



2014-12-01

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The Production of Voice Onset Time in Voiceless Stops by
Spanish-English Natural Bilinguals

Ivan K. Banov

A thesis submitted to the faculty of
Brigham Young University
in partial fulfillment of the requirements for the degree of
Master of Arts

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December 2014

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ABSTRACT

The Production of Voice Onset Time in Voiceless Stops by Spanish-English Natural Bilinguals

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Master of Arts

This study analyzes the production of Voice Onset Time (VOT) of natural Spanish-English bilinguals. VOT is a linguistic characteristic that measures the amount of aspiration occurring after the release of a stop consonant. In terms of VOT, English stop consonants differ substantially from their Spanish equivalents. This study analyzes whether or not natural bilinguals produce VOTs that approximate VOTs of monolingual speakers of each language. Participants completed two surveys to quantify their linguistic dominance in English and Spanish. They were then recorded performing similar speaking tasks in both languages.

The conclusions show that natural bilinguals do not produce their English or Spanish VOTs within the monolingual norms defined in previous studies. If conclusions were to be drawn solely from this data, then the participants would theoretically have no monolingual-like language production of VOT. There is also no correlation between language dominance scores and production of VOT. These results support the conclusion that a natural bilingual is not the equivalent of two natural monolingual speakers. Significant correlations exist between VOT production and gender, age of learning English, and amount of time spent watching TV in each language. Another interesting conclusion is that many of the participants score more Spanish-dominant when a survey is given in Spanish and more English-dominant when the very same survey is given in English. This shows that even the language of a survey may skew responses slightly.

Keywords: Phonetics, Spanish-English Bilinguals, VOT, Language Contact, Spanish in the US

ACKNOWLEDGEMENTS

First and foremost, I would like to acknowledge Dr. Scott Alvord for all of the support and guidance he has offered during the course of this project. His continuous encouragement allowed me to continue with this project through several trials and setbacks. I also would like to recognize the other members of my thesis committee, Dr. Fails and Dr. Smead, for their direction in this project. I also would not have been able to do this project without the support of the research personnel who aided in this study: Debra Banova, Josete Hernandez, and Franklin Acosta. They were indispensable in the data gathering and analysis stages of my research.

I am particularly appreciative of all of the faculty members at BYU who helped give me ideas on how to improve my research methods. Dr. Mary Zampini also provided me with exceptional feedback and advice on this study. Lastly, I am extremely grateful of the support I continually received from my family, my adopted family, and my friends. My wife has been my greatest motivator during this project and throughout my life.

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CHAPTER 1

Introduction

People often classify those who speak two languages as *bilingual*. But what is a bilingual, and to what extent are people truly bilingual? Do people really speak both of their languages like natural monolingual speakers? To add more insight on the topic of natural bilingual (NB) language production, this research examines the production of voice onset time (VOT) in voiceless stop consonants by natural Spanish-English bilinguals. The English and Spanish languages each contain the same three voiceless stop consonants—/p, t, k/. Yet notable differences exist in the pronunciation of these stops. One of the main differences between the production of Spanish and English stops is VOT (Castañeda Vicente, 1986; Hualde, 2005; Lisker & Abramson, 1964). VOT refers to the space of time between the instant the stop is released in the production of the consonant and the start of periodic vocal cord movement. In other words, there is a space of time between the release of air and the time the vocal cords start to vibrate. For voiceless stops, the average VOT of an English consonant is generally longer than the VOT of the correlating Spanish stop consonant.

The observation of the differences between English and Spanish VOTs has sparked several studies of the acquisition of VOT by language learners. The most notable studies dealing with these second language (L2) learners are Flege and Eefting (1987); Flege (1991a, 1995); Flege, Munro, and MacKay (1995); Thornburgh and Ryalls (1998); and Flege, Yeni-Komshian, and Liu (1999). Their conclusions all agree that L2 learners do not fully acquire monolingual-like VOTs in the second language, regardless of which is their first, or native, language (L1) and which is their second language. In fact, L2 learners tend to produce average VOTs that are

somewhere between the Spanish (shorter VOT) and English (longer VOT) norms in both languages.

Despite all of the research on VOT and second language acquisition, no studies have focused specifically on the production of VOT by NBs. To my knowledge, only two studies (Magloire & Green, 1999; Zampini & Green, 2001) have mentioned the topic of Spanish-English NBs. However, Zampini and Green (2001) only addressed bilabial stops and most of the participants were L2 learners, not NBs. Magloire and Green (1999) analyzed the effects of speaking rate on VOT production by bilinguals, but once again, not all of their participants were NBs and the study proposed no standard for NB production of VOTs. The purpose of this work is to research whether or not NBs differ from L2 learners in their production of VOT. It is possible that NBs have one set of VOT values that falls halfway between the monolingual norms. It is also possible that they have two separate VOT norms—one for each language. However, as we will see, the results are not necessarily clear-cut.

Research Questions

The questions guiding this study are as follows:

1. Do natural Spanish-English bilinguals produce average VOTs that are similar to monolingual averages in both languages?
2. Do demographic, social, and language use factors—specifically language dominance—predict the production of VOT by NBs in either language?

My hypothesis is that NBs will not consistently produce monolingual-like VOTs in either language. However, I hypothesize that VOTs will correlate significantly with specific variables, namely language dominance. I also anticipate that there will be some significant correlations between the production of VOTs and demographic or language use variables.

CHAPTER 2

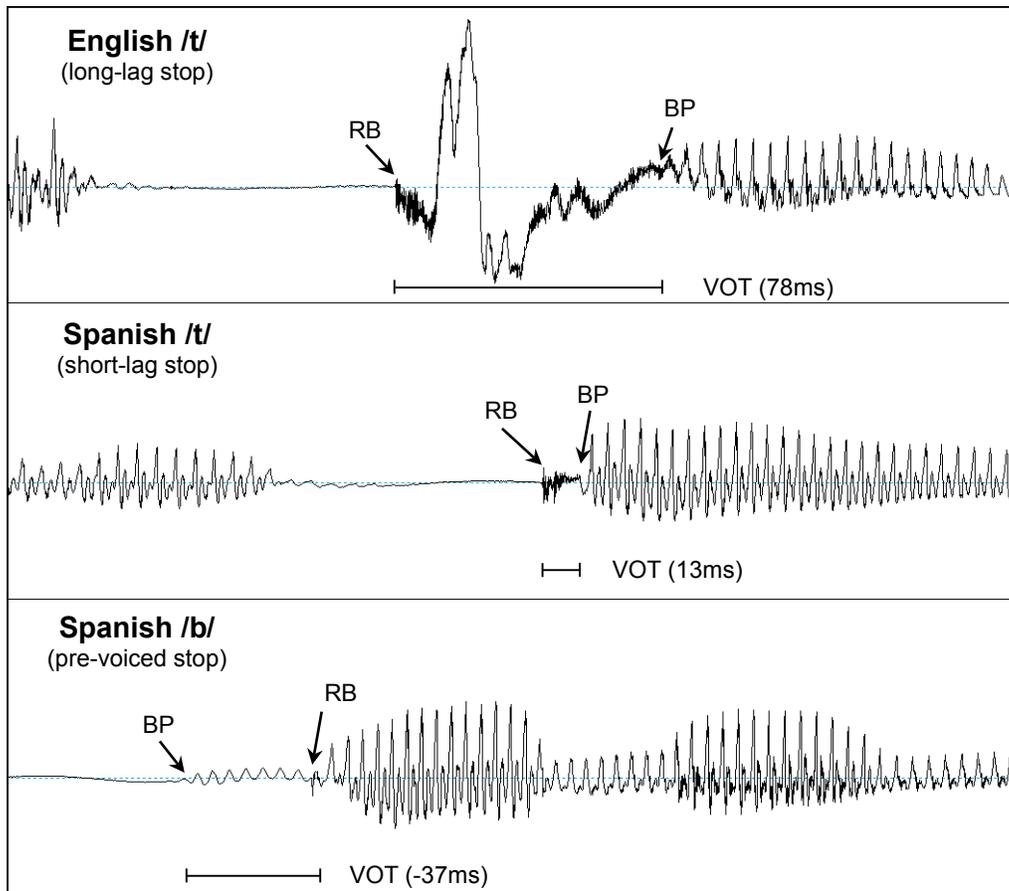
Review of the Literature

A Concise History of Studies on VOT

Agreeing on how to empirically differentiate between voiced and voiceless stops was difficult prior to the 1960s. The English voiced stops /b, d, g/ and the voiceless stops /p, t, k/ used to be defined by the presence of a glottal buzz, presence of aspiration, or amount of articulatory force (Lisker & Abramson, 1964). These measurements were not always consistent and they could be hard to measure. Lisker and Abramson (1964) were among the first to explore one of the most definitive differences between the two groups of stops. They observed that there was a space of time between the release of the stop and the onset of glottal vibration, or voicing. They termed this amount of time voice onset time (VOT). Zampini & Green (2001) provide a slightly clearer definition: VOT is measured in milliseconds from the release burst (RB) to the beginning of periodicity (BP) caused by vocal fold vibration. Provided that it is possible for the vocal cords to vibrate prior to the release of a stop—most commonly in voiced stops—VOT can be positive or negative (see Figure 2.1).

