

Phonetic Convergence:  
A Case Study of a Puerto Rican Spanish Speaker

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## **1. Introduction**

### **1.1 Background on Phonetic Convergence**

The phenomenon of phonetic convergence has only started to be examined relatively recently in the field of linguistics. According to Babel (2009), phonetic convergence can be defined as follows: "Phonetic imitation, also known as phonetic convergence or phonetic accommodation, is the process in which a talker acquires acoustic characteristics of the individual they are interacting with." (Babel 2009). As seen from other studies (Sancier & Fowler 1997, Fowler, Sramko, Ostry, Rowland, & Halle 2008), however, phonetic convergence is not only limited to the acoustic, but also includes other characteristics, such as changes in VOT. Despite being examined by various studies, many aspects of phonetic convergence are still not thoroughly understood. It is the purpose of this paper to give more insight into this phenomenon by examining convergence at the segmental and prosodic levels of speech.

Many of the studies done on phonetic imitation have examined phonetic convergence between native English speakers (Babel 2009, Babel 2010, Giles 1973, Parnell 2009, Pardo 2006). One of these studies (Pardo 2006) examines the presence of phonetic convergence in the conversations between pairs of native English speakers. In this study, each member in the group of participants was asked to be recorded individually reading a list of words aloud. Each member was then paired with another participant of the same gender with whom he or she held a conversation by means of the map task. After the conversation, each member was recorded once more individually. By means of a perceptual task performed by a separate set of listeners, the study found that the members of each pair that engaged in conversation through the map task began to converge towards each other, and this phonetic convergence became more apparent as

their conversations continued. In addition, it was also shown that the effects of convergence lasted after the participants ended their conversations.

Pardo (2006) shows phonetic convergence occurs when speakers interact with speakers of different dialects of the same language. Even more surprising is the time span in which the convergence occurred. Pardo (2006) shows phonetic convergence can occur in such a short amount of time as a simple conversation and between speakers who do not know each other. Therefore, this specific study gives us an idea of the time span necessary for phonetic convergence to occur and the circumstances in which it is found.

Not all studies have been limited to phonetic convergence in English. Various studies have examined the effects the languages of bilingual speakers have on each other (Flege & Eefting 1987, Fowler et al. 2008, Guion 2003, Sancier & Fowler 1997). Much of the experiment for this paper has been based in part on the findings found in Sancier & Fowler (1997). This study examined the effects of language environment on the English and Portuguese of a native Brazilian Portuguese speaker who learned English, fluently, as a second language. For the experiment, VOT measurements of the participant's English and Portuguese were taken after the participant's long stay in the United States and in Brazil. The study found that each time the participant spent a considerable amount of time in one of these two countries, the VOT for both of the participant's languages converged toward the direction of the language environment she was in. In other words, her VOT for both languages increased after a long stay in the United States, and decreased after a long stay in Brazil.

The importance of this study lies in the fact that phonetic convergence is not limited to the domain of one language. From Sancier & Fowler (1997) we learn that the language environment in which a speaker lives can have an effect on the languages of the speakers, even

for speakers fluent in two languages. On the other hand, we see from Pardo (2006) that a long period of immersion in a specific language environment can cause significant phonetic convergence in aspects such as VOT and can occur across language boundaries. Therefore, we are able to see how phonetic convergence can be present in both short and long time periods of interaction between speakers, and beyond the speech of monolinguals.

Similar results to the study mentioned above have also been found in native bilingual speakers (i.e. speakers brought up with two languages from birth). For example, Fowler et al. (2008) found significant VOT differences in the French and English of native bilingual speakers from Montreal, Canada. In this study, VOT measurements were taken for the French and English of these native bilinguals and were subsequently compared to the VOT measurements of French or English monolingual speakers from France, Canada and the United States. It was shown that for those bilingual speakers who use both French and English on a regular basis, the VOT's of both languages converged towards each other. In other words, the VOT of their French is longer than that of French monolinguals (converging towards English), while the VOT of their English shorter than English monolinguals (converging towards French).

This study demonstrates phonetic convergence can also occur between languages of bilingual speakers, even if they are both spoken natively by the speaker. Fowler et al. (2008) reveals that phonetic convergence is a tendency that can occur within the individual speaker's languages, not exclusively tied to the language environment or the speakers with whom a specific person interacts. One might assume that native bilingual speakers who regularly use both of their native languages will keep them distinct, avoiding any type of convergence as that found in Sancier & Fowler (1997). Fowler et al. (2008), however, refutes this idea, showing that even in these instances, a bilingual's languages might converge towards each other.

While the studies mentioned so far have shown the presence of phonetic convergence, other studies show that the extent of this phenomenon can be influenced by non-linguistic factors. Babel (2009) and (2010) examine the effects of social factors on the extent to which phonetic convergence is observed. For example, in Babel (2009), a study was conducted to see whether the extent of phonetic convergence present in the participants' vowels would be affected by their racial biases towards white or black speakers. For this experiment, each participant was asked to repeat words they heard in a recording that were spoken by either a white speaker or a black speaker. In some cases, participants were shown photographs of the speakers. They were also asked to participate in an Implicit Association Task (IAT) designed to test their racial biases. The results for this study revealed that, although the participants' vowels converged, the extent of convergence was highly influenced by the participant's racial biases towards the speakers such that there was less convergence towards a speaker if the participant had a negative view of the speaker's race.

This and other studies have added to our understanding of phonetic convergence by suggesting its extent can be affected by external factors, such as social biases. Therefore, although studies not examining the effects of social factors on phonetic convergence have shown that speakers do converge towards other individuals or language environments, factors such as social biases can halt the extent to which this occurs. Thus, speakers converge in some cases while in others they might not converge as much due to their social biases towards certain speech characteristics.

Not only social factors can be responsible for differences in the extent of phonetic convergence, however. In some instances, phonetic *divergence* can be observed due to more phonological reasons. One study (Flege and Eefting 1987) examined the effects of phonetic

convergence in the Dutch and English of native Dutch speakers. Contrary to what was found in the studies mentioned above, this study showed that the Dutch VOT for those participants more proficient in English actually diverged from English. For these speakers, their Dutch VOT was lower than the Dutch VOT for the participants not as proficient in English. This is exactly in the opposite direction of English VOT, which is longer. Flege & Eefting (1987) proposed that the reason for the divergence observed is related to how speakers group phonemes of different languages phonologically. For example, it is proposed that the participants in the study more proficient in English group Dutch /t/ and English /t/ into two separate phonological categories, thus keeping them distinct. In contrast, for speakers in different studies, if two phonetically similar phonemes of two languages are not categorized into distinct phonological categories by a speaker, there will be a tendency for them to converge. Thus, the circumstances in which phonetic convergence occurs cannot only be influenced by social factors, but can also be influenced by proficiency in a language.

