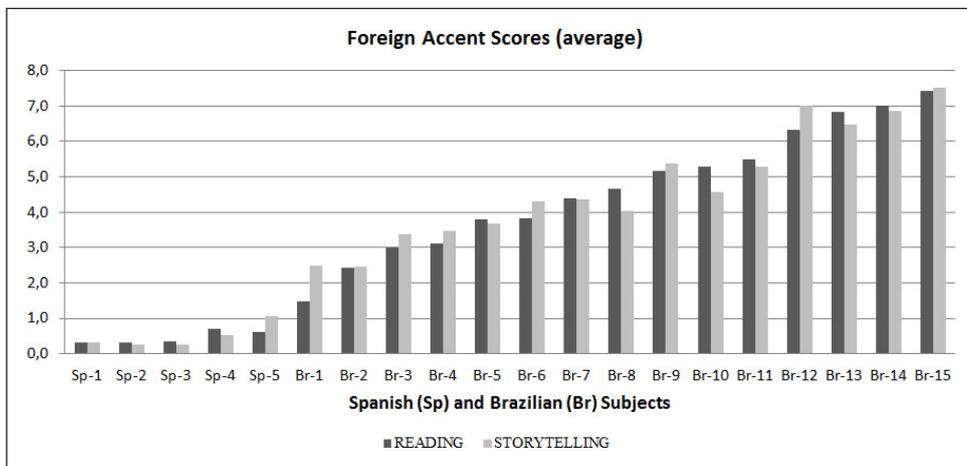
This result is interesting, since it corroborates the previous result with the delexicalized stimuli. The Sp-4 and Sp-5 stimuli were not correctly identified and, in addition, the natural stimuli presented averages of foreign accents slightly higher than those of the three other Spaniards did.

Compared with the Spanish subjects, the foreign accent averages of the Brazilian speakers are higher and much more variable (minimum 1.5 and maximum 7.5) in both styles: reading and storytelling.

Furthermore, we see that there is a relation between the foreign accent mean and the previous evaluation of the delexicalized stimuli. For example, the Brazilian subjects Br-1 and Br-2, who obtained the lowest averages of foreign accents (1.5 and 2.5), were also significantly identified as being Spanish. On the other hand, subjects Br-12, Br-9, and Br-11, identified as being Brazilians, had high foreign accent averages of 7.0, 5.5, and 5.2, respectively.

A logistic regression analysis was performed to check the relationship between the dependent variable 'foreign accent' (0 to 10) in reading and storytelling styles with respect to the independent variable 'answer to delexicalized stimuli' (Spanish or Brazilian). The analysis revealed that there is a statistically significant relationship between the degree of foreign accent in the reading stimuli (coefficient=-0.93 $p=2.10^{-16}$), storytelling (coefficient=-0.92 $p=2.10^{-16}$), and the answers given to the delexicalized stimuli. Thus, lower scores given in the foreign accent degree test are significantly associated to subjects that were previously judged as Spanish. This result suggests that it is possible to identify foreign accent with just the prosodic information provided in delexicalized stimuli, i.e., f_0 , duration, and overall intensity.

Figure 4: Foreign accent average from the converted continuous scale in discrete (0 to 10). Dark gray averages for reading and light gray for the storytelling.



A two-way ANOVA with degree of foreign accent as a dependent variable and recording style (reading vs. storytelling) and subject as independent variables was also performed, and which showed that there is no significant difference in the evaluation of the scores given by the judges for reading in comparison with storytelling ($F(1,19) = 0.14, p > 0.05$).

This goes against our hypothesis that storytelling would receive lower scores because the task would require the simultaneous planning, which could be reflected in pronunciation. However, the results showed that speech style in this data did not affect foreign accent.

Because there were no difference between reading and storytelling, the following analyses were performed with the reading and storytelling data together.