Figure 2.1.

Sample VOT Measurements



Lisker and Abramson (1964) observed the VOT of stops in eleven different languages and reported trends found in voiced and voiceless stops. The conclusion of their work was that no matter what language, VOT alone was almost always sufficient to differentiate between voiced and voiceless stops. This differentiation even applied to languages with two-, three-, and four-category stop phonemes. The study by Lisker and Abramson opened a new area of investigation for phoneticians. Numerous studies have been carried out analyzing VOT of different languages in diverse contexts.

The first category of studies stemming from the study by Lisker and Abramson (1964) was the measurement of VOT in a single language. Lisker and Abramson (1967) showed that

VOT could vary depending on phonetic context in speech. Word initial stops produced at the beginning of sentences or before stressed syllables tended to be longer than those produced in the middle of continuous speech or before unstressed syllables. For example, in the onset of stressed syllables the English /p/ had an average VOT of 59ms. However, in unstressed syllables, the average VOT was 38ms. Following the publication of this article, several studies were performed to set VOT standards for monolingual speakers of various languages. Some of the most notable studies in English or Spanish include Klatt (1975); Williams (1977); Castañeda Vicente (1986); Lisker (1986); Crystal and House (1988); and Rosner, López-Bascuas, García-Albea, and Fahey (2000). Since being published, these studies have been cited in most other articles concerning VOT. The observations for monolingual speakers of English and Spanish are as follows:

Table 2.1.

VOTs of English and Spanish Stops (Castañeda Vicente, 1986; Lisker & Abramson, 1964)

	/p/	/t/	/k/
Average Spanish VOT in ms	6.5	10.4	25.7
Average English VOT in ms	58	70	80

There are notable similarities and differences between English and Spanish VOTs. In both languages, the VOTs in the production of the bilabial stop are the shortest. The production of the glottal stop yields the longest VOTs. As the point of articulation moves back in the mouth, VOTs tend to be longer (Castañeda Vicente, 1986). While not a rule, this observation is common among many different languages (see Lisker & Abramson, 1964). Generally, Spanish stops have a much shorter VOT, which may even lead to pre-voicing in certain cases, whereas English stops have longer VOTs than their Spanish equivalents. As can be seen in Figure 2.2, the VOT of

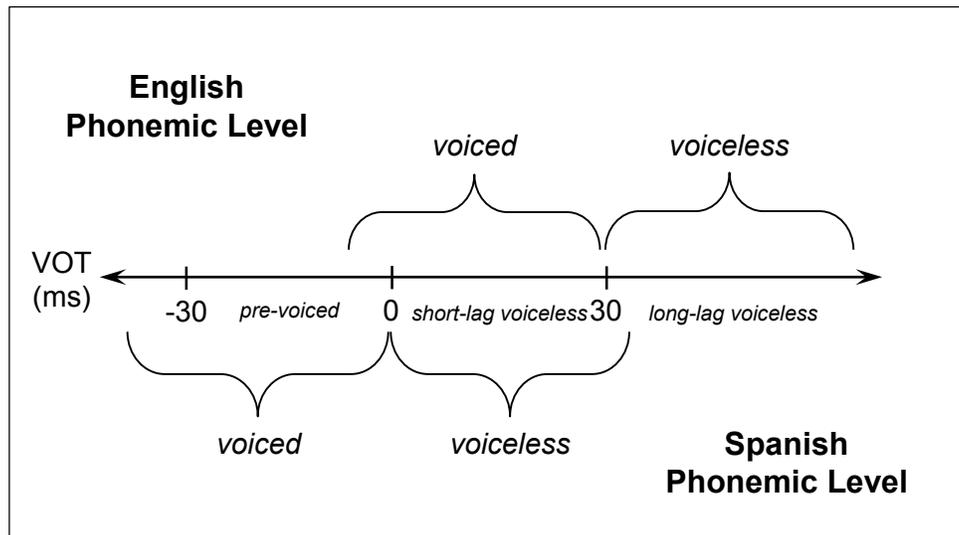
voiced English stops overlaps with the VOT of voiceless Spanish stops. Zampini and Green (2001) explain the following:

In English, voiceless /p t k/ are articulated with VOTs that typically exceed 30-35 msec., and are considered *long-lag* voiceless stops. English /b d g/, on the other hand, are produced with VOT values of less than 35 msec. and are considered *short-lag* voiceless stops. (p. 24)

Provided that each language has its own standard for monolingual VOT production, many studies were inspired in another area of VOT: the VOTs of L2 learners.

Figure 2.2.

Phonetic Category Classification of English and Spanish Stop Consonants (adapted from Zampini & Green, 2001)



VOT in L2 Learners

The analysis of the VOT of L2 learners began to expand around the late 1970s and continued to grow into the 1990s. The first analyses dealt specifically with the acquisition of VOT. One of the most influential studies was conducted with English-French bilingual

participants. Caramazza, Yeni-Komshian, Zurif, and Carbone (1973) showed that Canadian English speakers have longer VOTs than Canadian French speakers (see Table 2.2).

Table 2.2.

Means of Monolingual French and English VOT Values (Caramazza et al., 1973)

	/p/	/t/	/k/
Average Monolingual French VOT in ms	18	23	32
Average Monolingual English VOT in ms	62	70	90

As can be seen, the results of monolingual VOT production are comparable to the Spanish and English monolingual distinction. However, it was observed that bilinguals—no matter what language was learned first—produced average VOTs that were intermediate to both languages (see Table 2.3).

Table 2.3.

Means of Bilingual French and English VOT Values (Caramazza et al., 1973)

	/p/	/t/	/k/
Average Bilingual French VOT in ms	20	28	35
Average Bilingual English VOT in ms	39	48	67

Similar conclusions were again reported by Flege and Hillenbrand (1984). They showed that native English speakers learning French and native French speakers living in the United States produced /t/ with average VOTs of about 55ms, which is a value intermediate to both native English and French Speakers (see also Laeuffer, 1996). The same observation has been made with Brazilian Portuguese and English (Major, 1992) and English-speaking Italian natives (Flege et al., 1995), where bilinguals did not consistently produce VOTs similar to monolinguals of either language. Flege, et al. (1995) found that even when Italian natives had moved to

Canada at a young age (2-21 years old), they produced an English VOT 9-11ms shorter than the average English speaker. The VOT produced by these participants more closely approximated monolingual VOTs than the onset time produced by participants who had spent less time in Canada, but it was still not the same as the monolingual norms.

Flege and Eefting (1987) observed similar results in Spanish-English bilinguals. They concluded that Spanish speakers who learned English had shorter VOTs while producing stops in English. This was true for participants who began learning English as adults as well as for those who began studying L2 as early as five to six years old. Similar results are confirmed in studies by Port and Rotunno (1979), Flege (1991a, 1995), Thornburgh and Ryalls (1998), and Flege et al. (1999). L2 learners produce average VOTs that are different than those produced by monolinguals. There is a general conclusion that if participants begin learning the L2 earlier and if they are exposed to the L2 longer, they produce more target-like VOTs. Still, no studies conclude that L2 learners ever completely acquire average VOTs that equal those produced by monolinguals. Participants may produce individual tokens that fall near the target VOT, but not consistently.

VOT and Other Variables

Another emerging category of VOT research addresses how L2 acquisition and production are affected by other variables. Elliott (1995) researched how several variables (i.e. age, gender, foreign travel, concern for pronunciation, level of field independence, GPA, number of Spanish-speaking relatives) affected correctness of pronunciation as rated by three judges. In the end, the only variable that showed correlation through multiple regressions was attitude, or individual concern for pronunciation. The higher the individual concern for accurate

pronunciation, the better production by the L2 learners. Certain tasks correlated with other variables, but there was no consistency in the results.

