

# Second Language Acquisition and First Language Phonological Modification

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## 1. Introduction

While many second language (L2) acquisition studies analyze the effects that the first language (L1) has on L2 development, less common are studies that examine the converse situation: does acquisition of an L2 impact the L1? This study examines the effects of L2 acquisition on L1 use by looking at the L1 phonological productions of advanced L2 learners vis-à-vis the production of monolingual speakers of the same languages. While most research on L1 phonological modification focuses on speakers who lose their L1 as a result of becoming members of bilingual communities and reside in the L2 community, few studies investigate L2 speakers that remain in their L1 community. This pilot study project begins to fill in the picture of L1 attrition by investigating the modifications of advanced L2 learners of Spanish who remain in their L1 (English) community (the US).

It has been documented that L2 speakers are invariably influenced, to some degree, by their L1. However, following Flege's (1987, 2005) Merger Hypothesis, it is proposed that the merging of phonetic properties of phones that are similar in the L1 and L2 can potentially impact not only the acquired language but the native one as well. In other words, an English speaker with advanced proficiency in Spanish could not only pronounce Spanish with an English characteristics, but will also pronounce English words less "English-like" than a monolingual English speaker would. While this has been shown in French-English bilinguals (i.e., Flege 1987), corroborating evidence from Spanish-English bilinguals has been lacking (Flege 2005). This study attempts to fill that gap.

## 2. The acquisition of second language phonology

Although there is a growing body of research investigating second language phonological acquisition, of particular relevance here are those studies that examine Voice Onset Time (VOT), one of the quantifiable differences between Spanish and English phonologies. In English the production of the voiceless stops /p, t, k/ in tonic syllables results in aspiration, which does not occur in Spanish, so that English voiceless stops are said to have greater VOTs (i.e., Lisker & Abramson 1964) than Spanish. Because of the precise nature of VOT, this area has been widely investigated in the L2 phonology literature. Data obtained from these studies can provide valuable information about the ability of L2 learners to recognize and acquire allophonic variation between their two languages.

### 2.1. *First language influences on the acquisition of the second language*

Several studies have shown that English speaking learners of Spanish have difficulty producing the reduced aspiration of Spanish voiceless stops. González-Bueno (1997), for example, examined Intermediate Spanish students in the university setting and confirmed this initial difficulty, although she also showed that explicit pronunciation instruction could help them overcome these problems. Similarly, Flege (1980) investigated the ability of Saudi learners of English to produce sounds in their L2 and whether they experienced interference from the L1 in doing so. His findings confirmed the influence of L1 in L2 phonology, in that the word-final and -initial VOT values of the participants were similar to their L1.

Further work by Flege (1987) attempted to explain this L1-L2 relation through the development and formation of phonetic categories. In this study Flege investigated Spanish speakers' articulation of English voiceless stops in carrying out imitation tasks. Using a VOT continuum to evaluate accuracy of pronunciation, he discovered that the speakers who were able to accurately produce English /t/ had formed a phonetic category {t<sup>h</sup>}, allowing them to pronounce the stop with aspiration and achieve VOT values consistent with those of native English speakers. Those who articulated English stops with less aspiration, and thus had shorter VOT values, were analyzed as either having incorrect phonetic categories or as having not yet formed a separate phonetic category for English /t/. Flege also found that age of acquisition can be an important factor in this process of developing phonetic categories, as the speakers who had learned English at an early age were more likely to have formed a phonetic category for English /t/ than those who learned English later. Of course, Flege (i.e., 2005) recognizes, as have others, that age is a factor that is difficult to isolate from other relevant factors such as language use and language input, thereby making its role hard to categorize.

Flege's (1991) later work continued with this same vein of investigation, but refined his hypothesis to propose the Speech Learning Model (SLM). This model, through Equivalence Classification, stipulates that speakers who learn an L2 early (as children) will establish two different categories for their two languages (i.e., Spanish and English). Based on bilingual VOT data, Flege proposes those who learn an L1 and an L2 earlier rather than later can, in a sense, separate their two languages by separating the sounds. However, he also predicts that adults learning a second language are not able to create two unique categories for sounds that are similar in the two languages and will therefore classify the L2 sound using the L1 category. This erroneous classification will, of course, result in nonnative-like VOT values in the L2. Thus, Equivalence Classification leads to the conclusion that if one cannot form a new category for an L2 sound, one cannot produce that sound authentically.