With respect to the independent variable ‘speaker’, the ANOVA revealed a significant difference ($F(1,19) = 44.03, p < 0.00001$). Therefore, we conducted a Tukey test to verify which subjects were significantly distinct in terms of foreign accent mean; the test revealed that the Spanish speakers form an independent group with the subjects in it having the same average values for foreign accent. This group of Spanish speakers, in turn, differs from almost all Brazilian speakers, with the exception of only one Brazilian speaker, Br-1, (whose averages are statistically equal to the Spanish speakers Sp-4 and Sp-5) and Brazilian speaker Br-2 (whose average is statistically equal to the Spanish subject Sp-4).

In order to group the statistical distribution for the Brazilian speakers as for the evaluation of foreign accent, we conducted a post-hoc Waller-Duncan test with the scores obtained in the perception test for reading and storytelling stimuli. The test showed that there are eight distinct groups, as we can see in the boxplots of Figure 5.

Br-1 and Br-2 speakers form a group with the lowest average accent; speakers Br-3 and Br-4 form the second group with an average a little higher than the first group.

The third group is composed by speaker Br-5 and the fourth only by Br-6. Br-7 and Br-8 form the fifth group, and Br-9 and Br-10 form the sixth. The seventh is composed only by Br-11, and finally Br-12, Br-13, Br-14, and Br-15 form the last group with the highest foreign accent average.

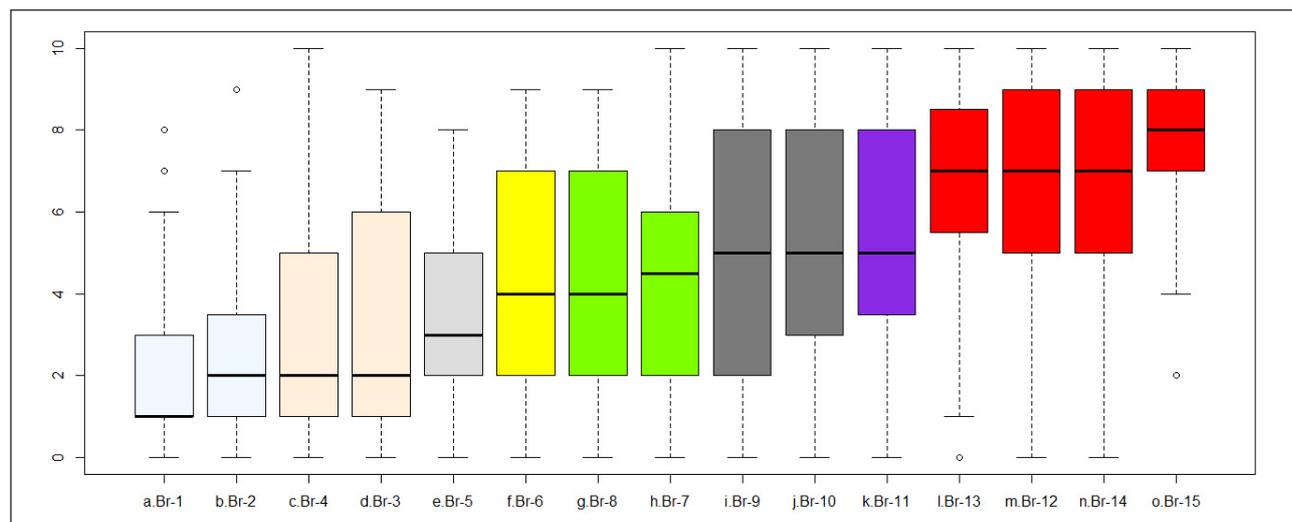
To answer the fourth question presented in Section 1—that is, “which factors have the greatest weight in determining the foreign accent?”—we conducted a second logistic regression analysis to investigate the relationship between the dependent variable ‘foreign accent (reading and storytelling)’ and the following independent variables: gender (male/female), the length of residence in Spain (months), formal education (months), age (arrival in Spain) and use of L1 (hours/day). These variables have received more attention in the studies of foreign accent (Piske, Mackay, & Flege, 2001).

The analysis revealed that there is a statistically significant relationship between the degree of foreign accent and all independent variables analyzed.