Similar studies have been done to see how well study abroad programs or spending time in an area that speaks the target L2 improves pronunciation (Díaz-Campos, 2004; Piske, MacKay, & Flege, 2001; Purcell & Suter, 1980; Zampini, Clarke, & Green, 2000). Piske et al. (2001) observed the pronunciation accuracy of Italian-English bilinguals and compared it to variables similar to those of Elliott (1995). Gender, self-estimated L2 accent, and other such variables had no correlation with the pronunciation accuracy of the participants in L2. Interestingly, length of residence in the L2-speaking country was also shown to have no statistical significance on L2 accent, contradicting Elliott's (1995) conclusions. This result was different than the hypothesis, and it helped lead to new sets of questions. Most recently, researchers in the field of L2 acquisition are looking for new variables that correlate strongest with monolingual-like production.

Martinsen (2010) completed a study, which analyzed the effect that short-term study abroad programs had on the acquisition of L2 language skills. His conclusion was that the only variable which correlated significantly with the accurate production of L2 was cultural sensitivity. Cultural sensitivity as defined in Twombly (1995) and Wilkinson (1998) is the understanding of and ability to deal with cultural differences. Cultural differences include anything from how to interact in commercial or business transactions to how to understand and react to a differing view on family roles and values. A higher rating in cultural sensitivity surprisingly proved to be the best predictor in ability to speak with a L2 accent. This has elicited several studies to determine whether or not cultural sensitivity ratings correlate with specific aspects of L2 production, including VOT (Tanner, 2012). Analyses in Tanner's study have

shown that while there were no significant correlations between VOT acquisition and cultural sensitivity, there was a correlation between VOT production and self-perceived cultural sensitivity. The results showed that the students who thought they were more culturally sensitive than they actually were produced less monolingual-like VOTs.

Speech formality also plays a role in the production of language. In the field of L2 production, Tarone (1979, 1982, 1983) proposed that the amount of attention speakers pay to their own speech directly affects their production of language. Zampini (1994) explains Tarone's research as follows:

Each type of task fits into a continuum of styles ranging from careless speech to the most formal of situations, with many intermediate styles found in between the two. The least careful (or least formal) styles, Tarone proposed, will contain the lowest number of accurate L2 forms. Accuracy will increase, however, as the student moves toward more careful styles of speech. (p. 472)

Formal tasks include the least natural forms of speech, such as reading word lists or paragraphs or recounting new material, while tasks such as spontaneous conversation make up the least formal speech style. Tarone (1979) concluded that participants produce fewer L2 errors when performing more formal tasks. In other words, the more a participant is focused on his or her speech production, the more monolingual-like his or her L2 speech will be. Dickerson and Dickerson (1977) conducted a study focused on the pronunciation of English /r/ by natural speakers of Japanese. The least formal tasks contained the highest number of errors in the pronunciation of the phoneme, and the most formal tasks contained the least number of errors. Major (1986, 1987) had similar results when comparing the production of English syllable-final words by natural Brazilian Portuguese speakers. Zampini (1994) also conducted a study focused

on comparing the use of spirants in English by Spanish speakers. Her results supported the previous studies showing that L2 pronunciation tends to improve with higher formality because L2 production tends to improve as participants increase their concern for and attention to accurate pronunciation (compare Elliott, 1995).

Natural Bilinguals

Grosjean (2010) observes that people “become bilingual either by acquiring two languages at the same time (simultaneously) or by acquiring them one after the other (successively)” (p. 178). While this statement is obvious, none of the aforementioned studies deal exclusively with simultaneous bilingual participants. The studies are mostly focused on second language acquisition, or successive language acquisition. In addition, in order for children to acquire a language natively, they must acquire it during the critical period of language learning, or the ideal time window to acquire language (Lenneberg, 1967). Lenneberg (1967) proposes that the critical period occurs from age two to before puberty. However, Krashen (1973) published an article arguing that cerebral dominance becomes established during the period from birth to five years old. Consequently, I will define the critical period as being from birth to five years old.

Grosjean (2010) further explains that in order for children to become simultaneous bilinguals, they must receive dual language input during this critical period. For example, each parent may use a different language with their child, or a child may receive one language in the home and another in a care center or in the community. Until the time of this publication, no study on VOT production has attempted to control all of these variables. People who meet these criteria (being simultaneous bilinguals) and maintain proficiency in both languages are defined as natural bilinguals in this study (see also Beardsmore, 1986).

There are three possible categories of VOT production for NBs. First, NBs could produce VOTs similar to L2 learners. Flege et al. (1995) showed that participants—some of which learned L2 early enough to be classified as consecutive bilinguals—that began learning an L2 as early as age two still produced VOTs intermediate to both languages. Williams (1980), Flege and Eefting (1987), and Flege (1991a) have found comparable results in their studies, where some of their participants had begun learning L2 during the critical period of language acquisition. It is possible that NBs produce VOTs in a similar manner, having one single average VOT value for both languages that falls between the Spanish and English monolingual norms.

The second possibility for the production of VOT by NBs is that they have two distinct productions of each stop—one production for Spanish and another distinct production for English. Some studies (see Caramazza et al., 1973; Hazan & Boulakia, 1993) have observed evidence supporting the conclusion that participants—some of which were NBs—may form two distinct productions of each stop phoneme. However, none have made conclusions for or against the hypothesis that NBs acquire monolingual-like VOTs in both languages. Magloire and Green (1999) conducted a study which investigated the production of VOT by bilinguals, but the study analyzed only the production of /p/ versus /b/. The main purpose of the study was to compare the effect of speaking rate on the VOT of voiceless stops. In their findings they show that NBs have similar VOTs to the monolingual speakers of both languages. Unfortunately, Magloire and Green conducted their study only in highly controlled contexts with highly formal speech.

The third possibility for NB production of VOT is that they acquire distinct VOTs, but tend to favor shorter or longer VOTs in accordance with their language dominance. For example, a Spanish-dominant speaker could produce target-like VOTs in Spanish and non-target-like VOTs in English. Once again, none of the aforementioned studies have NBs as their sole focus.

This means that no evidence for or against such a conclusion can be gathered. In former studies, there are too many important linguistic and demographic variables which remain uncontrolled and there are not enough NB participants in similar environments to gather the data needed to support this possibility.

Problems in past Studies of Bilinguals

As has already been explained, none of the studies published prior to the undertaking of this study focused specifically on the production of VOT by NBs. In addition, many of the studies mentioned above failed to control for several variables while assessing the production of languages by bilinguals. Grosjean (1992) points out several flaws common in many of the studies on bilinguals and suggests new ways of conducting studies with bilinguals. He addresses four key questions (p. 51):

1. What do we mean when we use the terms ‘bilingual’ and ‘bilingualism’?
2. Is the bilingual person the ‘sum’ of two monolinguals or a specific speaker-hearer in his or her own right?
3. Can one adequately compare monolinguals and bilinguals, and if so, can one continue to do so with traditional procedures?
4. Can the linguistic tools and methods developed to study monolinguals be used without reservation to study bilinguals?

All of these questions are extremely pertinent to and are addressed in this study. Researchers cannot necessarily perform the same study on a bilingual—especially a natural bilingual—the same way they can on a monolingual or adult L2 learner.

Grosjean (1992) made the following argument:

A monolingual (or fractional) view of bilingualism has played too great a role in our study of people who use two languages in their everyday lives. According to a strong version of this view, the bilingual has (or should have) two separate and isolable language competencies; these competencies are (or should be) similar to those of two corresponding monolinguals; therefore, the bilingual is (or should be) two monolinguals in one person. (p. 52)

The dangers of using this view of bilingualism are many. One can assume that if bilinguals do not produce tokens similar to monolinguals of both languages, they are somehow inferior or less bilingual. Many times, bilinguals are labeled as less proficient with their languages without any thought or concern of the bilingual's differential needs for the two languages or the different social functions of each language. Similarly, language mixing is many times viewed as accidental and anomalous or inferior.

Many studies also fail to control for language mode or speech mode of the bilingual. Language mode is a frame of mind or thinking in which bilinguals access or have access to their available languages. Grosjean (1992, 2010) defines language mode as a continuum with two endpoints. On one end, bilinguals are in a totally monolingual mode in that they are speaking to monolinguals of language A. On the other end, they are in a mode where they are speaking to monolinguals of language B. In the middle, they "find themselves in a bilingual language mode when they are communicating with bilinguals who share their two languages...and with whom they feel they can bring in the other language" (pp. 41-42). In other words, language A can influence language B in situations where speakers feel that they can speak language A, and care must be taken to avoid this phenomenon if results are to be compared to monolingual standards. To control for this, previous studies (see Green, Zampini, & Magloire, 1997; Zampini & Green,

2001) have separated the Spanish production tasks from the English production tasks by asking them to be performed on separate days and using only one of the languages on each day.