Another study, Thornburgh and Ryalls (1998), also looked at the influence of age on the VOT values of English stops produced by Spanish-English bilinguals. The authors hypothesized that Spanish speakers who had learned English prior to age 12 should more closely approximate English VOT values than those who had learned English after age 12. They found that the pre-12 participants produced more accurate English VOTs than the post-12 group, and made a larger distinction between their voiced and voiceless stops, indicating that learning English prior to the age of 12 may have enhanced their ability to correctly distinguish the L1 and L2 categories.

Of course, there are numerous other studies that investigate VOT acquisition in second languages, although in the interest of conciseness this review focuses on those studies that lay the groundwork for the present study. Yet even from this admittedly brief review, it is clear that the work that has been done exploring an L2 learner's ability to acquire new VOT values, and the difficulty<sup>1</sup> encountered in doing so, has confirmed a significant role for the L1 in this process. However, less common are studies that examine the converse situation: does acquisition of an L2 impact the L1? The following section presents some of the research that exists regarding this topic, although there is a much smaller body of work in this area than in the previous.

## 2.2. *Second language influences on the first language*

Most research on L1 change focuses on speakers who lose their L1 as a result of becoming members of bilingual communities and reside in the L2 community (i.e., Armour 2000; Bolonyai 1998; Major 1992; Porte 1999; Seliger & Vago 1992; Sorace 2000; Waas 1993, *inter alia*).

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<sup>1</sup> The term "difficulty" is admittedly vague, although it is beyond the scope of this paper to address all the possible reasons L2 learners encounter problems during language acquisition. One possibility is that those features that are more marked in the L2 will be those that are most difficult to acquire successfully, as predicted by the Markedness Differential Hypothesis (Eckman 1977, 1985, 1991). Another possibility is what Major calls the Similarity Differential Rate Hypothesis (Major & Kim 1996); that is that the "difficulties" we observe in L2 learning are not so much a result of similarities or differences between languages or systems but rather the rates at which different aspects are learned, which is determined by their similarities to or differences from the L1 system. As we have said, it would be impossible for this paper to address the possible causes or interpretations of difficulties that students encounter in learning an L2; suffice it to say that we recognize the issue is a complex one and use the term in its most general and comprehensive sense here.

Major (1990) studied L1 loss among native English speakers living in Brazil, and suggested that individuals who acquire an L2 as adults cannot preserve native-like pronunciation in both their L1 and L2. Therefore, learners are left with three options: they can preserve their L1 without achieving native-like L2 pronunciation; they can lose their L1 and achieve native-like L2 pronunciation; or learners can fall short of native-like pronunciation in both L1 and L2. To test these possibilities, he recorded VOT data from English-Portuguese bilinguals in both languages and found that although L2 learners usually maintain their L1 without achieving native-like L2 pronunciation, this option only came somewhat close to describing two of the participants in this study. One participant fit the second hypothesis, demonstrating native-like L2 pronunciation, but losing native-like L1 pronunciation. The third hypothesis characterized the other two subjects, whose L1 and L2 differed significantly from that of native speakers. Major continued this investigation into the effects of L2 on L1 in Brazil in a later study (1992), this time expanding his hypothesis to propose that the L2 influences the L1, with a direct relationship between L2 proficiency and L1 loss. Major predicted that L1 loss would be associated with L2 proficiency. His results showed that command of Portuguese was indeed correlated with loss of English, especially in casual speech.

Flege (1987) also investigated this issue of L1 change or loss, as a precursor to his Equivalence Classification theory. As noted in the previous section, Flege works under the premise that learners can create unique phonetic categories for new L2 phones, but not similar ones, based on the model of Equivalence Classification. Under this view, learners should associate similar phones in their L1 and L2, which thus restricts their ability to realize sounds with standard VOT values in both languages. In other words, learners merge similar sounds due to a lack of separate phonetic categories, and realize similar phones with similar VOT values in L1 and L2; Flege classifies this process of combining categories in his Merger Hypothesis. Category merger is one possible explanation for difficulties individuals have in pronouncing L2 sounds, but could also be responsible for L1 changes as a result of L2 acquisition. Flege analyzed the pronunciation of English /tu/ and French /tu/ and /ty/ of both L1 English and L1 French bilinguals and found that the speakers' L2 did in fact influence their L1, though the L1 English speakers showed greater effects in their L1 than the L1 French speakers. Moreover, Flege posited that because the VOT values showed mutual influence of L1 and L2, Equivalence Classification could be responsible for the hybrid values, meaning that the speakers had not formed new phonetic categories for similar sounds, but rather merged them. These studies seem to demonstrate that the L1 phonological system may be susceptible to modifications as a result of learning an L2.