With respect to the independent variable gender (coefficient = $-0.74, p = 2.10^{-16}$), the lowest scores of the evaluation of foreign accent are significantly associated to stimuli produced by men. This result differs from that found in the literature (Suter, 1976; Thompson, 1991). In general, studies show that women have lower accent compared to men or that there is no significant difference among women and men. Note that in this study, the number of women (10) and men (5) is discrepant and this may have influenced the results obtained.

The length of residence in the country was also significant (coefficient = $-0.004, p = 2.10^{-16}$), i.e., the greater the length of residence in the country, the lower the degree of foreign accent. The importance of the length of residence in the country was also widely observed in previous studies (Flege, Munro, & MacKay, 1995; Purcell & Suter, 1980; Suter, 1976).

Figure 5: Boxplots for each Brazilian subject. The different colors divide the subjects into eight groups, which have statistically the same means of foreign accent. Group 1 (light blue), the subjects with the lowest means and group 8 (red), the subjects with the highest means.



The formal education time was also significant, but contrary to our expectation (coefficient=0.01, $p=6.9.10^{-14}$), i.e., the higher the formal education time, the greater the degree of foreign accent. Thus, it appears that the formal instruction time did not reduce the degree of foreign accent. Thompson (1991), Flege, Munro, and MacKay (1995) and Flege, Yeni-Komshian, and Liu (1999) also found that formal education does not predict the degree of foreign accent.

The age variable (coefficient=0.036, $p=2.10^{-16}$) indicates that the higher the age at which the informant arrived in Spain, the greater the degree of foreign accent. Thompson (1991) also found the influence of the age factor of Italians living in the United States. This result clearly shows the importance of naturalistic acquisition of L2.

Finally, with respect to the variable use of L1 (coefficient=0.035, $p=3.9.10^{-05}$), we found that the longer the time using the mother tongue, the greater the degree of foreign accent. Piske, Mackay, and Flege (2001) found the same result by analyzing the productions of Italians that live in Canada. The authors noted that Italians who continue to speak Italian very often have significantly more accent than those who speak it less frequently.

Finally, in order to check if the listeners' gender, age, knowledge of BP as L2, frequency of listening to Brazilians speaking Spanish L2, and familiarity with Brazilians speaking Spanish L2 could have influenced their responses in the perceptual test, a logistic regression analysis was performed. The dependent variable was 'foreign accent' (for both reading and storytelling as a group) and the independent variables were gender, age, BP as L2, frequency of listening to Brazilians, and familiarity.

The analysis revealed that there is a statistically significant relationship between the foreign accent rates and gender, age, frequency, and familiarity.

With respect to the independent variable gender (coefficient=-0.23, $p=2.9.10^{-6}$), the lowest scores of the evaluation of foreign accent are significantly associated to stimuli listened by men.

The age of the listener was also significant (coefficient= 0.23, $p=2.10^{-16}$), i.e., the higher the age of the listener, the higher the foreign accent rate.

The frequency and familiarity were both significant (coefficient=-0.05, $p=0.02$) and (coefficient=-0.07, $p=0.0002$), i.e., the greater the frequency and familiarity of Spanish listeners with Brazilians speaking Spanish the lower the foreign accent score. A similar result was found by Carey, Mannell, and Dunn (2011): a significant proportion of examiners rated pronunciation higher when they had prolonged exposure, and lower when they had no, or little, exposure to the subject's L1. Huang, Alegre, and Eisenberg (2016) and Winke and Gass (2013) also found that raters who are familiar with the subjects' L1 tend to be more lenient toward speakers with familiar accents.

The relationship was not significant for the variable BP as L2, which means that the Spanish listeners who lived in Brazil and Portugal for more than one year did not evaluate the foreign accent in a different way compared to the group of Spaniards who had not lived in those countries for more than a year.

4. LIMITATIONS AND CONCLUSION

There are limitations to this study that we would like to address. First, more detailed information about the listeners' profile would be required in order to evaluate in a more consistent way the role played by raters' familiarity with subjects' L1. The questions we set out in a previous questionnaire (see Table 1 and Table 2) were not enough to precisely evaluate this variable in the study. Future inquiry should include more detailed information about the listeners' familiarity with the speakers' L1 such as: whether they had previously studied BP, the precise amount of time they have lived in Brazil or Portugal, whether they had close friends who speak BP, etc.