The focus of the following study is to analyze whether natural bilinguals produce target monolingual VOTs of the voiceless stops /p/, /t/, and /k/ in both languages. I also analyze data to conclude whether or not the language dominance of the participants correlates with their production of VOT. This study does not attempt to evaluate or define how “bilingual” each participant is. It is a given that each participant already is a natural bilingual. This study does not try to show whether or not participants are more or less proficient in Spanish or English. Rather, this study aims to set a standard for VOT production by Spanish-English NBs that can be referenced in future studies of Spanish-English NBs. I also hope to be able to add evidence in favor of or against previous conclusions that have been made in similar studies regarding L2 learners and their production of VOT. Due to generally accepted hypotheses, I would expect that the bilinguals in this study would be able to produce target VOTs, but not consistently. Given that previous studies have not shown evidence that would necessarily support this conclusion or one contrary to it, I have chosen to undertake this study.

CHAPTER 3

Methodology

Participants

The participants in this study consisted of ten adults (at least 18 years old), five males and five females. They were Spanish-English natural bilinguals (NBs). In this study, NBs were defined as adults that learned both English and Spanish during the critical period of language acquisition, or from birth to five years old (Krashen, 1973). Prior to data gathering, the participants indicated that they had maintained proficiency in both Spanish and English during their formative years. A summary of the participants and the nationality of their parents can be seen in Table 3.1.

Table 3.1.

Summary of Participants

Unique ID	Age	Sex	Country of Birth	Mother's Country of Birth	Father's Country of Birth
11	26-35	F	Spain	England	Spain
23	18-25	F	United States	El Salvador	El Salvador
35	18-25	F	United States	United States	Spain
50	18-25	F	Mexico	Mexico	Mexico
61	18-25	M	United States	Mexico	Mexico
66	55+	M	Mexico	Mexico	United States
72	18-25	M	United States	Mexico	Guatemala
73	26-35	F	Peru	Peru	United States
86	35-45	M	United States	United States	Mexico
96	18-25	M	United States	United States	Guatemala

Previous studies have shown that there is little difference in the production of voiceless stops, no matter what dialect or variety of English (see Docherty, 1992; Keating, 1984; Klatt, 1975; Lisker & Abramson, 1964) or Spanish (see Borzone de Manrique, 1980; Castañeda

Vicente, 1986; Lisker & Abramson, 1964; Poch, 1984) is spoken. All of the participants learned Spanish and English prior to age six and maintained proficiency in both languages up until the time of the study. Every participant was able to speak both English and Spanish at an advanced level of proficiency. This was evaluated by the facilitators of the study during the data gathering phase of research. More information is provided hereafter.

Using this definition of an NB allows us to define our participants as bilinguals independent of the results of this study. Some may criticize how “bilingual” the participants are, how well they can speak each language, or how living in an English-dominant environment can skew their proficiency. Nevertheless, each participant is bilingual from a very early age, is proficient in both languages, and uses both languages on a regular basis. Any criticisms directed at this definition of an NB would simply be aimed at an individual bilingual, and not at that person’s ability to speak both languages (see Grosjean, 1992; 2010).

The participants were recruited by two principal methods: word of mouth (referrals) and classroom announcement. The most effective way of finding participants for this study was through referrals, given that many of the participants knew others who met the criteria detailed above. I also visited an upper-level Spanish course at my institution to announce the study. Any students that met the criteria and desired to participate, did so of their own free will without educational compensation or hope for extra credit. Each participant received \$40 total for their participation in the study

Procedures

Data gathering. The data was gathered in two different sessions on two different days for each participant: one session on one day, and the other session on a separate day. The two sessions were at least 48 hours apart, meaning that they could not be conducted in consecutive

days. One of the sessions was conducted wholly in English, while the other was conducted wholly in Spanish. Half of the participants completed their Spanish session first, and the other half had their English session first. Each session was conducted by a researcher whose L1 was the target language. While the researchers were bilingual, they were instructed to only speak the target language with the participant. The purpose of this instruction was to help the participants enter and maintain the respective language mode.

For example, Participant 11 completed the first session on a Monday. The session was proctored by an assistant (not the researcher) whose L1 was Spanish. All of the tasks were performed and moderated in Spanish. On the next Wednesday, Participant 11 returned to the same place to complete similar tasks. However, the second session was conducted by a second assistant whose L1 was English. All of the tasks were completed in English. At the end of the recording sessions, the participants were debriefed and given some details of the study. It was important that the participants remained unaware of the research personnel's capability to speak the non-target language, because it helped control for cross-language interference.

Instruments. There are two categories of instruments in this study. The first group is comprised of two surveys aimed at gathering demographic and sociolinguistic data. The first survey was adapted from Smead (1988) and Jiménez Trinidad (2008). Both studies used questions focused on determining a participant's language dominance by asking questions focused on instinctual or unexpressed language. For example, the language you dream in or the language you use to vent or express anger tends to correlate directly with your language dominance (Smead, 1988). Therefore, I chose to include similar questions in my survey. The survey asks what language the participant prays in, what language the participant vents in, what language the participant plans in, what language the participant uses to perform simple

mathematical operations. My hypothesis is that language dominance in the preceding variables correlates directly with the production of monolingual-like VOT. The participants also provided other information including demographic information (gender, age, age at which the participant entered the United States, level of education), where and when they learned each language, their self-rated proficiency in each language, and how often they used or received input in each language on an average day (overall, when watching TV, and when reading). The first survey took around 10 minutes to complete.

The second survey in this group is called the Bilingual Language Profile (BLP). The BLP is an instrument for assessing language dominance, or language use and skill (Birdsong, 2014). It is intended to produce a scalar and empirical dominance score and a general bilingual profile taking into account a variety of linguistic and social variables such as education, living circumstances, and individual language use (Birdsong, Gertken, & Amengual, 2012). This instrument was released in 2011, and has been undergoing validation in several studies since (see Amengual, Birdsong, & Gertken, 2014; Gertken, Amengual, & Birdsong, 2011; Gertken, Amengual, & Birdsong, 2014). This assessment was chosen because it was simple, it was easy to use, and it considered many different aspects of language dominance. In addition, it provided a scalar result that could be used easily in statistical analyses. In this study, the BLP was used to assess whether or not each participant had a dominance of one language over another and whether or not language dominance was related to the production of monolingual-like VOT. The second survey took around 15 minutes to complete.

The tasks eliciting VOT production were based on previous VOT studies (see Castañeda Vicente, 1986; Dickerson & Dickerson, 1977; Klatt, 1975; Lisker, 1986; Lisker & Abramson, 1964; Lisker & Abramson, 1967; Zampini & Green, 2001). There were three different tasks

aimed at getting a comprehensive profile of VOT production by each participant. As has been mentioned previously, VOTs differ depending on phonetic context. Therefore, the tokens analyzed in this study were either word-initial or part of a stressed syllable. This helped provide the most stable VOTs and the clearest VOT recordings (Lisker & Abramson, 1967).

Like Dickerson and Dickerson (1977), this study includes the reading of a word list as the most formal task and an unscripted conversation as the least formal task. This study includes a third task that is meant to fall in between the two extremes. The third task is adapted from a study by Crane (2011), in which she asked participants to tell a story following visual inputs. In this study, participants were asked to retell a children's story after watching it on a computer. This task is not as formal as reading individual words, but some structure still exists, prompting participants to use certain vocabulary in their responses. In an additional effort to control the formality of the tasks, this study incorporated principles from Labov's (1972) Observer's Paradox. The Observer's Paradox refers to phenomena where the observation of an event or experiment is influenced by the presence of the observer or prompter. In the context of this study, the presence and influence of the prompter can increase the formality of the tasks. The tasks are performed starting with the most formal, when participants feel most uneasy. The least formal task is performed at the end. Lastly, the questions asked in the final task are adapted from Labov (1981). The questions used are targeted at emotionally charged events or sentimental life topics. According to Labov, these questions help lower the effective filter and speech formality of the participants. These methods together ensured that wide range of speech formality was used. Each recording session consisted of the following three tasks:

1. Reading of Word List: Participants were told that they would be recorded prior to the beginning of the task. Then, each participant was asked to read one word shown on a

monitor. After a clear recording was obtained, a new word was displayed on the screen and the process was repeated until the word list was complete. There were 26 words, one for each letter of the alphabet (see Appendix B). The words were displayed in alphabetical order in order to help distract the participant from what I might have been looking for, namely the production of stop consonants. The recording provided a sample of highly formal or controlled speech. This task took about three minutes.