At the same time, however, few studies investigate L2 speakers who remain in their L1 community (as opposed to immigrants living in the L2 environment). The relatively few studies there are in this area, however, can provide some preliminary insights into this phenomenon. In the case of early bilinguals, there is evidence that these speakers may continue to be influenced by their L1 even well into adulthood, and perhaps vice versa (Caramazza, Yeni-Komshian, Zurif & Carbone 1973). These authors suggest that in bilingual speakers, the L1 categories can be modified upon learning an L2, so that their L1 categories are no longer like those of monolingual speakers. Other studies have found similar results. A case study by Sancier and Fowler (1997) investigated VOT values in a Portuguese-English bilingual speaker. They found that both the L1 and the L2 values differed from the monolingual norms, "drifting" between the two. In a related study, Bullock, Toribio, González and Dalola (2006) investigated VOT values in L1-L2 code switching tasks by bilingual speakers. They found that the English L1 speakers, when anticipating or recovering from a code switch, demonstrated VOT values in English that were lower than monolingual values; in other words, their first language appears to have suffered a degree of modification under the influence of their second.

Even though these studies have provided valuable insight into the mutual effects of L1 and L2, they remain limited in number, and it is still unclear whether or not a learner's first language is truly modified in the process of acquiring or using an L2. Voiceless stops provide a fertile testing ground for obtaining such data considering the abundant L2 research done in this area. Therefore, this study explores these questions as applied to Spanish and English voiceless stops, using VOT as a quantifiable basis for comparison of bilingual to monolingual VOT values.

### 3. Methodology

#### 3.1. Research Questions

The research questions that guided this investigation were the following:

1. How do the English VOT values of /p, t, k/ produced by advanced learners of Spanish (L1 English) compare to those produced by monolingual English speakers?
2. How do the Spanish VOT values of /p, t, k/ produced by advanced learners of Spanish (L1 English) compare to those produced by monolingual Spanish speakers?

Question (1) is the main motivation behind this research study, asking about the influence of the L2 on the L1: by knowing (and accurately producing) L2 sounds, does a speaker necessarily restructure her/his L1 also? Question (2), in contrast, essentially asks the same question asked by the researchers whose work was reviewed above: does the L1 influence L2 phonological production? Even though this is not the primary focus of this study, these questions are necessary to gain an understanding of the L1-L2 interaction. In other words, in order to find speakers whose L1 has been modified by the L2, we must find speakers whose L2 is advanced. Therefore, both questions are addressed in these data.

Based on the above studies and on the premises of the Merger Hypothesis and Equivalence Classification, it is hypothesized that English speakers who have learned Spanish will produce VOT values for English /p, t, k/ that are shorter (i.e., less aspirated and thus more Spanish-like) than those of monolingual English speakers, confirming a role for the L2 in L1 pronunciation. Further, it is expected that English-speaking learners of Spanish will produce VOT values for Spanish /p, t, k/ that are longer (i.e., more aspirated and thus more English-like) than those of monolingual Spanish speakers.

#### 3.2. Participants

A total of 15 participants took part in this study. Participants were divided into three groups: the experimental group and two control groups. The control groups consisted of English monolinguals (n=7) and Spanish monolinguals (n=3), while the experimental group consisted of native English speakers with advanced proficiency in Spanish (n=5). The monolingual speakers in the control groups grew up in either Spain or the United States, spoke only their L1 in their households and had not studied any other language in high school or college. There was no placement test administered to assess proficiency of the experimental group, but their high proficiency was determined through the researcher's personal knowledge of their linguistic skills, as well as based on the fact that they were all graduate students or professors of Spanish who had studied, spoken and/or worked with Spanish for a minimum of 10 years. These participants all reported using Spanish for their profession, to teach and to carry out research and/or graduate coursework, although they primarily used their native English at home.

