RHYTHMIC VARIATION IN SPEAKERS OF SPANISH AS A HERITAGE LANGUAGE

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A Dissertation

Presented to

The Faculty of the Department

of Hispanic Studies

University of Houston

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In Partial Fulfillment

Of the Requirements for the Degree of

Doctor of Philosophy

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By

Allison N. Yakel

May, 2018

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ABSTRACT

Within the field of Spanish as a Heritage Language, phonology is an area of linguistics that has received the least attention. In particular, prosodic phonology (which encompasses tone, stress and rhythm) has garnered even less consideration by researchers. As such, this research project sought to understand how the rhythm systems of English and Spanish behave in the language produced by Spanish/English bilinguals who belong to different levels on a bilingual continuum. In other words, the objective was to understand the extent to which Spanish/English bilinguals are able to separate the rhythm systems depending on their relative dominance in each language.

This study employed the well-established rhythm metric, the normalized Pairwise Variability Index (Grabe & Low, 2002) to calculate the durational variability of vocalic and intervocalic intervals in each language. Results of the study show that the more balanced a bilingual speaker is (that is, he or she speaks both languages with similar proficiency), the better he or she is able to separate the rhythms of English and Spanish. On the contrary, the more heavily a speaker dominates one language over the other, the more the rhythm of the dominant language transfers to and effects the rhythm of the non-dominant language.

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1. INTRODUCTION

1.1 U.S. Hispanic demographics

The Spanish language has a long and storied history in the territory known today as the United States. Beginning with the arrival of Spanish colonizers in the early 16th century, the population of Spanish speakers has continued to grow as a result of the shifting of borders in the Treaty of Guadalupe Hidalgo in 1848 as well as increased migration of Hispanic people into the region (Lipski, 2009).

The 2010 U.S. Census reported that the number of Hispanic people in the U.S. was approximately 50.5 million, or 16.3% of the total U.S. population (U.S. Census Bureau, 2010). This represents an increase from the 2000 U.S. Census, in which the number of Hispanic people in the U.S. was approximately 35.3 million, or 12.5% of the total U.S. population. Furthermore, by 2050 it is projected that the U.S. Hispanic population will rise to 132.8 million, or around 30% of the total projected population (U.S. Census Bureau, 2010). According to Beaudrie & Fairclough (2012), Census estimates as of 2009 indicate that the U.S. has the second largest Hispanic population in the world, only behind Mexico (2012, pg. 1).

The U.S.Hispanic community is diverse in its composition, but a 2015 population estimate report from theU.S.Census indicated that people of Mexican origin comprise approximately 64% of the total population (likely due to the close proximity of Mexico to the United States). The next largest group is of Puerto Rican heritage, making up 9.5%, followed by 3.8% Salvadoran, 3.7% Cuban, 3.2% Dominican, and 2.4% Guatemalan.

The remaining 13.4% is comprised of people of other Central or South American origin ("Population Estimates", 2014).

The linguistic implications resulting from such a prominent community are many. As Beaudrie and Fairclough (2012) affirm,

> The growth and increasing importance of Spanish in all U.S.regions is being reflected in changes throughout government, media, business and education… As U.S. Hispanics have gained economic power and political influence, attention directed to research in and teaching of the Spanish language has grown correspondingly (p.2).

The increase in the presence and importance of Spanish in the U.S. has led to an increased interest in how it interacts with English and the linguistic effects this interaction tends to produce in Spanish-speakers from the United States.

1.2 A brief history of Mexican Spanish in the U.S.

While the increased academic interest in U.S. Spanish and its features is relatively recent, the presence of the Spanish language in the United States is not. As a matter of fact, the language has existed in this territory since the arrival of the first Spanish colonists before the United States was recognized as a country (Kanellos, 2002). From there, a colorful history which includes wars and moving borders fostered a steady arrival of Spanish-speaking people to the U.S.

Given that the largest community of U.S. Latinos is of Mexican origin, it is logical, then, that the largest dialect of Spanish is also that which has Mexican roots. Lipski (2009) provides an overview of the history of Mexican American Spanish in this country, beginning with the Texas war of independence in 1836 and the signing of the

Treaty of Guadalupe Hidalgo in 1848 following the Mexican-American war. During this tumultuous time in the history of the region, the U.S./Mexico border was changed when Texas came under the control of the U.S. As such, many Spanish-speakers who had previously been living in Mexico were suddenly living in United States territory (p. 78).