2. Retelling of Children's Story: Once again, the participants were reminded that they would be recorded prior to the beginning of the task. They watched a video of a children's story online. Each video was about five minutes in length, and contained a short story with a moral at the end. (For more information on the videos, see Appendix C.) The video was played on a computer monitor and the audio was played on in-room speakers. Once the video was completed, the participants were asked to repeat the story they saw with as much detail as possible in the target language while being recorded. This task provided a recording of semi-formal or less controlled speech. Because the participants were reminded that they would be recorded, that idea was on their mind. However, the need to focus on the content of the video and lack of script helped lower their level of formality. This task took about 10 minutes to complete.
3. Simulated Oral Proficiency Interview: After the completion of the second task, the prompter conducted a short sociolinguistic interview with each participant in the target language. No mention of the recording was made and the prompter asked specific questions with the aim of lowering the speech formality of the participants (Labov, 1972). The subjects covered included family life, religion, education, near-death experiences, and hobbies. (For a list of sample questions, see Appendix D.) During the

interview, prompters evaluated the oral proficiency of each speaker, ensuring that the participant was proficient at an Advanced level as described by ACTFL (2012). This means that each speaker was able to “engage in conversation in a clearly participatory manner in order to communicate information on autobiographical topics, as well as topics of community, national, or international interest” (p. 5). All of the participants were able to narrate and describe in the major time frames of past, present, and future. They also were able to speak using complete paragraphs and linked ideas (ACTFL, 2012). This instrument provided a sample of the proficiency of the participant in the target language and a recording of informal or less controlled speech. This task took around 10 minutes. The recordings took place in a recording room on the Provo, UT campus of Brigham Young University. The recordings were made on a computer with a Logitech A-0234a USB microphone and the Audacity (v. 2.0.4) recording program. They were recorded on a 44.1 KHz Mono track and exported as a 16 bit PCM .WAV file which was used in the analysis of the stop phonemes.

Data Analysis

At least six tokens were analyzed per stop per task per language for each participant. If a stop was deemed not measurable due to the quality of the recording or the production of the participant, another stop from the same task was selected to replace it. Each recorded stop yielded one token for VOT measurement. VOT was measured in the computer program *Praat* (Boersma & Weenink, 2014). Each .WAV file was imported into the program and then each individual stop was labeled in Praat. After the stops were labeled, random stops were chosen from the recording to be included in the analysis. For a sample of different VOT measurements, see Figure 2.1. After the VOT was measured, it was added by the research personnel to a Microsoft Excel spreadsheet where all of the averages were determined. The VOT measurements

gathered provided one average VOT for each stop in each task in each language. In addition, one overall average was calculated using the mean of all tokens of each stop in each language, regardless of task. A sample of the data gathered and evaluated can be seen in Table 3.2 and Table 3.3.

Table 3.2.

Sample VOTs Gathered from Tasks

Participant 23	<u>Word List</u>		<u>Story</u>		<u>OPI</u>	
	English	Spanish	English	Spanish	English	Spanish
/p/	98	18	55	21	24	10
	27	18	28	18	13	23
	32	8	19	14	48	25
	25	38	28	35	32	28
	28	13	66	18	14	31
	85	22	72	15	14	18
/t/	75	16	73	17	58	21
	77	14	50	18	68	17
	68	12	72	13	48	13
	70	17	74	15	86	16
	95	16	39	24	92	17
	49	15	80	17	73	20
/k/	70	37	66	37	29	40
	84	34	68	26	62	29
	30	29	44	39	31	30
	67	26	24	39	12	47
	61	41	82	35	84	30
	43	71	82	35	49	31

Table 3.3.

Sample Averages Calculated from Tasks

Participant 23	<u>Word List</u>		<u>Story</u>		<u>OPI</u>		<u>Average</u>	
	English	Spanish	English	Spanish	English	Spanish	English	Spanish
/p/	49.2	19.5	44.7	20.2	24.2	22.5	39.3	20.7
/t/	72.3	15.0	64.7	17.3	70.8	17.3	69.3	16.6
/k/	59.2	39.7	61.0	35.2	44.5	34.5	54.9	36.4

The averages of the stops in each language were compared using ANOVA and ANCOVA regression analysis and a paired sample test in IBM SPSS Statistics 21 to conclude

whether or not there was a statistically significant difference between the production of VOT in English and Spanish stops. The averages were then used in bivariate correlation analyses with the results from the survey data. This helped determine if there were any correlations between the linguistic or demographic data and the production of VOT. These correlations helped draw conclusions about whether NBs had two separate productions of the voiceless stop phonemes or not and why that may be the case.

CHAPTER 4

Results

Means

The first analysis was a simple overview of the mean VOT values produced by the participants (see Table 4.1). In both Spanish and English, NBs produced VOTs that approximated the monolingual standards set by Lisker and Abramson (1964) and Castañeda Vicente (1986). However, none of the mean values in this study quite reached the average values from studies involving monolinguals (compare to Table 2.1). It is interesting to note that when the participants were speaking Spanish, their average VOT for /t/ (18.4ms) was shorter than their average VOT for /p/ (18.8ms). Then, their average VOT for the English /t/ (59.3ms) was longer than their average VOT for /k/ (53.1ms). In other words, the average values for VOTs did not agree with the tendency that VOTs tend to become more positive as the point of articulation moves back in the mouth (Castañeda Vicente, 1986). Also interesting is the large range of VOT tokens gathered from the different tasks. Both the ranges and the standard deviations tend to be larger than those of previous research conducted with monolinguals (compare to Castañeda Vicente, 1986; Lisker & Abramson, 1964) and L2 learners (compare to Magloire & Green, 1999).

Table 4.1.

Average VOTs over All Tasks for All Participants

	Average VOT	Range	St. Dev.
Spanish /p/	18.8	5:101	12.25
Spanish /t/	18.4	8:39	6.48
Spanish /k/	32.3	11:122	14.488
English /p/	38.0	7:126	29.48
English /t/	59.3	17:147	28.56
English /k/	53.1	12:121	22.62

When comparing mean VOTs by task, some mixed results were found. In Spanish, the average VOT for /p, t, k/ in the most formal task was shorter than or equal to the mean VOT for the least formal task. There was some variance in the storytelling task, where VOTs were sometimes longer and sometimes shorter than the other task. In the end, there were no clear trends regarding task formality. This observation was even more prominent when comparing the English mean VOTs to each other over task formality (see Table 4.2). Yet, it is interesting to note that none of the Spanish VOTs became consistently shorter as formality decreased, and none of the English VOTs became consistently longer.

Table 4.2.

Average VOTs by Task for All Participants

	Word List	Story	Interview
Spanish /p/	14.4	21.0	20.9
Spanish /t/	17.9	17.6	19.7
Spanish /k/	33.1	30.6	33.1
English /p/	31.6	45.7	36.8
English /t/	58.0	67.1	52.1
English /k/	45.2	58.8	55.3

When comparing the means of one language to the other, it was important to inquire whether or not NBs actually have two distinct productions of each phoneme, one for English and a different one for Spanish. I ran a Paired Samples Test in order to decide whether or not there was a statistically significant difference in production of VOT in English and Spanish stops. The results are overwhelmingly in favor of the distinct production of stops, one for English and one for Spanish (see Table 4.3). With the exception of one case, there is a statistically significant difference in the production of all of the stops in Spanish versus English, $p < 0.05$. The only exception is the paired samples test comparing English /p/ and Spanish /p/ in the least formal task, which still has an extremely low probability of error, $p = 0.052$. All of the data suggest that

NBs have two distinct productions of each phoneme, but that the productions do not match the monolingual norms for Average VOTs.

Table 4.3.

Paired Sample Tests of Mean Spanish and English VOTs

	Paired Differences					t	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% C.I.			
				Lower	Upper		
Average /p/ All Tasks	19.3	9.8	3.7	10.2	28.3	5.1	.002
Average /p/ Task 1	17.2	11.7	4.4	6.4	28.0	3.9	.008
Average /p/ Task 2	24.7	14.0	5.3	11.8	37.6	4.7	.003
Average /p/ Task 3	15.9	17.3	6.6	-0.2	31.9	2.4	.052
Average /t/ All Tasks	40.9	11.7	4.4	30.0	51.7	9.2	.000
Average /t/ Task 1	40.2	13.2	5.0	28.0	52.4	8.1	.000
Average /t/ Task 2	49.5	20.9	7.9	30.1	68.8	6.3	.001
Average /t/ Task 3	32.4	12.0	4.5	21.3	43.5	7.1	.000
Average /k/ All Tasks	20.9	8.2	3.1	13.2	28.5	6.7	.001
Average /k/ Task 1	12.2	7.1	2.7	5.6	18.7	4.5	.004
Average /k/ Task 2	28.2	8.2	3.1	20.7	35.8	9.2	.000
Average /k/ Task 3	22.2	14.3	5.4	9.0	35.5	4.1	.006

Correlations with Other Variables

The next analyses performed in this study were on how well the production of VOT correlated with data gathered in the surveys. I ran Pearson correlations with each variable and all of the mean VOT values and also performed a linear regression analysis to decide whether or not there was a statistically significant correlation. Several things needed to be considered when

analyzing the data in this study. First of all, many different variables were considered in this analysis. They included gender, age, age at which the participant entered the United States, education level, age at which the participant began learning English and Spanish, how often the participant used each language on an average day, how often the participant watched TV in each language on an average day, how often the participant read in each language on an average day, the participant's self-rated proficiency in each language, what language the participant prayed in, what language the participant vented in, what language the participant planned in, what language the participant used to perform simple mathematical operations, and the numerical result from the Bilingual Language Profile (BLP). In addition, every variable was reported twice—once during the English session and again during the Spanish session. It is interesting to note that although the surveys asked the same information, responses varied slightly depending on the language of the survey. Therefore, each variable is analyzed twice with the mean VOTs of the participant.