#### 3.3. Tasks

Tasks were carried out in a digital language lab or in a quiet room with a digital voice recorder and head-mounted microphone. Participants first filled out a language background questionnaire, which was tailored to the participant's language background and asked for information regarding their language exposure, experience and use. Then participants proceeded to the recording portion of the tasks, which consisted of reading out loud a list or lists of words in isolation, as well as a paragraph-length passage, although only data from the former are discussed here. The monolingual control groups performed tasks in their native language only, while the experimental group carried out the tasks in both English and Spanish, with the Spanish tasks preceding the English. Each word list contained 36 randomly ordered words embedded within the carrier phrases *Yo digo \_\_\_\_ para ti* or "I say \_\_\_\_ for you," depending on the language. Ten words began with /p/, 10 began with /t/, and 10 began with /k/; 6 words were distracters that began with a consonant other than /p, t, k/. (Given the variety of vowel contexts and other consonants included in the experimental words, it was deemed unnecessary to include more than six distracters.) All words contained two syllables only, and all

words received penultimate stress. Please see the Appendix for the lists of Spanish and English words used.

### 3.4. Data Analysis

Individual tokens of initial /p, t, k/ were identified in the sound files, isolated, and saved separately so that each file contained only a single item from the list. This isolation process resulted in a total of 30 sound files associated with each monolingual participant, and 60 sound files for the L2 Spanish speakers (30 in English and 30 in Spanish). Isolated sound files were imported individually into the voice analysis software program Praat, version 4.4 (Boersma & Weenink, [www.praat.org](http://www.praat.org)), which was used to measure the duration of VOT in each token. VOT was measured from the consonant release burst to the onset of periodicity of the following vowel. Both a student assistant and the author measured all tokens; in cases where these two VOT measurements differed by less than 3 ms, the average of the two was used. In the few cases where there was greater disagreement between the two measurements, both the assistant and the researcher, as well as a second student assistant, measured the VOT of those tokens again until agreement within 3ms was reached.

These VOT values were then used to calculate average values for the subjects' pronunciation of each of the sounds (/p/, /t/, and /k/), which were then submitted to non-parametric statistical analyses (Mann-Whitney) comparing the experimental group's values to each of the monolingual control groups.

## 4. Results

Table 1 shows the average VOT values per sound for each of the three groups, with standard deviations indicated in parentheses. Recall that the monolingual groups only carried out tasks in their native language, while the control group made recordings in both English and Spanish.

	Eng /p/	Eng /t/	Eng /k/	Spn /p/	Spn /t/	Spn /k/
Monolingual Spanish				21.202 (7.163)	24.999 (7.929)	33.914 (15.225)
Experimental	70.478 (22.841)	70.879 (22.353)	78.953 (22.968)	25.360 (15.850)	29.092 (13.644)	49.952 (16.150)
Monolingual English	83.801 (32.178)	91.476 (37.736)	99.727 (24.434)			

**Table 1: Average VOTs by group, in milliseconds (with standard deviations)**

The first research question asked if English speakers who have advanced proficiency in Spanish would produce English any differently than monolingual English speakers. Results of the statistical analysis, as shown in Table 2 below, reveal that there is no difference in the production of /p/ or /t/ between the two groups. For /k/, the English speakers who have learned Spanish produce significantly less aspiration in English than monolingual speakers.

	English /p/	English /t/	English /k/
Mann-Whitney U	17.000	7.000	5.000
Wilcoxon W	32.000	22.000	20.000
Z	-0.081	-1.705	-2.030
Exact Sig. [2*(1-tailed Sig.)]	1.000	0.106	0.048*

**Table 2: L1 English in English vs. Monolingual English**

It is also important to know, however, if these English speakers have achieved advanced proficiency in their pronunciation of their L2, Spanish. Recall that the second research question asked how their production of Spanish compares to monolingual Spanish speakers. The results, shown below in Table 3, indicate that there is no statistical difference in the English speakers' production and the

Spanish speakers' production. In other words, these learners of Spanish have been able to suppress the aspiration from their L1 in order to authentically produce L2 sounds.

	Spanish /p/	Spanish /t/	Spanish /k/
Mann-Whitney U	4.000	3.000	3.000
Wilcoxon W	10.000	9.000	9.000
Z	-1.043	-1.342	-1.342
Exact Sig. [2*(1-tailed Sig.)]	0.393	0.250	0.250

**Table 3: L1 English in Spanish vs. Monolingual Spanish**

In summary, then, we had hypothesized that English speakers who have learned Spanish will modify their L1 values in English /p, t, k/ to resemble shorter Spanish VOTs. This hypothesis was not confirmed, as the only consistent and significant L1 modification this group shows is in their production of /k/; their production of /p, t/ resembles that of the monolingual English speakers. It was also expected that these English-speaking learners of Spanish would produce native-like VOT values for Spanish /p, t, k/. This hypothesis was confirmed, as there is no statistical difference found between the Spanish /p, t, k/ of the experimental group and the Spanish /p, t, k/ of the monolingual Spanish-speaking control group.