Second, in future research, a Spanish language test could be applied to the speakers in order to assess their Spanish level, so that it would be possible to compare their Spanish L2 level with the scores of the foreign accent test. In addition, future studies could evaluate a higher number of subjects and a more balanced number of female and male speakers.

Third, we were aware about the differences in recording conditions between the two sections. However, the sound quality was equivalent and this could be evaluated by listening to the audio files.

In this study, we attempted to evaluate the contribution of prosody (f_0 , duration, and overall intensity) on the perception of foreign accent by using delexicalized stimuli and natural speech. Results suggested that it is possible to identify the foreign accent with just prosodic information present in delexicalized stimuli. Alongside other studies, we also demonstrated that prosody plays a key role in determining foreign accent (Anderson-Hsieh & Koehler, 1988; Derwing & Munro, 2005; Hahn, 2004; Holm, 2008; Jilka, 2000; Munro, 1995).

However, it is important to note that when analyzing only the results for the delexicalized stimuli (that is, without comparing them with natural speech), only the productions of three of the five Spanish subjects were significantly and correctly evaluated by the Spanish listeners as being Spanish. This result may indicate that there are subjects whose prosody is easier to identify than others, that is, that the acoustic cues of f_0 , duration, and intensity could be more salient, which may explain this variation in the results.

For the Brazilians, we expected to find greater variability in the responses given by the Spanish listeners to the delexicalized stimuli and that was exactly what we found. The recordings of three Brazilian subjects were correctly evaluated as from BP speakers, which means that BP prosody was apparent enough to reflect in L2 Spanish. As for the data of two other BP speakers, they were evaluated as from Spanish subjects, which means that the influence of BP prosody was very low in that case. Finally, the responses given by Spanish listeners were not significant for the 10 remaining subjects, which can suggest that their L2 prosody is in the middle way, it does not reflect either the prosody of L1 or that of L2.

The field of L2 research could benefit from future work that would examine the correlation between the per-

ceptual results with prosodic acoustic such as f_0 contours, stress, accent, rhythm, in order to quantify the prosodic distance between the less foreign accented speech compared to the more accented speech.

In this study, we could not quantify precisely the contribution of prosody on the perception of foreign accent but the direct comparison between the judgments of the delexicalized stimuli and natural speech seems to indicate that prosody plays an important role in the perception of foreign accent as the lower scores in foreign accent assessment were significantly associated to stimuli that were previously evaluated as belonging to Spanish speakers.

In this experiment, we also tried to evaluate if the different type of task (reading and storytelling) could affect foreign accent assessment, that is, if storytelling speech samples would have foreign accent average values significantly higher than those for reading task. But the results suggest that there is no significant difference between the evaluations of both speech styles. In future studies, in order to evaluate the different speech styles it could be asked of the speakers to produce extemporaneous narratives and then read the transcriptions of their own utterances (Munro & Derwing, 1994).

By the analysis of the foreign accent scores, we evaluated foreign accent degree of the Brazilian speakers. The Waller-Duncan test grouped the 15 Brazilian subjects in eight distinct groups according to their foreign accent scores.

We could say that the variability we observed is an intrinsic characteristic of foreign language productions because we controlled other variables that could have caused such variability. We selected Brazilian subjects who came from the same State of the Federation, with the same level of education, with similar ages, who have learned Spanish after the age of 18, who were in an immersion situation and that, moreover, lived in the same city (Madrid) at the time of the recordings.