After all of the analyses, the two variables that were the most significant predictors of the length of VOT production were gender and age at which the participant learned English. Females produced more monolingual-like VOTs than males in English /t/ and /k/, $p < 0.05$ (see Table 4.4). Although not statistically significant, females also had shorter VOTs for their production of /p/. In addition, the age at which the participant learned English correlated significantly with longer mean Spanish VOTs, $p < 0.05$ (see Table 4.5). This means that the later an NB learned English, the less monolingual-like their Spanish /p/ and /k/ VOTs were at the time of recording.

Table 4.4.*Gender and Mean English VOTs*

	Gender (F=1, M=2)	
	Pearson Correlation	Sig. (2-tailed)
English /p/	-.229	.622
English /t/	-.913	.004
English /k/	-.831	.020

Table 4.5.*Age of Learning English and Mean Spanish VOTs*

	Age of Learning English	
	Pearson Correlation	Sig. (2-tailed)
Spanish /p/	.836	.019
Spanish /t/	.006	.990
Spanish /k/	.773	.042

At the beginning of this study, I hypothesized that the participants' BLP (or language dominance) scores would correlate with their monolingual-like production of VOT. However, the analysis showed that there was no statistically significant correlation with the any of the VOT averages tested (see Table 4.6). This analysis included the average VOTs for each individual phoneme in each task and overall average VOTs for each phoneme.

Table 4.6.*BLP Scores and Average VOTs*

	English Session BLP Score		Spanish Session BLP Score	
	Pearson Correlation	Sig. (2-tailed)	Pearson Correlation	Sig. (2-tailed)
English /p/	.086	.854	.020	.967
English /t/	.085	.855	.173	.710
English /k/	.640	.121	.627	.132
Spanish /p/	.081	.862	.029	.951
Spanish /t/	-.340	.456	-.548	.203
Spanish /k/	.037	.936	-.101	.829

An unexpected correlation was also discovered between how often participants watch TV in English compared to Spanish and their production of English VOTs in formal tasks (see Table

4.7). The more that participants watched TV in Spanish, the more monolingual-like their English VOTs were. The correlations in the production of /p/ and /k/ were extremely strong, $p < 0.01$. There is also a slight correlation in the production of /t/, although it is not statistically significant. Another positive correlation was found between the amount of Spanish spoken in an average day and the production of English VOTs. The more that the participants spoke Spanish on an average day, the shorter their English /k/ ($p = 0.028$) and /t/ ($p = 0.081$) VOTs were. Some other stray correlations did exist in the analysis, but no individual variable seemed to be significantly predictive of VOT production.

Table 4.7.

TV Language and Mean English VOTs in Formal Speech

	Time spent watching TV in Spanish	
	Pearson Correlation	Sig. (2-tailed)
Formal English /p/	.988	.000
Formal English /t/	.484	.271
Formal English /k/	.911	.004

Other Results

In addition to the quantitative results already stated, there were other results that were observed during this study. First of all, all of the participants, except two, expressed feelings of insecurity with their language skills during the simulated oral proficiency interview task of the study. Phrases such as “I can’t really speak English” or “No hablo español muy bien” were common during the interviews. Many of the participants expressed this feeling during both their English and Spanish interviews. It is interesting that they felt largely uncomfortable when they knew that their language skills were being evaluated, no matter what language was being spoken.

Another unexpected observation occurred in the BLP results. As was previously explained, each participant took the BLP twice—once in English, and once in Spanish. Once

again, both of the BLPs were identical, except for the language in which they were offered. However, when taking the BLP in Spanish, 70% of the participants tested more Spanish dominant than they did when they took the BLP in English (see Table 4.8). This doesn't necessarily mean that participants tested Spanish dominant on the Spanish BLP and English dominant on the English BLP. For example, Participant 23 tested 43.8 points English dominant on the English BLP, and only 22.3 points English dominant on the Spanish BLP. Ideally, the responses should not vary, no matter what language they are in.

Table 4.8.

BLP Results by Participant

Unique ID	Spanish BLP Score	English BLP Score
11	+35.96	-30.24
23	-22.25	43.77
35	-30.88	37.42
50	-23.89	12.90
61	-30.06	40.96
66	-10.90	15.26
72	-48.13	44.86
73	+16.82	-10.53
86	-37.40	32.61
96	-8.45	15.10

CHAPTER 5

Conclusions and Discussion

Research Questions

At the beginning of this study, I hypothesized that NBs would not consistently produce VOTs like natural monolingual English and Spanish speakers. The results of this study supported my hypothesis, showing that although NBs have two distinct productions of each stop, their VOTs are not as separated as those of monolingual speakers. This conclusion can be attributed to several factors. Most importantly, NBs are not the equivalent of two monolingual speakers. Grosjean (2010) proposes that a bilingual is an integrated whole which cannot easily be decomposed into two separate parts. In the case of VOTs, this is clearly evident. While the average VOT values of the English stops and their Spanish equivalents are statistically different, the productions of the VOTs still may overlap, producing some short-lag English VOT tokens and some long-lag Spanish VOT tokens. When comparing standard deviations of NBs to monolinguals, the NBs are not as consistent in the production of their VOTs as monolinguals are. The results of this study are similar to previous research concluding that L2 learners do not acquire monolingual-like production of VOTs (see Caramazza et al., 1973; Flege & Hillenbrand, 1984; Flege et al., 1995; Laeufer, 1996; Major, 1992), producing average VOT values that fall between the monolingual values for English and Spanish. However, the range of individual VOT values produced by NBs includes the whole range of English monolinguals and Spanish monolinguals (Castañeda Vicente, 1986; Lisker & Abramson, 1964). Therefore, it may be concluded that while NBs produce VOTs that match monolingual standards, they do not produce them regularly. Consequently, their average VOTs do not match those of monolinguals in either language and their standard deviations are considerably larger.

Another factor that definitely influences NB speech is the amount of input they receive in each language (Flege, 1991b). All of the participants live in the United States. None of the participants reported that they spoke more Spanish than English on an average day. Because the input and output for both languages is not equal, it is hard to expect that the participants can produce VOTs equally target-like in both languages. In fact, the participants who reported speaking both Spanish and English equally on an average day had consistently shorter English VOTs than those who reported using more English than Spanish—1.9ms shorter for English /p/, 16.1ms shorter for English /t/, and 9.7ms shorter for English /k/. In other words, the more that NBs used Spanish in an English-dominant society, the less monolingual-like their English VOTs were.

Before conducting this study, I also hypothesized that VOT production would have a significant correlation with the BLP scores of the participants. I believed that if the participants were more Spanish dominant, they would produce shorter VOTs and that if the participants were more English dominant, they would produce longer VOTs. However, this hypothesis proved to be completely rejected by the results in this study. BLP scores did not correlate with the production of English /p/ ($p = 0.967$). This extreme lack of correlation can once again be explained by Grosjean's (1992, 2010) statement that bilinguals simply cannot be compared to two monolinguals in the case of speech production. A Spanish-English NB is not just one person that falls somewhere along a straight continuum between English and Spanish monolinguals. In a similar manner, their BLP score—while measuring individual language use and skill—cannot really measure what linguistic traits are acquired by each bilingual. While NBs can be fluent in both languages and more dominant in one language over another, they have their own individual phonetic and phonological traits.

While BLP scores did not correlate with monolingual-like production of stops, some other variables did. Gender had a surprisingly strong correlation with the production of VOT. Females produced VOT values that more closely approached the previously cited monolingual values. In the field of sociolinguistics, Labov (1972) was the first to postulate that women were more conservative in language production and favored standard, prescriptive norms. The evidence in this study supports this conclusion, where the females produced average VOTs that approximated monolingual standards more than men did. On average, the female participants produced 9.2ms longer VOTs in English than males, and in the Spanish production of /t/, female participants produced an average VOT that was 4.1ms longer than the average VOT for males.