## 5. Discussion

The two primary premises behind this study were Flege's Equivalence Classification and Merger Hypothesis. There is support for Equivalence Classification in the statistical results, in that the English speakers proved to be successful at suppressing aspiration when speaking in Spanish. It is worth noting, however, that in English both aspirated and unaspirated (as well as unreleased) allophones of /p, t, k/ exist, so it is not a brand new sound the speakers have to learn but rather a new distribution. Further, it is possible that short-lag stops may be a universally unmarked tendency (Kewly-Port & Preston 1974). In other words, it would be relatively easier for English speakers to learn to pronounce Spanish-like VOTs than it would for Spanish speakers to learn to produce English-like VOTs. Future research will have to determine if universal principles play a part in this finding. In terms of the Merger Hypothesis, there is little evidence in these data to confirm the influence of a learner's L2 on the existing L1 system, as the experimental group only showed significantly different L1 pronunciations of one sound, /k/.

Although the hypotheses were not confirmed through the statistical analysis, visual examination of the data reveals a definite trend toward the hypothesized outcomes, as can be seen in Figures 1, 2 and 3 below. The bars in the figures represent the average VOT values produced by the experimental group for each of the three sounds in question; the dotted line represents the VOT value produced by the monolingual English group, and the dashed line represents the VOT value produced by the monolingual Spanish group.

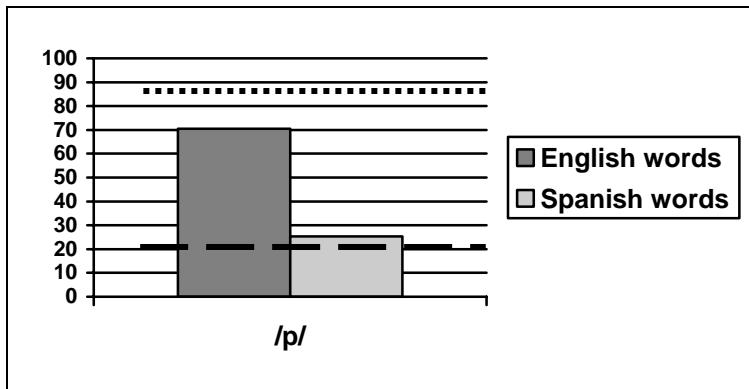


Figure 1: VOT values for /p/

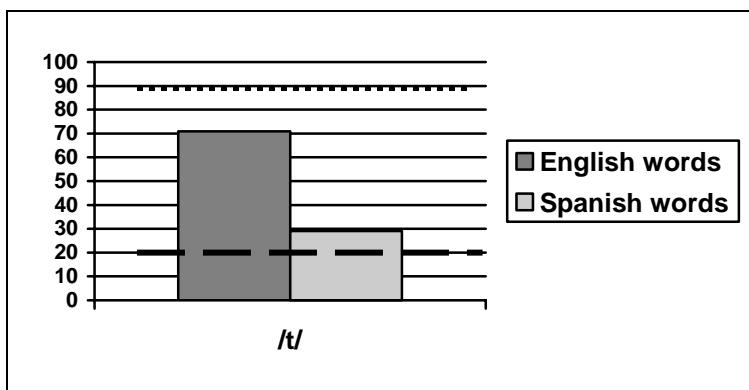


Figure 2: VOT values for /t/

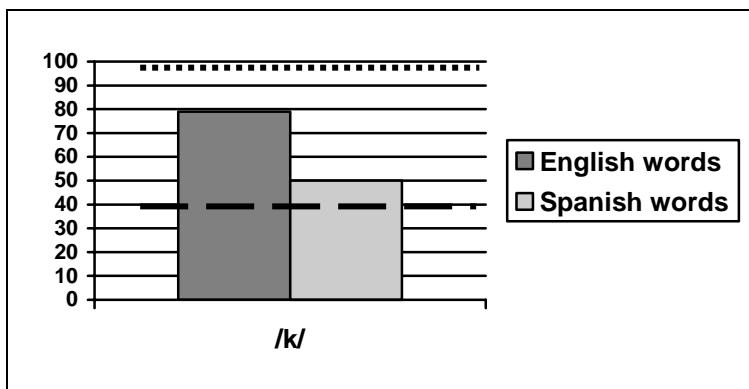


Figure 3: VOT values for /k/

In each of the three figures, one clear trend emerges: the experimental group produces VOT values for each of the three sounds that are intermediate to the monolingual values of the English and Spanish speakers, in both English and Spanish. In other words, the participants in the experimental group have indeed experienced a degree of merger between their L1 and L2 categories, producing both languages differently than monolingual speakers do.