In addition, the analysis of foreign accent also showed the relationship between the degree of foreign accent and gender, length of residence, formal education, age of arrival in Spain, and use of L1, which are some of the variables analyzed in previous studies. Our study found statistically significant differences between the degree of accent and all these variables: the longer the residence in Spain, the lower the foreign accent; the earlier the Brazilian subject moved to Spain, the lower his/her foreign accent; the less he/she speaks BP in Spain, the lower the foreign accent. Finally, with respect to the amount of formal instruction in Brazil before going to Spain, we found that the higher the formal education time, the greater the degree of foreign accent. Some studies also have suggested the importance of naturalistic L2 learning (Flege, Munro, & MacKay 1995; Flege, Yeni-Komshian, & Liu, 1999; Thompson, 1991). However, Díaz-Campos (2004) points out that it is important to be cautious in interpreting the studies related to the role of formal instruction compared to naturalistic learning because there is also evidence for the opposite result, showing that formal instruction helps learners to develop greater L2 proficiency (Ellis, 1994).

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APPENDICES

Appendix A. Speakers' Profile–Brazilian

Subject	Gender	Age	Job	City of birth	Spain ^a	FI ^b	Total ^c
Br-1	f	36	Journalist	São Paulo	184	6	190
Br-2	m	36	Musician	São Paulo	156	0	156
Br-3	m	48	Musician	Itapeva	156	0	156
Br-4	m	36	Nurse	São Paulo	108	0	108
Br-5	f	30	PhD Student Literature	São Paulo	12	36	48
Br-6	f	33	Administrator	Santo André	72	4	76
Br-7	m	27	Advertising	São Paulo	12	12	24
Br-8	m	37	Economist	São Paulo	6	36	42
Br-9	f	33	Journalist, Sociologist	Ribeirão Preto	54	12	66
Br-10	f	33	Journalist	Marília	66	12	78
Br-11	f	42	Portuguese Teacher	São Paulo	15	30	45
Br-12	f	28	Art teacher	São B. do Campo	9	0	9
Br-13	f	41	Pedagogue	São Paulo	84	12	96
Br-14	f	41	Pedagogue	São Paulo	192	0	192
Br-15	f	27	Photographer	São Paulo	12	18	30

^aLength of residence in Spain (in months)

^bFormal instruction in Brazil (in months)

^cTotal amount of time in contact with Spanish language (in months)

Appendix B. Speakers' Profile–Spanish

Subject	Gender	Age	Job	City of birth
Sp-1	m	32	Engineer	Madrid
Sp-2	f	31	Sound Engineer	Segovia
Sp-3	m	33	Engineer	Madrid
Sp-5	f	22	Philologist	Madrid
Sp-4	f	22	Philologist	Ciudad Real