Although the existence of phonetic convergence has been verified by various studies, studies like those above suggest this phenomenon is not straightforward and is susceptible to other linguistic factors. From these studies we can start to understand just how phonetic convergence occurs, under what circumstances it is present, and how it is affected by other factors. However, there are many open questions left un-answered, and much more to understand on the aspects of phonetic convergence that created the motivation for this present study.

## **1.2 Goals of the Study**

In order to understand why more work is needed on phonetic convergence, we need a greater understanding of the relevance this phenomenon has to the field of linguistics.

Further studies on phonetic convergence can shed light on the link between production and perception. For example, when speakers converge towards other speakers or the language in the environment, they are converging in the direction of the acoustic and articulatory characteristics they perceive (Babel 2009, Nielsen 2008, Sancier & Fowler 1997). Studies in the literature (Goldinger 1996 and 1998) have shown that during speech perception, language detail is stored in the listener's memory. More research is needed to understand which properties are stored in the memory and converged to in speech.

In the same realm, understanding phonetic convergence and the link between production and perception are closely related to language acquisition. Although there is a consensus that a certain critical age exists for children to learn languages natively, the phenomenon of phonetic convergence suggests that adults still have the ability to acquire language to a certain extent. Adults are able to use the input they receive from speech and imitate it in a similar way as young children acquire language by imitating the speech of the individuals that surround them. Thus, phonetic convergence allows us to see that both adults and children are still capable of acquiring linguistic characteristics from the input speech signals they receive, even if in the case of adults it is to a lesser degree.

Phonetic convergence also plays a significant role in language change. For example, the work in Bullock & Gerfen (2004) examines changes in the vowel system of Frenchville French, arguing that the changes it is undergoing are due to phonetic convergence towards English. More specifically, it is argued that the distinct French /œ/ and /ø/ phonemes present in the speech of Frenchville French speakers in the 1970's has converged to the rhoticized American vowel /ə/ in the speech of the study's participants due to the influence of American English. Another study (Christen 2011) explores changes in Swiss German dialects as they come into close contact by



looking at different linguistic aspects of change, including the areas of phonetics and phonology. From such studies we can see the important role phonetic convergence plays in changes due to language contact. Phonetic convergence can be seen as an agent of linguistic change, as many changes in languages, such as the case of Frenchville French, are possibly initiated partially by phenomena such as phonetic convergence.

This present study attempts to shed light on the phenomenon of phonetic convergence through an experiment conducted on a native Puerto Rican Spanish speaker. The speaker, who has been living outside of Puerto Rico for a considerable amount of time, has some differences in his Spanish compared to the speech of local Puerto Ricans. This study (explained more thoroughly in Section 2) investigates if the Spanish of the participant will converge back to the Spanish of local Puerto Ricans at the segmental and prosodic levels during a one-week stay in the island. The read and spontaneous speech of the participant was analyzed before, during, and after the trip to Puerto Rico, examining changes of phonetic variables at both the segmental and prosodic levels due to the phenomenon of phonetic convergence. Results are analyzed and discussed in the context of the questions mentioned above.

The main motivation and goals of the study can be summarized as follows: Work done on phonetic convergence has given us much insight into the phenomenon, but has left us with many un-answered questions. Through this study, two specific aspects of phonetic convergence are examined in an attempt to better understand the properties of the phenomenon.

The first aspect is the time frame of phonetic convergence. Pardo (2006) shows convergence for a specific variable (vowels) can occur during a conversation, while Sancier and Fowler (1997) and Fowler et al. (2008) examine changes in VOT in a much longer time frame. In this study, a different time frame (one week) is chosen to examine changes in a greater variety

of variables in order to investigate the importance specific time frames have on phonetic convergence and the variables that converge. The second aspect analyzed is the extent of phonetic convergence. More specifically, this study analyzes which of the chosen variables converge and which variables remain the same during the time frame chosen. In addition to examining phonetic convergence at the segmental level as seen in the literature, this specific study also investigates phonetic convergence at the prosodic level, which so far has not been examined in the literature.

## **2. Experiment**

As explained below, an analysis of the speech of the Puerto Rican participant is made with the goal of examining segmental and prosodic convergence. Results obtained are used to try to answer the main questions posed in Section 1.2 and to gain a deeper understanding of the properties of phonetic convergence.

### **2.1 Participant**

The participant chosen for this study is a 58 year-old male native Spanish speaker born and raised in the town of Hormigueros, Puerto Rico. The speaker received an education in the island all the way through High School and two years of college. Although he was mainly instructed in Spanish, the participant was exposed to the English language from a very young age and had daily English classes during his time in school. At the age of 18, the participant moved to New York City, where he resided until the age of 23. At the age of 23, he once more returned to his native Puerto Rico. Three years later, at 27 years of age, he moved to Acapulco, Mexico, where he lived for over ten years. After his long stay in Mexico, the participant moved once more to New York City and has been living there since.



after his stay in Puerto Rico. This will occur if, while in the US, the participant's Spanish stops converged to the aspirated equivalents present in American English. Therefore, VOT is one of the linguistic variables analyzed in this study to demonstrate whether the participant's VOT converged to English in the United States, and whether it will converge back to the speech of Puerto Rican speakers during the participant's one week stay in Puerto Rico.

*b. Coda /s/ deletion/aspiration*

Previous research (Figueroa 2000, Matluck 1961, Terrell 1968, Torreira 2006) all account for the phenomenon of coda /s/ deletion or aspiration in Puerto Rican Spanish. In the speech of local Puerto Ricans, coda /s/ tends to be phonetically produced as [h] (aspiration) or deleted all together. For example, a word like *estás* 'you are' will be pronounced as [ehtah] or [eta] by a Puerto Rican speaker, instead of the more standard [estas] production. Figueroa (2000) shows that when the coda /s/ is aspirated or deleted, vowel lengthening occurs to compensate for the loss. Therefore, words such as *gato* 'cat' and *gasto* 'cost' are pronounced as [gato] and [ga:(h)to] respectively, differentiating the meanings of the two words. It is important to note that deletion or aspiration of coda /s/ is somewhat stigmatized in Puerto Rico, despite being the main way of pronouncing this consonant in this phonetic context. In the case of the participant for the present study, informal observation indicated a strong tendency for the speaker to delete or aspirate the coda /s/ in his speech, but in some cases he does pronounce the coda /s/ as the fricative [s], just as in standard Spanish. This might be due to influences of other Spanish dialects, such as Mexican Spanish, which do not delete or aspirate the coda /s/, pronouncing it instead as a fricative [s]. Therefore, the changes in the production of this linguistic variable also form part of the analysis for this experiment.