Lipski goes on to explain that the influx of Mexicans to the U.S. was quite slow until the Mexican Revolution which took place from 1910 to 1920. During this time, masses of Mexican people of all different social classes took refuge from the chaotic environment in which they had been living (p. 79). Per Lipski, "For the first time, Spanish was deliberately taken into areas where English had been the prevailing language, and for the first time Spanish as a "foreign" language entered the southwestern United States from outside its (new) borders" (p. 79).

The next historical event that resulted in a large wave of immigrants from Mexico was the establishment of the *Bracero* program, a program developed to compensate for the labor shortage experienced when the United States entered the Second World War.[1] Following the war, repatriation efforts did not go as planned, and as per Lipski, "…the conduits opened by the *Bracero* movement brought ever greater numbers of Mexican workers to the United States, following in the footsteps of the first recruits" (p. 79). With time, the population continued to grow, rendering the U.S. the second-largest Spanish-speaking nation in the world.

Other varieties of Spanish in the U.S., while not as prominent given the sizable difference in population, have equally colorful histories in the U.S. (for an overview, see

[1] Lipski (2008) inaccurately states that the *Bracero* program was initiated during WWI, which lasted from 1918-1930. The program was in fact initiated during World War II, beginning in 1942 (Kosack, 2013).

Lipski 2009). Given the proximity of Mexico to the United States, and the availability of Mexican and Mexican-American Spanish-speakers, this study will focus on Mexican Spanish in the United States.

1.3 Spanish & English in contact

According to Carmen Silva-Corvalán (2001), two or more languages are considered to be in contact when they exist in the same geographic space and are spoken by the same individuals. In other words, there is bilingualism (or even multilingualism) and bilingual speakers are considered the point of contact of these two languages (p. 269). Silva-Corvalán affirms that contact situations are one of the biggest catalysts for linguistic change given the large quantity of language interference, or transfer, which exists between the two. She goes on to explain that linguistic transfer can be either temporary or permanent. Temporary transfer tends to appear during the process of acquiring a second language or native-like abilities in another language. A characteristic is considered a permanent transfer once it becomes categorical in the receiving language (p. 281). Silva-Corvalán then specifies and defines different types of linguistic transfer:

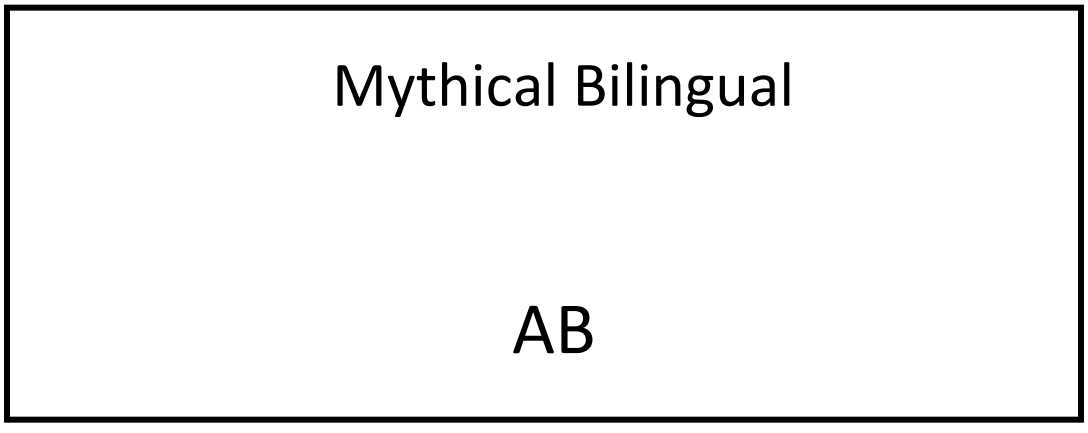
- Lexical: the transfer of specific lexical items from one language to another or the semantic extension of a word that already exists in one language to include the meaning of the homonym in the other.
- Syntactic: Transfer of anything related to the order of constituents, agreement, dependence, subject expression, etc. [2]

[2] Silva-Corvalán (1994, 1998) defends the stance that bilinguals do not transfer syntactic structures, but rather discourse pragmatic structures. For more information, see Silva-Corvalán (2006).