Appendix C. Storytelling excerpts

Br-1	y bueno cuando emprendieron camino hasta los molinos de Montiel pues lo que eran molinos para Sancho Panza eran gigantes con muchos brazos para Don Quijote y lo que quería era Don Quijote era luchar contra ellos
Br-2	bueno me parece que están programando todos los viajes, ¿no? se es difícil de hablar cuan/ cuando ya sabes la historia pues nada están programando el viaje e:: se han conocido porque necesitaba: un escudero el/ el Don Quijote
Br-3	no básicamente era eso no que estaba loco perdió la la noción del del de lo normal no entonces pues es: dio un/ dio un/ un fin a sus libros de caballería para justamente para evitar que él siguiera con ese mecanismo no de de imaginación y locura
Br-4	y bus/ y sale en busca de aventuras pero como sale la primera vez solo y y: y se interroga él porque a: a la cosa ha salido mal se ve como un fracasado y de pronto cuando se recupera busca sus libros pero su sobrina y la criada
Br-5	Sancho no Don Quijote ve unos molinos y cree que: que son gigantes e: Sancho su escudero se da cuenta que no tiene sentido de: realidad pero no logra convencerle a su amo
Br-6	pensó bueno eh un caballo tengo una dama pues necesito un escudero entonces lo que hizo fue invitar a un vecino que era un hombre eh muy sencillo era una persona muy humilde y tenía un barrigón que era el Sancho Panza
Br-7	que para él no se llama Frístón se llama Frestón y luego fue a buscar un acompañante que:: que solo tenía que acompañarle que no tenía nada de pinta de acompañante que era un labrador allí que era Sancho Panza que tenía un barrigón que era una buena persona pero no muy sagaz
Br-8	y: se pregunta qué necesita más además de armas y de: y de coraje sale en busca de un escudero encuentra un labrador vecino llamado Sancho Panza y salen al tercero día ya había salido antes
Br-9	y:: y luego de caminar toda la noche y la mañana avistan lo que son tres/ treinta o cuarenta molinos de viento y: Don Quijote pues piensa que: son gigantes
Br-10	buscaba: a un compañero que allí Sancho y: con Sancho se fue otra vez a: bueno se fue a la aventura y: bueno y su imaginación tenía creaba cosas que Sancho no veía
Br-11	había sumido con los libros y también de cómo Don Quijote invitó a: a Sancho Panza a ser a/ a ser su escudero
Br-12	el que: Don Quijote crees que son gigantes y: Sancho está allí para decirle que no que no que son molinos pero eh: Don Quijote sigue con su lucha
Br-13	se depararon con muchos molinos de viento y Don Quijote con su fantasía creía que los molinos de viento eran gigantes con: con brazos abiertos y: Sancho
Br-14	no es el principio de la historia: o sea de Don Quijote eh: coge.. eh un eh un capítulo después si puede decirlo eh... en que él ya había intentado una aventura anterior pero no le fue bien.
Br-15	pero y qué gano con esto y Don Quijote le: le dijo que cuando pudiera le conseguiría sería gobernador de una ínsula pero Sancho Panza no sabe lo que es una ínsula y bueno pero no importó porque dijo que pues le parecía bien
Sp-1	y: dice que algo había salido mal en esa primera aventura y realmente: se da cuenta que lo que necesitaba era un escudero trata de: buscar un escudero e: un campesino que vivía cerca que es Sancho Panza
Sp-2	y está buscando sus libros sus libros y con la imaginación que tiene pues al preguntar qué qué había pasado con ellos y su sobrina decirle que se los había se habían ido por los aires él ya pensaba en magia y que había un mago que se los había quitado
Sp-3	e:: luego cuenta: cómo se/ cómo convence Don Quijote a Sancho Panza para que: para que vayan de aventuras juntos y aunque Sancho Panza no comprende muy bien por qué por qué motivo debe ir pues bueno como él piensa que va alcanzar una posición social interesante pues decide ayudarlo
Sp-4	de: de la adaptación del Quijote a los niños se cuenta el: se cuentan tres partes importantes de: lo que se habrá del Quijote la primera parte hace la presentación y cuenta un poco el inicio de la historia de Don Quijote
Sp-5	y: y él echa la culpa al mago Frestón e: entonces pues se se plantea otra vez volver a salir y entonces para: para ver qué: que es lo que falló la primera vez pues intenta corregirlo y entonces se: se da cuenta de que le: lo que le falta es un escudero

Appendix D. Listeners' profile

Listener	City of birth	In Spain > 1 year	Abroad > 1 year
1	Madrid		Brasilia (Brazil)
2	Madrid		Portugal
			Germany
3	Madrid		Brasilia (Brazil)
4	Madrid		
5	Vigo	Santiago de Compostela	Amsterdam (Netherlands)
			Glasgow (UK)
			Braga/Oporto (Portugal)
			Rio de Janeiro (Brazil)
6	Segovia	Madrid	
7	Murcia		São Paulo (Brazil)
8	Cudillero	Avilés	Sheffield (England)
		Oviedo	Salt Lake City (USA)
9	Logroño	Pamplona	
10	Gijón	Barcelona	
11	Madrid		Tromsø (Norway)
			Bologna (Italy)
12	Ferrol	Madrid	
		Santiago de Compostela	
13	Madrid		
14	Madrid		
15	Madrid		
16	Pamplona	Rincón de Soto	
		Madrid	
17	Madrid		
18	Palencia	Valladolid	Toulouse (France)
		Madrid	England
			Mexico
			Poland
			Quebec (Canada)
			Hong Kong
19	Valladolid		
20	Madrid		
21	Madrid		
22	Madrid		Lafayette (USA)
23	Madrid		Asunción (Paraguay)
			Berlin (Germany)
			São Paulo (Brazil)
24	Almería		São Paulo (Brazil)