It is important to note that despite the tendency of deleting or aspirating the coda /s/, Puerto Rican Spanish also has the phenomenon of /s/ elision for a coda /s/ found between two vowels (Terrell 1978). The coda /s/ that are not found between vowels or are at the end of a pause or an utterance are not affected by the phenomenon of elision. In order to avoid any interference of this phenomenon with the analysis of coda /s/ deletion and aspiration, only the coda /s/ that are not affected by elision were used in the analysis for this study. This was to make sure that those coda /s/ counted as standard were actually standard productions of this variable, instead of being affected by elision.

c. Coda /r/ → [l]

Another characteristic of local Puerto Rican speech is the production of coda /r/ as a liquid [l], as attested in the literature (Matluck 1961, Medina-Rivera 1999, Valentin-Marquez 2007). For example, a word like *comer* 'to eat' would be pronounced by a Puerto Rican speaker as [komeɫ] instead of the standard [komeɾ]. As discussed in Valentin-Marquez (2007), this non-standard pronunciation of the coda /r/ is socially stigmatized. Medina-Rivera (1999) shows that the percentage of the non-standard production of this consonant is influenced by the social context of a conversation. The more informal the social context, the more non-standard pronunciations will be present in the speech of Puerto Rican speakers. In the case of the study's participant, he indicated a strong preference for the standard pronunciation of this consonant, despite in some instances pronouncing it as a liquid [l]. This might also be due to the influence of other Spanish varieties on the participant, such as Mexican Spanish. Although the dialect of the experimenter is closer to the Mexican Spanish variety, since the experimenter and the local Puerto Ricans the participant held conversations with during the experiment are all his close family members, it is expected that the experiment is controlled for social context. Therefore, for

this study, the experimenter looked for any change in the production of this linguistic variable, with the expectation that non-standard productions would possibly increase during the participant's time in Puerto Rico.

*d. Velar/Uvular production of /r/*

In the speech of many local speakers of Puerto Rican Spanish, the alveolar trill /r/ will have velar or uvular productions, as seen in the literature (Matluck 1961, Valentin-Marquez 2007). For example, a word like *carro* 'car' will be pronounced as [kaxo] or [kaxo], instead of the standard [karo] pronunciation. Out of the three consonant productions discussed in this study, this is perhaps the most stigmatized in Puerto Rico. The participant for this study indicated great disdain for this non-standard pronunciation of the phoneme /r/, exclusively using the standard alveolar trill in his speech. The fact that the participant sees the velar or uvular pronunciations of this variable in a very negative ways suggests that he might not want to converge to this way of pronouncing the phoneme /r/. However, it is still included as part of the analysis for this experiment, as convergence is expected to be influenced by other linguistic factors and not exclusively by social factors.

*e. Intonation*

The last linguistic variable included in the analysis for this experiment is intonation. One of the differences between dialects of Spanish is intonation (Prieto & Roseana 2010), and since the participant has been exposed to different types of Spanish and to English, the question that arises is whether his intonation diverged throughout the years from local Puerto Rican Spanish, and whether or not it will converge back to local Puerto Rican intonation during his trip. Since no extensive labeling system, such as the Tones and Break Indices (ToBI) system described in Beckman, Hirschberg and Shattuck-Hufnagel (2005), has so far been established specifically for

Puerto Rican Spanish, and the required research for developing one is beyond the scope of this paper, for this study only basic intonational contours will be analyzed to see if any changes occurred in the intonational patterns of different sentence types. These sentence types and the methods used to analyze them are further discussed in Section 2.3.

Based on the information about phonetic convergence gathered from the literature and the characteristics of the participant's speech, some predictions can be made for the results of the experiment, as outlined below.

From studies such as Sancier & Fowler (1997) and Fowler et al. (2008), we can expect that the VOT of the participant's Spanish has converged towards the direction of English VOT. More specifically, since English voiceless stops have a longer VOT than those in Spanish, based on these previous studies, the VOT of the participant's Spanish should have increased. If this in fact is the case, the opposite is expected to occur when the participant returns to Puerto Rico, when he is immersed in a completely Spanish-speaking environment. Once the participant arrives to Puerto Rico, it is expected that his Spanish VOT will start to converge to the local speech, thus decreasing. Since the studies cited on VOT all have tested changes after a long term (a few months to years), however, it is not possible to predict if any changes will occur in the course of one week.

For the three Spanish consonants mentioned in Section 2.2, the general hypothesis would be that the percentage of non-standard Puerto Rican variants of these consonants in the participant's speech will increase over the span of the week in Puerto Rico. If the participant does show convergence, we can expect this increase to be measurable. One complicating factor, however, is the social stigma attached to these consonants. As mentioned in Section 2.2, the non-standard variants of these consonants are stigmatized in Puerto Rico and by the participant

himself. The degree to which each of these variables is stigmatized, however, is different, which suggests any influence social factors will have on the production of the participant will not be the same for all three variable consonants.

As for intonation, since no major work has been done exploring phonetic convergence at the prosodic level, it is difficult to make any predictions with certainty. In this exploratory study, it is first necessary to analyze the differences between the participant's intonation before the trip, and that of a local Puerto Rican. If there are differences present, the main prediction that could be made is that the participant's basic intonational contours will converge toward the intonation of the locals. If it is found that the intonation of the participant before the trip was already very similar to that of a local Puerto Rican, then that would indicate the participant's intonation never converged towards another variety of Spanish (or to English).

### **2.3 Experiment Materials**

For this experiment, two types of materials were used to analyze different aspects of phonetic convergence, namely read speech and spontaneous speech.