- Morphological: the transfer of bound morphemes, either derivational or grammatical.[3]
- Phonological: the transfer of phonological characteristics of one language into another that results in the *sub-differentiation,* or *fusion,* of two sounds of the secondary language system into one. Alternatively, *hyper-differentiation* can occur, when one sound forms into two separate ones.

These phenomena can manifest themselves in many different ways, and they do so to varying degrees depending on the ability of a bilingual individual in both languages. The fact that bilinguals possess different degrees of dominance or ability in their respective languages as a result of their own experience with the languages has led to the affirmation that bilingualism is not the merging of two monolingual speakers of two given languages into one person; rather, it is a continuum. The concept of the bilingual continuum was first proposed by Silva-Corvalán (1994) and expanded upon by Valdés (2001). Figure 1, adapted from Valdés (2001) illustrates the idea of what she calls a "mythical bilingual" (p. 4):

Figure 1: The Mythical Bilingual (Valdés 2001, p. 4)



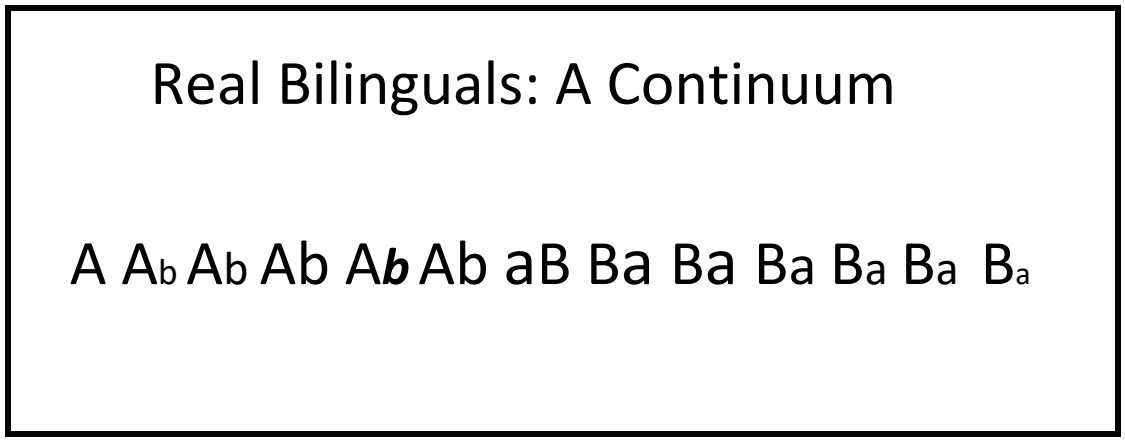
[3] Silva-Corvalán (2006) asserts that cases of morphological transfer to or from English to Spanish are polemic (p. 283).

If A and B are two different languages, their equal size and design would indicate an individual is equally dominant in both languages. According to Valdés (2001), "This would mean that whatever the individual could do in one language (recite childhood poems, pray, write academic papers, tell jokes, argue with a sibling) that person could do equally well in the other languages" (p. 4). Valdés goes on to explain that while this in theory is a possibility,

> …individuals seldom have access to two languages in exactly the same contexts in every domain of interaction. Neither do they have opportunities to use two languages to carry out the exact same functions with every person with whom they interact. Thus, they do not develop identical strengths in both languages. (p. 4)

According to Valdés, then, a continuum is a more appropriate way to think about bilingualism. She provides examples of a native speaker of English who can read French, or a native speaker of English who can understand spoken Polish, and asserts that both of these individuals are not completely bilingual but are certainly not monolingual (p. 5). Figure 2 is a visual representation of the bilingual continuum proposed by Valdés:

Figure 2: Real Bilinguals: A Continuum (Valdés, 2001, p. 5)



Valdés (2001, pg. 6) explains the bilingual continuum by providing examples of bilinguals with very different linguistic experiences. For example, a person who has recently arrived in the United States from another country may be represented as *Ab*, whereas *A* represents a dominance in their native languages and the *b* represents the beginning stages of learning English. Conversely, a person who was born and raised in the United States and who was formally educated in English, but grew up in a household where a language other than English was spoken, may be denoted by a *Ba*, whereas the *B* represents a dominance in the English language (given the formal education in the language and the likely use of the language in social situations outside the home) and the *a* represents the language spoken at home. The degree to which the person may be proficient in the home language can vary, but it is likely that he or she will not have the same ability in that language as he or she has in English.