Another strong predictor of monolingual-like VOT production by NBs was the age at which the participants reported that they started learning English. The correlation showed that the later that participants began learning English, the longer their Spanish /p/ and /k/ VOTs became. This conclusion is similar to past L2 acquisition studies which concluded that the acquisition of L2 can affect the production of L1, causing the average VOTs of the L1 to move towards the monolingual VOT norms of the L2 (see Caramazza et al., 1973; Flege & Hillenbrand, 1984; Laeufer, 1996). Although NBs are exposed to both languages during the critical period, a difference of one or two years in first exposure to the second language may influence the acquisition of certain linguistic traits.

The final significant predictor of monolingual-like VOT production seen in this study was the amount of time participants spend watching TV in Spanish versus English. The results showed that the more time that participants spent watching TV in Spanish, the better they produced formal English VOTs. This may relate to the amount of input that participants receive from each language. All of the participants reported that at their current stage of life, they

received at least equal—if not more—input in English than Spanish on an average day. As the amount of Spanish input increases (by watching more TV in Spanish), it may be the case that the ability to distinguish the Spanish stops from the more common English input increases (see Flege 1992, 1995).

Other Observations

While conducting this study, there were several observations that were made which are of value to this area of research, but which cannot be substantiated by statistical results. During the study, I began to note that the two sets of surveys taken by the participants, while identical in the questions asked, yielded slightly different results. For example, on the BLP survey offered in English, Participant 23 showed to be 43.8 points English dominant (out of a maximum of 218 possible). However, on the BLP taken in Spanish, the participant resulted only 22.3 points English dominant. Something similar occurred with several other participants, where they registered significantly more English dominant on the English BLP than they did on the Spanish BLP. All of the participants who came out Spanish dominant on the English BLP came out even more Spanish dominant on the Spanish BLP. All of the tasks were performed in the exact same sequence and administered in the exact same manner during both sessions for each participant. Both of the BLPs asked for the same information. Therefore it may be concluded that simply the language of the survey can have an influence on how a participant answers questions. For example, Participant 23 reported speaking English with friends 90% of the time on an average week on the English BLP, yet reported only 70% on the same question of the Spanish BLP. While one small change such as this one did not make a significant difference, several such differences did, as can be noted in Table 4.8.

Another interesting observation is the average VOT values for /t/. Since Abramson and Lisker (1964), it has been generally observed that as the point of articulation of the stop moves backward in the mouth, VOT tends to become longer. For example, /t/ is produced closer to the back of the buccal cavity than /p/, and /k/ is further back than /t/. Therefore, it is expected that the average VOT values for /t/ would fall between those of /p/ and /k/ in the same language (see Table 2.1). However, for each of the languages analyzed in this study, the average VOT value for /t/ does not lie between the averages of the other two stop phonemes (see Table 4.1). While the average VOT for /t/ is not far out of the expected range, this observation is one that has not been made before. A possible explanation is that of the voiceless stops, /t/ is the stop that has the largest difference in average VOT values between English and Spanish pronunciation (60ms). Given that NBs learn both languages at the same time, it may be concluded that the more marked that a difference is, the easier it is acquired by NB. A clearer explanation, proposed by Flege (1992, 1995), states that when learners hear an L2 sound that is foreign, new, or distinguishable to L1, they are forced to create a new phonetic category. However, if the L2 sound is similar enough to an L1 sound, the learner has a harder time separating and distinguishing it mentally. Therefore, L2 learners end up readjusting the definition of phonetic boundaries and produce a token foreign to both L1 and L2. It is possible that NBs have a similar acquisition of distinct VOT production. In the most marked VOT productions (/t/), NBs acquire VOTs that are most distinct, while in the least marked productions (/p/), NBs produce VOTs that are the least distinct. The evidence gathered in this study would support the conclusion that markedness influences the acquisition of distinct productions of VOT in NBs.

Future Research

My purpose in conducting this study was to add insight to the topic of natural bilingual speech production. It would be beneficial to conduct this same study in a Spanish-dominant region and compare those results to the ones found in this study. Nevertheless, it seems that none of the natural bilinguals in this study produce VOTs like native monolinguals. So what do we designate as “native”? It is interesting that L2 learners generally do not acquire native-like VOTs without explicit instruction (see Flege et al., 1995; Piske et al., 2001). However, the same appears to be true for NBs. Therefore, two questions remain to be answered: What is native? And what importance does the native ideal really have when studying bilinguals? It is interesting that every VOT study cited in this work accepts native or standard values for mean VOTs. However, none has defined where native monolingual VOT values start and where they stop. Given that native monolingual Spanish speakers produce /p/ with a mean VOT of 6.5ms (Castañeda Vicente, 1986), would an NB who produces /p/ with a mean VOT of 10ms be considered native? What is the range of acceptable native production of VOT? Beardsmore (1986) writes:

Although we have queried whether monoglot norms of reference are relevant in decisions on whether a speaker is bilingual or not, since they well may represent an exceptional, if not unattainable, goal for the vast majority of users of two languages, yet they still tend to represent the beginning and end point of all discussions on the question for many people. If they represent an idealized and often exceptional measure of ability...we might wonder how significant such types of bilingual proficiency are for investigation purposes. (p. 9)

A study which has a panel of monolingual speakers evaluating the pronunciation of NBs would be valuable in defining whether or not NB VOT production can classify as native and what an acceptable range of mean VOT values may be. While hard to evaluate the sole influence

of VOT in monolingual-like production of speech, it may be helpful for giving a range of possible mean VOTs. It would be helpful to assess whether or not monolinguals can tell that the NBs are not monolinguals. If the outcomes of such a study were to show that NBs still sound like monolinguals, there would have to be a considerable reevaluation of what should be considered native by researchers. If native simply means belonging to or associated with one by birth, then I would propose that the mean VOTs found in this study should also be considered in future VOT studies. And perhaps studies on second language acquisition ought not to compare their results with the results from studies on monolinguals, but rather from studies on natural bilinguals, such as this one.

Appendix A

Social Survey

This form will help us gather information concerning your language exposure, use, and proficiency. Please fill out your responses as accurately as possible. Thank you.

I. Demographic Information

First Name*

Last Name(s)*

Gender*

- Male
- Female

Age*

- 15-25
- 26-35
- 36-45
- 46-55
- Over 55

Country of Birth

- United States
- Other:

If not born in the United States: Age at time of arrival to the United States

Highest Level of Education

- None
- Some Grade School
- Finished Grade School
- Some High School
- Finished High School
- Some University or College
- Associate's Degree
- Bachelor's Degree
- Master's
- Doctorate
- Other:

Father's Country of Birth

- Prefer Not to Answer
- United States
- Other:

Mother's Country of Birth

- Prefer Not to Answer
- United States
- Other:

II. Linguistic Information

Languages you speak*

- English
- Spanish
- Other:

Languages your father speaks (Check all that apply)

- Prefer Not to Answer
- English
- Spanish
- Other:

Languages your mother speaks (Check all that apply)

- Prefer Not to Answer
- English
- Spanish
- Other:

**Age at which you began learning or being exposed to English
(for “since birth” please write 1)***

Where you learned English*

- At home
- With friends
- In school
- At work
- Other:

**Age at which you began learning or being exposed to Spanish
(for “since birth” please write 1)***

Where you learned Spanish*

- At home
- With friends
- In school
- At work
- Other:

How often you speak English on a typical day*

- All of the time
- More than half of the time
- About half of the time
- Less than half of the time
- Never

How often you speak Spanish on a typical day*

- All of the time
- More than half of the time
- About half of the time
- Less than half of the time
- Never

Do you listen to music in English?*

- Yes
- No

Do you watch television in English?*

- Yes
- No

Do you listen to music in Spanish?*

- Yes
- No

Do you watch television in Spanish?*

- Yes
- No

What part of your time listening to music and/or watching television is done in English and Spanish?

- All of the time in English
- More than half of the time in English
- About half of the time in English and half of the time in Spanish
- More than half of the time in Spanish
- All of the time in Spanish

Do you read newspapers, magazines, or books in English?*

- Yes
- No

Do you read newspapers, magazines, or books in Spanish?*

- Yes
- No

What part of your time reading newspapers, magazines, or books is done in English and Spanish?

- All of the time in English
- More than half of the time in English
- About half of the time in English and half of the time in Spanish
- More than half of the time in Spanish
- All of the time in Spanish

What part of the English media (music, television, newspapers, magazines, books) you come into contact with do you understand?