The stimuli used for read speech was based on the study conducted by Sancier & Fowler (1997) on a bilingual Brazilian Portuguese-English speaker. In the case of the Puerto Rican speaker, he was provided with twelve sentences in English and was asked to translate them into Spanish. As in Sancier & Fowler (1997), the participant was asked to translate in order for him not to focus on the way he was pronouncing the words. Six of the sentences had a test word designed to measure changes in VOT. In order for these test words to be controlled, each consisted of two-syllable words with an initial /t/ and stress on the first syllable. These sentences designed for VOT plus an additional six were used to examine properties of intonational contours. These twelve sentences can be divided into six sentence types: affirmative declarative,



negative declarative, yes/no question, wh-question, focus, and list. Each sentence was designed to be approximately the same length (10-12 syllables) in order to better compare the intonational contours between sentences. For the twelve English sentences and their respective Spanish translations, please see the appendix.

The second type of material used for the experiment was spontaneous speech. For the recordings done in the United States, the experimenter engaged the participant in a conversation on a variety of topics ranging from daily life matters to politics. For the recording performed in Puerto Rico, the participant engaged in conversation with three of his family members, all local Puerto Ricans. As with the recordings in the United States, the topics of conversation between the speaker and the local Puerto Ricans were also varied. The spontaneous speech was later used to look for changes in the variable consonants discussed in Section 2.2.

#### **2.4 Procedure**

In total, the participant was recorded three different times: once before going on the trip to Puerto Rico, once during the trip, and once after returning to the United States. The first recording session was on February 27, 2011, ten days before the participant left for Puerto Rico. This session was performed so many days in advance in order to get a realistic record of the participant's natural speech while in New York. Similarly, the second recording session was on March 14, 2011, two days before returning to the United States. By having two days in between, the participant was given ample time for convergence, while avoiding that he begin thinking of his return to the United States. The last session, on March 16, 2011, was performed right after the trip. The purpose of this last recording was to see whether any convergence effects lasted after the speaker left the language environment in Puerto Rico.

Each of the three recording sessions had the same format. First, the participant was asked to translate twelve English sentences into Spanish (see Section 2.3 and Appendix). The sentences were randomized, and given to the speaker in five sets for a total of 60 translated sentences recorded per session (180 in total). Next, the speaker was engaged in conversation (either by the experimenter or by local Puerto Ricans) for a total of about an hour. For each session, the experimenter's laptop computer and an external microphone were used to record the speech of the participant. The translated sentences were recorded using the program Praat<sup>1</sup>, while the program Audacity<sup>2</sup> was used to record the participant's much longer spontaneous speech.

In order to have a reference point for local Puerto Rican intonation, a local male Puerto Rican speaker of about the same age as the participant was asked to be recorded reading the Spanish translations of the same twelve sentences used as the stimuli for the participant to test for changes in VOT and intonation. Since the reference speaker mainly speaks Spanish, he was not asked to translate the sentences from English into Spanish as this could cause various disfluencies. He was asked to read the sentences, instead. The same procedure used to record the participant was used to record the read speech of this reference speaker.

## 2.5 Measurements and Analysis

For the sentences in read speech, VOT measurements were taken for the initial /t/ phoneme in the six test words from the beginning of the release burst to the onset of the vowel by using Praat. Certain test words that were affected by ambient noise, making it impossible to accurately measure VOT, were discarded. The durations of the VOT were averaged for the six test word taken for the pre-trip, trip, and post-trip recordings, and the averages were compared. The local Puerto Rican reference speaker's VOT was also examined in the same manner.

<sup>1</sup> Software downloadable at <http://www.fon.hum.uva.nl/praat/>.

<sup>2</sup> Software downloadable at <http://audacity.sourceforge.net/>.

To analyze intonation, Praat was used to compare pitch patterns for both the speaker's sentences and those of the reference speaker. First, the speaker's sentences from each of the three separate recordings were compared to see if any change in intonational contours had occurred. Next, these sentences' intonation contours were compared to those of the reference speaker's to observe if any changes in the participant's intonation were converging or diverging from the local Puerto Rican speech. As mentioned before, a ToBI analysis was not conducted in this basic analysis of intonational patterns, since no extensive ToBI scheme has been designed specifically for Puerto Rican Spanish.

The spontaneous speech was analyzed in the following way. The first thirty minutes of the second recording (recording made during the trip) were analyzed by orthographically transcribing any utterance made by the speaker, and the number of standard and non-standard productions were recorded. The recordings before and after the trip were analyzed in a similar manner. These two recordings were transcribed until the same amount of instances of the variables occurring in the recording made during the trip was obtained. Percentages of non-standard realizations were taken for these two recordings, and subsequently were compared to each other.

### **3. Results**

#### **3.1 VOT**

The hypothesis for this experiment was that we would find a decrease in the participant's VOT. Since Spanish lacks aspirated stops, and the participant's stops might have converged to the English aspirated stops while in the United States (like in Sancier & Fowler 1997), this was the expectation. Figure 1 shows the averages of the VOT for all of the repetitions of the test words for each of the three recordings and their standard deviations.

	Pre-Trip Recording	Trip Recording	Post-Trip Recording
Average VOT	18.6 (0) ms	19.4 (0) ms	19.9 (0) ms

**Figure 1.** Participant's average VOT and standard deviation of Spanish [t]

As seen in the figure, there are only minute differences between the VOTs of the speaker as time progressed, not enough to indicate convergence. Although the Puerto Rican reference speaker was recorded mainly to analyze changes in intonation, this speaker's average VOT for the test words in the stimuli was examined as well. If the reference speaker's average VOT was significantly different, this might have provided evidence as to whether the main speaker converged or diverged to the aspirated English stops while living in the United States. The reference speaker's average VOT was 17.1 (0) ms, an average slightly lower than the experiment's main speaker. It can be concluded that the speaker's VOT for Spanish /t/ did not undergo major changes due to his short stay in Puerto Rico, nor did the speaker converge to the VOT of English /t/ while living in the United States.

### 3.2 Consonants

In section 2.2, it was established that three variable Spanish consonants would encompass the analysis of the speaker's spontaneous speech: coda /s/ deletion or aspiration, phonetic realization of coda /t/ as [t̚], and velar or uvular productions of /t/. Figure 2 presents the percentages of the non-standard variations of these variables present in the data from spontaneous speech.

Non-standard variable	Percentage of Variables in Recordings		
	Pre-Trip	Trip	Post-Trip
Coda /s/ deletion/aspiration	372/383 (97.178%)	379/383 (98.956%)	379/383 (98.956%)
Coda /r/ → [ɹ]	6/147 (4.082%)	16/147 (10.884%)	8/147 (5.442%)
Velar/uvular production of /r/	0.000%	0.000%	0.000%

**Figure 2.** Number and percentage of non-standard variables present in participant's speech

As seen from the figure above, the speaker already presented a high percentage of coda /s/ deletion and aspiration before his trip to Puerto Rico. The data taken from the trip and after the trip shows a minimal increase in the percentage of this variable. Therefore, we can assume that no major convergence or divergence of this variable occurred during the speaker's stay in Puerto Rico.