## 6. Conclusion

This study has offered tentative support for the Merger Hypothesis (Flege 1987) and shows that it is possible for L1 modification to occur, even when the learner has remained in an L1 community. These findings show that the L1 and the L2 interact to produce a hybrid system subject to

modification, and offer insight into how L2 learners manage assimilation of two linguistic systems, in keeping with the Merger Hypothesis and Equivalence Classification.

As with any investigation, there are some limitations to this study that may have impacted the results and should be considered and corrected in future work. To begin with, the sample size in this pilot study was extremely small, which could have affected the statistical tests and, by extension, the internal validity of the study. An examination of standard deviations also reveals that variability is not uniform even within participant groups. This too could be related to the small number of participants, whereas a larger group might have yielded more heterogeneous samples, or at the very least afforded the opportunity to discard some of the most extreme outliers. As always, when working with bilinguals, it is extremely difficult to ensure homogeneity of language levels (of the L1, L2 or both), and a larger sample size might help to remedy this shortcoming as well.

At the same time, it must be recognized that the experimental group in this study does indeed differ from Flege's (i.e., 1987), in that they were not immersed in the L2 environment at all times, but only during limited periods of their daily professional lives. Therefore, in order to more accurately replicate Flege's work, and to truly find evidence from Spanish-English bilinguals that would mirror his French-English bilinguals, a different group of participants would need to be investigated; namely, this study could be replicated with a group of English speakers living in a Spanish-speaking country at the time of testing and for an extended period of time. The data obtained from this group would be more comparable to those obtained in Flege's study.

Nonetheless, it is interesting to explore how the L1 and L2 systems of advanced L2 speakers may be modified without this intense immersion, as the results presented here have suggested is possible. This is a new area of research that is just now opening up, as was discussed above. Future research could benefit by extending these investigations of L1 modifications while still in the L1 environment, and could investigate a number of variations on the data presented here. For example, it could be enlightening to expand the tasks to include a variety of speech patterns, such as spontaneous speech, or more extended discourse, given that Major (1992) found that the effects of L2 interference in L1 are dependent, among other things, upon the amount of attention the speaker is paying to her/his speech. Also worthy of investigation are other sounds in English and Spanish. VOT provides a fertile testing ground as there is ample L2 research in this area, and VOT is an easily quantifiable phenomenon. However, it is possible that there are other phonological areas that are more susceptible to interference or language transfer, such as vowels (i.e., Flege 1987).

Studies in these areas would provide valuable information in the ongoing investigations into the relationship between L1 and L2 in the language acquisition process and could help to further elucidate the workings of the bilingual mind in showing how language learners deal with and treat two linguistic systems (Grosjean 1985, 1989; Grosjean & Soares 1986). Some participants in the present study commented on their language background questionnaires that they felt "clumsy" in their L1 after studying an L2 or spending time abroad. The preliminary data presented here, although tentative, begin to offer an explanation for these types of sentiments and provide encouraging enough findings to continue the investigation.

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## Appendix: Words used in data collection

### Spanish word list

1.	tercio	19.	piña
2.	quema	20.	queja
3.	pipa	21.	fama
4.	carta	22.	tímido
5.	pelo	23.	quitan
6.	barco	24.	turno
7.	toque	25.	culpa
8.	quince	26.	silla
9.	tarde	27.	tigre
10.	pena	28.	templo
11.	dentro	29.	compras
12.	colcho	30.	cobra
13.	pulga	31.	marcha
14.	tuco	32.	parte
15.	pase	33.	puja
16.	genio	34.	tonto
17.	pongo	35.	pobre
18.	tabla	36.	caja

### English word list

1.	kinship	19.	ticket
2.	temper	20.	peddle
3.	tunnel	21.	debit
4.	puddle	22.	kettle
5.	cuddle	23.	pistol
6.	stairway	24.	public
7.	package	25.	toggle
8.	tamper	26.	breakage
9.	kennel	27.	pendant
10.	tangle	28.	capture
11.	groggy	29.	kitchen
12.	panel	30.	current
13.	tested	31.	melting
14.	college	32.	tumble
15.	popcorn	33.	pigeon
16.	fruitful	34.	topping
17.	copper	35.	polish
18.	timid	36.	cabbage

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