- I understand all of the media in English
- I understand more than half of the media in English
- I understand about half of the media in English
- I understand less than half of the media in English
- I understand none of the media in English

What part of the Spanish media (music, television, newspapers, magazines, books) you come into contact with do you understand?

- I understand all of the media in Spanish
- I understand more than half of the media in Spanish
- I understand about half of the media in Spanish
- I understand less than half of the media in Spanish
- I understand none of the media in Spanish

How well do you speak English?

- I speak well in all situations
- I speak well in most situations
- I speak well in some situations
- I cannot speak well in most situations
- I cannot hold a conversation

How well do you speak Spanish?

- I speak well in all situations
- I speak well in most situations
- I speak well in some situations
- I cannot speak well in most situations
- I cannot hold a conversation

If you pray, what part of your time do you pray in English and Spanish?*

- All of the time in English
- More than half of the time in English
- About half of the time in English and half of the time in Spanish
- More than half of the time in Spanish
- All of the time in Spanish
- Not Applicable

When you are really upset, what language do you typically speak when you vent or express your feelings?*

- All of the time in English
- More than half of the time in English
- About half of the time in English and half of the time in Spanish
- More than half of the time in Spanish
- All of the time in Spanish

When thinking about the future, making plans, or daydreaming, what language do you typically think in?*

- All of the time in English
- More than half of the time in English
- About half of the time in English and half of the time in Spanish
- More than half of the time in Spanish
- All of the time in Spanish

When doing simple mathematical operations (counting, adding, subtracting, etc.) in your head, what language do you typically think in?*

- All of the time in English
- More than half of the time in English
- About half of the time in English and half of the time in Spanish
- More than half of the time in Spanish
- All of the time in Spanish

Appendix B

Word Lists

Attacker	Albaricoque
Bodybuilders	Bosque
Catastrophe	Caravana
Database	Depósito
Epitome	Estomago
Frumptiness	Fachada
Goggles	Gato
Hawkeye	Hogar
Iguana	Interrogación
Juniper	Junípero
Kindergarten	Kilogramo
Latitude	Langosta
Monopoly	Mapa
Noble	Napolitana
Opening	Odio
Package	Panadero
Quintuplets	Querida
Radar	Reducción
Suburban	Soberbio
Testament	Testigo
Undertaker	Úvula
Vagabond	Vuelo
Wagon	Wilfredo
Xylophone	Xenofobia
Yearbooks	Yugoslavia
Zygote	Zapatero

Appendix C

Summary of Videos Used in Task 2

As was explained previously, participants were asked to watch a short video of a children's story during the second VOT elicitation task. The stories were about five minutes long and contained morals. They were both animated and they were narrated by a reader. The English video was titled *The Elephant Child* and can be found online at <https://www.youtube.com/watch?v=buqw2bvlv2Q>. The Spanish video was titled *El Gatito Desordenado* and can be found online at <https://www.youtube.com/watch?v=UKP9KTZ9Smo>.

Appendix D

Interview Task Modules and Sample Topics

These questions acted as a guide, giving suggestions to the interviewer of how to lead a conversation. Several of the questions included were meant to distract the informant from thinking about speech production, and thus decreased the level of formality of speech. Knowing that some of these questions could create an uncomfortable situation for the participants, they were made aware that it was not requisite for them to answer any question if they chose not to. The interview lasted around ten minutes. The modules listed below were meant to help the interviewer create a natural flow of speech without difficulty, helping the informant produce as much natural speech as possible in the given time (Labov, 1981). The questions that are underlined were required to be asked by the interviewer. The individual modules and each individual question could be asked in any order. There is a conceptual map of how modules could be followed in natural speech in Figure 6.1.

1. Demography

- What is your name?
- Where are you from?
- Where have you lived?
- How old are you?

2. Peers/Friends

- How important are your friends to you?
- What does it mean to be a good friend?
- How do you feel about the phrase “You can judge a man by the company he keeps”?

- Does being able to speak two languages affect the friendships you have?

3. Religion

- What is the importance of religion in your life?
- Can you share a spiritual experience you had?
- What do you believe is the way to find happiness?

4. Fear

- Share a couple of your fears.
- Why do you believe we feel fear?

5. School

- Are you a student?
- Where do you study?
- Why are you in your current field of study?
- What are your thoughts on the quality of your educational experience?
- How did being able to speak multiple languages affect you in school?

6. Work

- Are you employed?
- What do you do for work?
- If you could choose anything, what would you like to do for work?
- How does being able to speak multiple languages affect you in the workplace?

7. Language

- What languages do you speak?
- When did you start learning English?
- When and where do you tend to use English?

- When did you start learning Spanish?
- When and where do you tend to use Spanish?
- Do you prefer English or Spanish? Why?
- What are the benefits of speaking both English and Spanish? Are there any disadvantages?

8. Family

- Describe your family.
 - How many siblings do you have? What do they do?
 - Do you have any nieces or nephews? What are they like?
 - What are some of your family traditions?
- Describe some ways that your family has influenced the person you are.
- What kind of a family life would you like to have in the future?
- How important is the family to society?
- How does language affect you family's identity?

9. Danger of Death

- Have you ever had a life threatening experience? What?
- Is risking death worth the thrill or feeling you get?
- Is death something that you are afraid of? Why?

10. Relationships

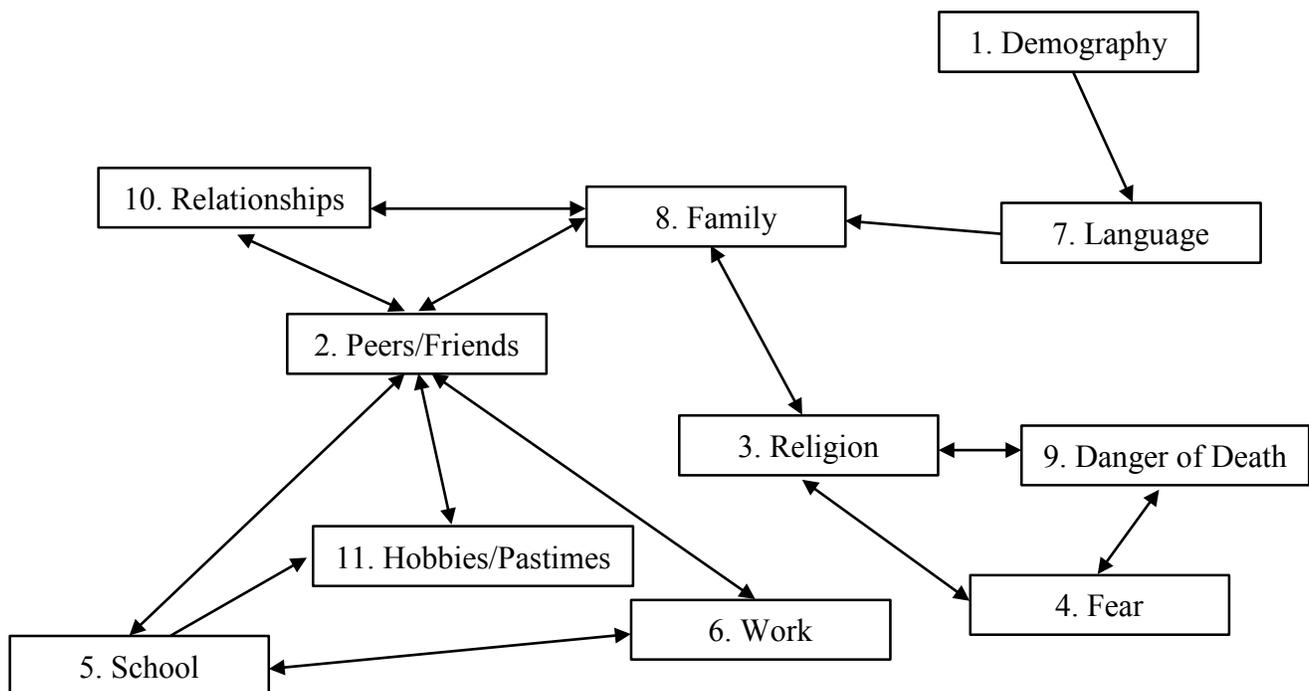
- What are some important principles for successful relationships?
- What relationships are most important to you?
- Why do you think so many relationships fail in today's society?

11. Hobbies/Pastimes

- What do you do in your free time?
- Do you have any hobbies that others might not approve of?
- Is there anything that you would like to do in the future?
- Describe your favorite vacation.

Figure 6.1.

Sample Network of Modules for Participant Interviews



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