As for the coda /r/, we can observe an increase of almost 7% in the non-standard production of this variable in the speaker's speech during the trip. Although this is not a very large increase, it is large enough to suggest that in effect the speaker tended to converge to the local variant of this variable while present in Puerto Rico. After the speaker's return to the US, this percentage decreased, almost to the same amount as before the trip. This suggests that the convergence of this variable was limited to the speaker's trip. Possible reasons for this are discussed further in Section 4.

From the table above, we see that no velar or uvular productions of the phoneme /r/ were found in the data, and thus it is assumed the participant did not converge to the local Puerto Rican variant of this linguistic variable. This confirms the expectations discussed in Section 2.2 that convergence for this consonant would be less likely to occur due to the participant's views on this non-standard pronunciation.

### 3.3 Intonation

In order to see if the participant's intonation converged to the local Puerto Rican intonation, it was first necessary to see if the participant's intonation changed at all. In order to do this, all of the participants' sentence types were first compared to see if there was any variation in his intonation before going to Puerto Rico. Although occasional differences were found in pitch accent placement, there seemed to be no variation in general intonation patterns for the different sentence types in the participant's speech before leaving NY. By comparing the same sentence types produced in New York and in Puerto Rico, it was found that no change in general intonational patterns occurred during the participant's stay in Puerto Rico. The same occurred when comparing these sentences with those recorded after the speakers' return from the trip.

To examine whether the participant's intonation differed from local Puerto Rican Spanish, a comparison between the participant and the local Puerto Rican reference point was made. In this analysis, the different sentence types from the participant recorded before arriving to Puerto Rico were compared to the versions produced by the local Puerto Rican speaker. Although the local Puerto Rican's speech rate was much slower than that of the participant and he tended to exaggerate the production of the utterances (often seen in read speech), no major differences in general intonational patterns were found between the sentences of the participant and the local reference speaker. This demonstrates that the participant for this study did not converge to any intonational patterns of English or the different Spanish dialects he was exposed to, preserving his intonation from the local Puerto Rican speech.

#### 4. Discussion

From the results shown in Section 3, we can conclude from the changes in production of the coda /r/ that some phonetic convergence in effect did occur. However, the other linguistic variables in which change might have been expected did not show changes indicating convergence or divergence to the speech of local Puerto Rican Spanish. Below, the results for each of the linguistic variables included in the analysis for this experiment are discussed, in addition to the answers they may provide to the main questions that motivated this study.

At the beginning of this study, analyzing changes in VOT was proposed to examine phonetic convergence in the speech of the participant. From studies in the literature (e.g. Sancier & Fowler 1997 and Fowler et al. 2008), it is shown that bilingual speaker's languages can influence each other, causing changes in VOT for both languages. Based on this information, it was expected that the participant's English might have exerted some influence on his Spanish. For example, in Fowler et al. (2008) it is shown that the VOT in the French stops of bilingual French and English speakers is higher than that of a monolingual French speaker. In the same manner, it was expected that, after living in the US for many years, the participant's Spanish stops might have had a higher VOT than that of a monolingual Spanish speaker. With this in mind, and based on the work done on the Brazilian Portuguese speaker in Sancier & Fowler (1997), the expectation was that the participant's Spanish VOT would decrease after his short stay in Puerto Rico. This, however, was not the case.

Since the differences in the averages of the participant's VOT in the three recordings are minute, we can assume that no major changes occurred during that period of time. Furthermore, when compared to the VOT of the reference speaker, the participant's VOT is also not different.

This, in turn, suggests that the participant's Spanish stops were not influenced by the use of English in the United States.

There are some differences between previous studies on VOT and this present study that might explain the results obtained. First, Sancier & Fowler (1997) focus on a speaker who spent a relatively long amount of time in two different language environments, almost exclusively using Brazilian Portuguese when in Brazil, and almost exclusively using English when in the United States. In contrast, the participant for this study had only spent one week in Puerto Rico when his VOT was measured, a much shorter period of time than that of the Brazilian Portuguese speaker in Sancier & Fowler (1997). Second, the participant makes frequent use of both his Spanish and English while in the United States, more like the participants of the study in Fowler et al. (2008). Since the VOT of the participant and that of the local Puerto Rican reference speaker are almost identical, the data suggests the participant's Spanish VOT did not converge towards English VOT. If the participant's Spanish VOT had converged to English, we would expect the participant's initial Spanish VOT to be significantly longer than the reference point, and when in Puerto Rico it could have possibly decreased, converging back to Puerto Rican Spanish. Since no convergence towards English occurred while in the United States, this directly contrasts with the results found in Fowler et al. (2008). One possibility is that the participant might have categorized the Spanish and English /t/ as separate, similar to the native Dutch bilingual speakers in Flege and Eefing (1987). Further study is needed to understand if this is the reason the participant's VOT did not converge to English VOT, remaining the same as that of local Puerto Rican Spanish.

The results obtained for the coda /s/ variable were also not enough to indicate phonetic convergence occurred. As shown from the first recording of the participant while still in the



United States, the participant's speech showed a very strong preference toward deleting or aspirating the coda /s/. However, despite this strong preference, it is shown that the participant does produce the standard fricative /s/ occasionally in certain words, in contexts which do not seem to be lexically defined. The expectation is that the speaker received some influence from other Spanish dialects that do not delete or aspirate the coda /s/, such as Mexican Spanish. The main expectation for the experiment was that when the participant was immersed in the language environment of local Puerto Rican Spanish, the percentage of the occasional standard coda /s/ would greatly decrease when compared to the participant's Spanish in the United States.

The data does show a very small increase in the non-standard production of the coda /s/ both during the participant's stay in Puerto Rico and after he returned to the United States. These differences, however, amount to less than 2%, rendering these results insignificant. One possible reason for these results is a ceiling effect. Since the participant's speech already presented such a high percentage of non-standard coda /s/ before the trip, any differences between the percentages of coda /s/ for the participant and a local Puerto Rican speaker would be too small to show convergence or divergence. More specifically, even if the participant's speech presented more standard coda /s/ productions before the trip, since this percentage was too small to differentiate it from local Puerto Rican Spanish, the percentages are unable to show either convergence or divergence. A more extensive study analyzing the percentages of standard coda /s/ in Puerto Rican Spanish using a larger number of participants might yield results indicating if in effect the participant's percentage of standard coda /s/ is too small to differentiate it from speakers of local Puerto Rican Spanish.

The variable in this study that indicates phonetic convergence did occur in the participant's speech is the coda /s/. Despite the local liquid production [l] being stigmatized both

in Puerto Rico and by the participant himself, the data shows an increase of the non-standard variant of the variable by almost 7% during his stay in Puerto Rico. This indicates convergence to the speech of local Puerto Rican Spanish occurred during his trip. However, for the recording done after the participant returned to the United States, the percentage of non-standard productions of coda /t/ dropped drastically, almost to the same amount as before leaving for Puerto Rico. This suggests there might be specific factors influencing the participant's choice between the standard [t] and non-standard [ɫ] of the coda /t/, as discussed below.

In Medina-Rivera (1999), it is shown that for local Puerto Rican Spanish speakers, the percentage of the non-standard production [ɫ] of the coda /t/ is highly dependent on the social context. For example, more non-standard productions are found in informal dialogues than in formal speeches performed by the same speakers. For this present study, the experimenter made sure that all recordings of spontaneous speech were those of informal dialogues that spanned different topics, such as daily life and politics. However, other social and linguistic factors might be the cause for the increase of non-standard productions of coda /t/ in the participant's speech during his trip in Puerto Rico.

Although both the experimenter and the local Puerto Ricans with whom the participant engaged in conversation for this experiment were close family members, eliminating any confound due to formality vs. informality, the dialects of the experimenter and the local Puerto Ricans differ significantly. The experimenter's Spanish being closer to the Mexican variety shows various differences from the Spanish of the local Puerto Rican speakers. It is possible that the trigger for phonetic convergence of the variable coda /t/ is socially dependent on the dialect of the speaker with whom the participant converses. For example, the participant might associate the non-standard variant of coda /t/ to local Puerto Ricans, identifying it as a social marker that

signals closeness between speakers coming from Puerto Rico. Therefore, although the experimenter is also the participant's close family member, due to the difference of dialects, the participant might not have felt the non-standard variant of coda /r/ as appropriate for conversations with the experimenter.

The reasoning above is similar to those present in studies such as Babel (2009) and (2010) in which social factors such as race (Babel 2009) and national biases (Babel 2010) are explored as causes of convergence and divergence in the speech of individuals. Had the effects of phonetic convergence in the speech of the participant for this study remained after his return to the United States, we could have dismissed social factors. Since the increase in the non-standard variants is only observed in the participant's speech during the trip, however, it is very plausible that since the participant was speaking with local Puerto Ricans and in Puerto Rico, he unconsciously increased the percentage of non-standard pronunciations of coda /r/ to show more closeness between himself and the speakers with whom he was engaging in conversation.

For the next variable, the velar/uvular productions of the phoneme /r/, no changes were observed at all. Out of the three variable consonants taken into consideration for this study, this variable was the most stigmatized, as indicated by the participant. The participant views velar and uvular pronunciations of the phoneme /r/ as very sub-standard and characteristic of very low social class. It is thus understandable that the participant wanted to diverge as much as possible from this non-standard pronunciation of /r/. While this stigma also prevails in Puerto Rico (Medina-Rivera 1999 and Valentin-Marquez 2007), it is interesting to note that it seems much more engrained in the mind of the participant, possibly explaining why no changes were observed for this specific variable.

From the recordings taken in Puerto Rico, informal observation showed that the speakers with whom the participant was conversing all had a preference for the velar and uvular productions of /r/ over the standard alveolar trill. Therefore, in this respect, the speech of the participant differed from the speech of the local speakers of Puerto Rican Spanish. We can speculate that, unlike the non-standard variant of the coda /r/, the participant does not view the velar or uvular pronunciations of the phoneme /r/ as a social marker of closeness between Puerto Rican speakers. It seems like no matter what the pronunciation of the Puerto Rican speakers he was surrounded by used, the participant was reluctant to use the non-standard variant of /r/, pronouncing each instance as the standard Spanish alveolar trill instead. Perhaps further work might be necessary to determine why this specific variable is looked down upon more than the non-standard variants of the coda /s/ and coda /r/. It might also be interesting to see if the participant would continue his reluctance to converge in this variable after a much longer stay in Puerto Rico. If he converged after a longer period of time, this might indicate the limitations certain social factors could have on phonetic convergence amongst speakers.

The last linguistic variable analyzed in this study was intonation. As explained in Section 3, no major differences in the intonation of the participant before, during, and after the trip were found. In addition, the intonational patterns of the local Puerto Rican reference speaker were very similar to those of the participant. To get a better idea of the similarities found in the speech of the participant and the reference speaker, Figure 3 shows the intonational contours for three repetitions of a wh-question: the first produced by the participant before leaving to Puerto Rico, the produced by the participant in Puerto Rico, and the third read by the reference speaker. As can be seen, for the wh-question *¿Dónde está la torre de la ciudad?* 'Where is the tower of the city?' the basic intonational contours for the participant's utterances and the reference point

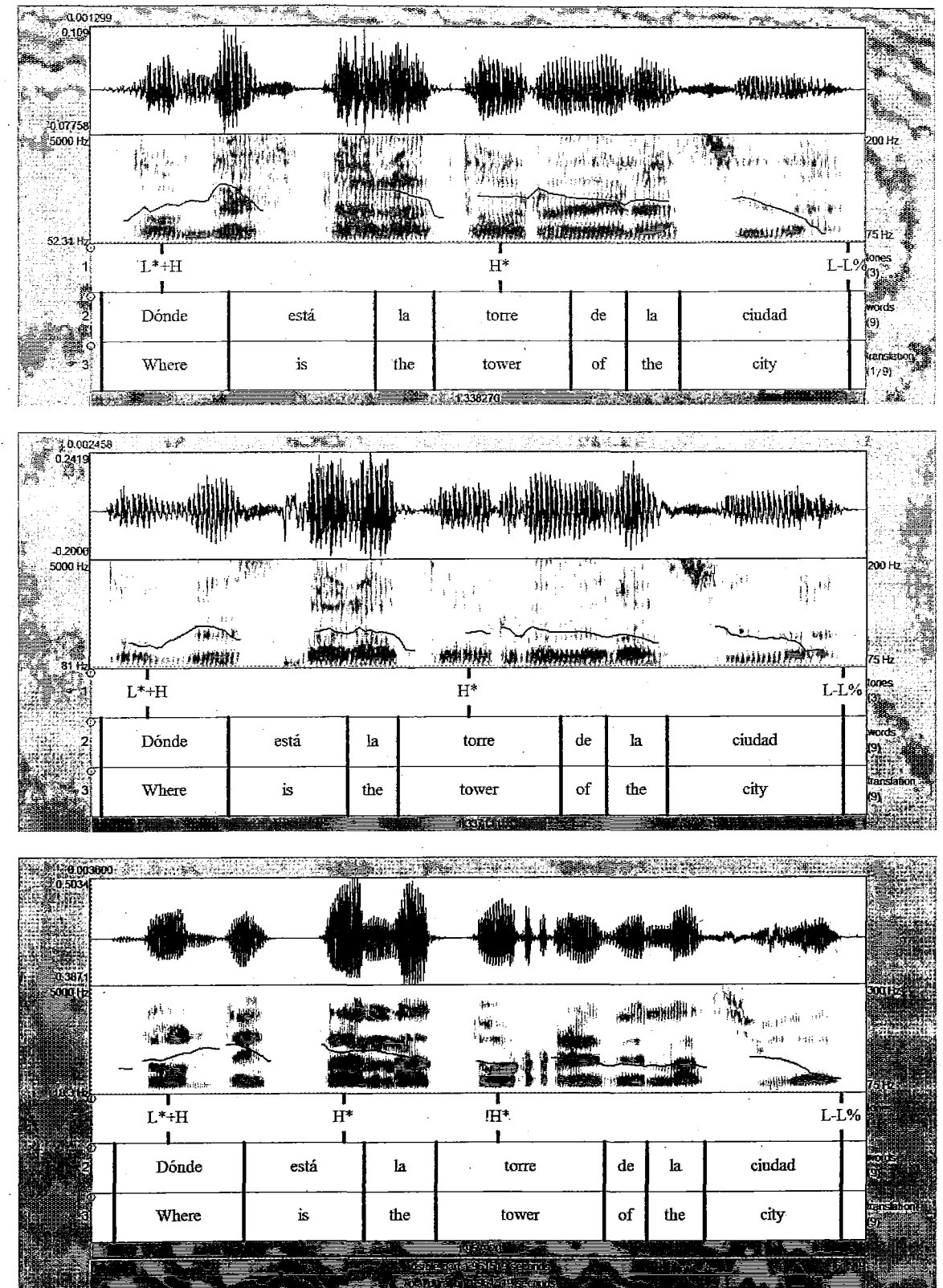


Figure 3. Comparison of intonational contours between participant and reference speaker. From top to bottom: participant before trip, participant during trip, reference speaker.

are very similar. At the beginning of the question there is a L\*+H pitch accent on the first syllable of the word *dónde* 'where', and the question ends with a low boundary tone. When analyzing the other sentences in the data, the same types of similarities were found, indicating that the participant's intonation did not change much over the years compared to the local Puerto Rican speech.

Once it has been verified that the participant's intonation did not undergo major changes due to the influence of other Spanish dialects or English, it is necessary to examine why the participant's intonation did not converge to these language varieties when living outside of the United States. A brief comparison of English and Puerto Rican intonation can give us some answers. There are two possible reasons why the participant's intonation did not converge to English: 1) English and Puerto Rican Spanish intonation are already similar, leaving no room for convergence or 2) Intonation is inherently difficult for speakers to converge to. From studies done on Puerto Rican intonation (Morales-Muñoz et al. 2008), we can see that in some respects English and Puerto Rican intonation are similar. For example, Morales-Muñoz et al. (2008) mentions the presence of final cadence as the realization of a falling contour over the final syllables in declarative sentences for both English and Puerto Rican Spanish. English focus, as examined in studies such as Selkirk (2002), does not seem to differ much from how the participant showed focus, as seen in Figure 4.

In the figure below, we can see that for the focus word *domingo* 'Sunday', the participant places a type of high tone (L+H\*) on the stressed syllable of the focus word, followed by a fall in the contour due to the low phrase accent. This is similar to English focus described in Selkirk (2002), in which it is observed how L+H\* predominates in English medial focus.

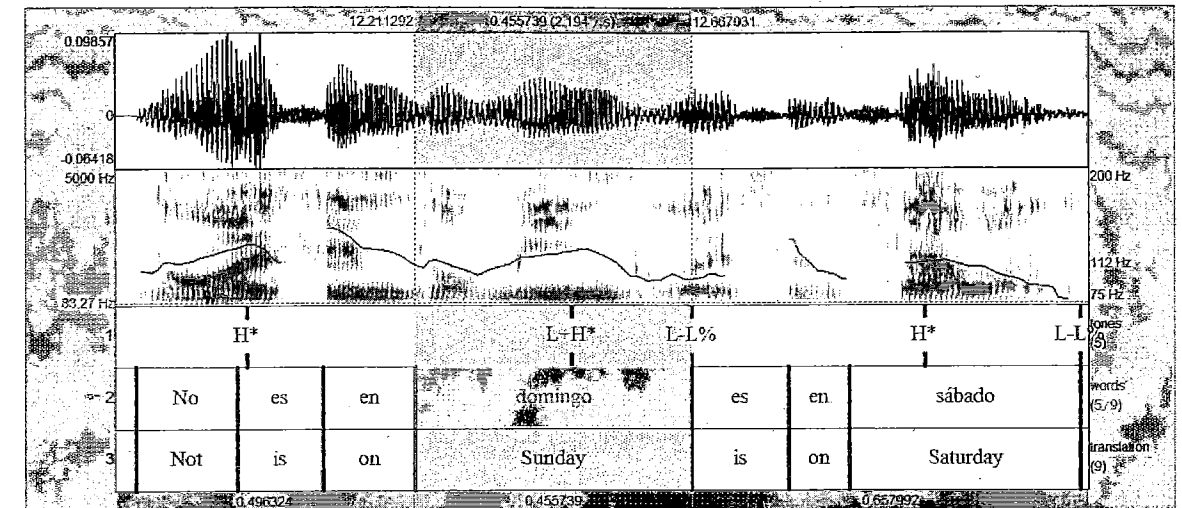


Figure 4. Sample focus sentence from participant: *No es en domingo. Es en sábado.* 'It's not on Sunday, it's on Saturday.'

There is one sentence type, however, in which English and Puerto Rican Spanish intonation differ significantly: yes/no questions. Yes/no questions in Puerto Rican Spanish are realized with a falling contour, ending in low boundary tones (Armstrong 2010, Morales-Muñoz et al. 2008). This is in direct contrast to English intonation in which yes/no questions are realized with a rising intonation. This is a major difference in intonation between both languages, in which the participant's intonation could have converged to English or possibly other varieties of Spanish which, like English, use a rising intonation to indicate a yes/no question.

The fact that Puerto Rican Spanish and English differ so drastically in their intonational patterns for yes/no questions suggests the reasons why the participant's intonation did not change do not lie in similarities between the languages' intonation. Since yes/no questions are so common, it is expected that the participant was constantly exposed to the rising intonation of yes/no questions in English and other Spanish varieties. The participant's speech thus had this type of input for a very long time, giving the participant ample opportunity to converge to this different intonational pattern. The data shows, however, that even after so many years of

exposure to the rising intonation contour for yes/no questions, the participant did not converge. This suggests that intonation is inherently more difficult for speakers to converge to when compared to other linguistic variables. However, it is also possible to say that, since the differences are so obvious, the two intonational contours for yes/no questions could have been categorized differently, leaving no room for convergence. Further research on phonetic convergence at the prosodic level is needed to confirm the veracity of these hypotheses.

## 5. Summary and Conclusion

In this study, phonetic convergence has been explored through an experiment on a native Puerto Rican Spanish speaker. The experiment consisted in analyzing the participant's speech before, during, and after a one-week stay in Puerto Rico in which he constantly interacted with local Puerto Ricans. Based on the work found in the literature, it was expected that the participant would converge in certain of the chosen phonetic variables for analysis. It was uncertain, however, what role the time frame (one week) of the experiment would play, and to what extent the participant would converge to the local Puerto Rican speech. These two questions were part of the motivation for this study, and the main questions it attempted to answer. The variables examined were VOT, coda /s/, coda /t/, velar/uvular productions of /r/, and intonation

From the data, we saw only one conclusive indicator that phonetic convergence did occur: a higher percentage of non-standard productions of coda /r/. It was proposed that a plausible cause for this variable's convergence were social factors associated with it. For the rest of the variables, including VOT and intonation, no major changes were found that could indicate the presence of phonetic convergence. In the specific case of VOT, the data suggests that the



participant's original Spanish VOT did not converge to English over the years. As a result, no change in VOT was observed during the one-week stay in Puerto Rico.

The case of intonation gave us new insight into phonetic convergence. It was found that the participant's intonational contours for basic sentence types did not converge significantly to the intonational patterns of English or other Spanish varieties while the participant was away from Puerto Rico. More specifically, the participant's yes/no question contour ending in low boundary tones did not acquire the rising intonation characteristics of English and other Spanish varieties which have high boundary tones. This strongly suggests that intonation, when compared to other linguistic variables, might be inherently more difficult for speakers to acquire and converge to phonetically when interacting with speakers of other dialects or languages.

From the results obtained, we can make some preliminary conclusions. First, the time frame does seem to have a direct effect on the extent speakers converge. Although studies on phonetic convergence have shown it occurs in short conversations and in months or years of linguistic contact, changes in different variables have been examined during different time frames. For example, Pardo (2006) examined vowels in a short time frame (a conversation), while Sancier & Fowler (1997) and Fowler et al. (2008) examined a different variable, VOT, during a much longer time frame (a few months to years). This present study, however, incorporated different segmental and prosodic variables, previously examined in different time frames, into the same time frame (one week). Since only one variable converged, this suggests other variables might require a longer period of time to converge. Therefore, this study also gives us insight into which linguistic variables do and do not converge in the time frame chosen. For example, no changes in coda/*r*/ were observed, probably because of the participant's rejection of the non-standard variant of this consonant, but a longer time frame might yield different results.

Thus, from this experiment, we can get an idea of how certain factors influence which linguistic variables converge, and to what extent a speaker can converge during a given time frame.

The results of this study give rise to further questions. For example, phonetic convergence and intonation is still not completely understood and must be examined further. It is not clear if intonation is inherently difficult for speakers to converge to, or under what circumstances it would converge. More specifically, the time frame necessary for intonation to converge must be investigated. Studies on changes in VOT also seem to be limited to long terms of linguistic contact, ranging from months to years. It might be useful to delve more into changes in VOT during shorter time frames. This will shed light on the minimum time necessary for changes in VOT to occur. It is also necessary to investigate what caused the participant's Spanish VOT to remain the same over the years, not converging to English. Since these results contradict the findings in Fowler et al. (2008), more work is needed to understand the factors that influence convergence of VOT. Further work can also be conducted on how certain social factors might affect phonetic convergence in cases such as that of this study's participant.

In conclusion, this present study was able to examine how phonetic convergence occurs, during which time frame, and to what extent. The results were enough to make some preliminary conclusions, but also show the need to conduct more work on phonetic convergence to understand it more thoroughly. It is hoped that this present study contributed to our knowledge of this phenomenon, and that it can serve as a gateway to further research on various aspects of phonetic convergence.

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## Appendix

The following are the English sentences used as stimuli to test changes in VOT and intonation, followed by the Spanish translations produced by the participant of the study. All twelve sentences were used to examine changes in intonation, while only the first six were used to examine VOT. Words in bold text indicate focus, and the consonants underlined in the Spanish translations are those that were measured for changes in VOT.

### English Stimuli:

1. The teacher has many books.
2. He left the cup in the kitchen.
3. The house doesn't have many rooms.
4. I don't like the theme of this book.
5. Do you know if that tunnel is very expensive?
6. Where is the tower of the city?
7. Do you want to come with me to the park?
8. When are you going to prepare the dinner?
9. I like **magazines**, not books.
10. It's not on **Sunday**. It's on Saturday.
11. I want to go to Paris, London, and Rome.
12. Buy a book, a pen, and a pencil.

Spanish Translations:

1. La maestra tiene muchos libros.
2. Él dejó la taza en la cocina.
3. La casa no tiene muchos cuartos.
4. No me gusta el tema de este libro.
5. ¿Tú sabes si ese túnel es muy caro?
6. ¿Dónde está la torre de la ciudad?
7. ¿Tú quieres venir conmigo al parque?
8. ¿Cuándo tú vas a preparar la cena?
9. A mí me gustan **magazines**, no libros.
10. No es en **domingo**. Es en sábado.
11. Yo quiero ir a Paris, Londres y Roma.
12. Compra un libro, una pluma y un lápiz.