The variability of proficiency in these bilingual speakers has become a point of increasing interest for researchers and instructors over the past few decades. With the large Spanish-speaking population that constitutes an important part of our society, it is of no surprise that when these students enter school and are required to take a foreign language class, they often choose to take Spanish. However, the large majority of Spanish classes at the secondary and post-secondary levels are designed for students of Spanish as a second language. When a student has grown up in a household where Spanish is

spoken, he or she is no longer considered a second-language learner but instead is denominated as a speaker of Spanish as a heritage language. By definition, a heritage language can be categorized as indigenous, colonial or immigrant languages (Fishman 2001, p.12).

Defining heritage language speakers is more challenging and at times has caused disagreement among scholars. In general, there are two types of definitions that are commonly used (Beaudrie & Fairclough 2012). In a broad sense, Fishman (2001) defines a heritage learner as someone who has a cultural connection to the language. A more narrow definition of the term is given by Valdés (2001) who asserts that a heritage learner is one who has some proficiency in both languages, even if he or she is merely receptively bilingual in the heritage language. For the purpose of this particular study, Valdés' definition will be adopted because in order for the research to be conducted, a speaker must be (at minimum) marginally productive in the language.

Heritage speakers of Spanish (or any other language) comprise a very heterogeneous group of bilinguals. Their varying experiences and attitudes with the language play a large role in their language use and, by default, proficiency in their heritage language. Following the Ethnic Revival in the mid/late 1960's, heritage languages started being viewed as a resource more than they had beforehand (Fishman, 2001,p. 17). As such, more attention was paid to how they were being used by their speakers. To date, there have been many studies conducted on the linguistic production of heritage students, particularly in the written domain (Colombi 1997; Fairclough 2006; Sánchez-Muñóz 2010; Beaudrie 2012; Fairclough & Belpoliti 2016, to name a few).

Despite this growing body of research, the one linguistic area that has only recently begun to gain momentum is that of phonology (Rao & Ronquest 2015).

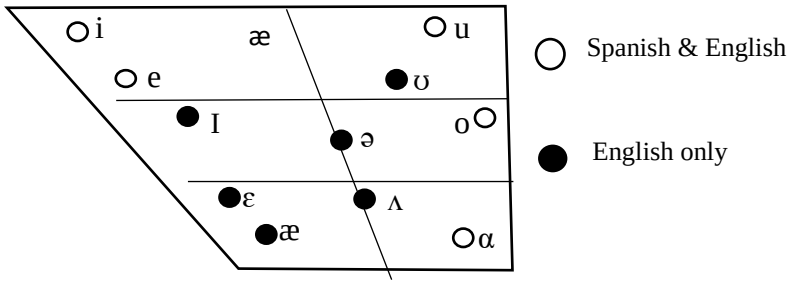
1.4 Previous studies of heritage Spanish phonology

Recently, the phonology of the Spanish spoken by heritage language learners has started to attract the attention of scholars. To date, there have been several studies centered on vocalic and consonantal production of heritage speakers of Spanish, in addition to a limited number that focus on prosodic aspects of their production. For a summary overview, please see Rao & Ronquest (2015).

1.4.1 Overview of Spanish/English vowel inventories

A vowel is a sound which is produced without any obstruction of airflow from the lungs through the vocal tract (Hualde 2005, p. 41). The articulation of vowels cross linguistically is described based on the position of several articulators, including the tongue, lips and velum. The most important characteristics to describe Spanish vowels are tongue height (high, mid or low), horizontal position of the tongue (front, back, or central), and lip rounding (Hualde 2005). The Spanish and English vowel systems differ greatly in the size of their specific vocalic inventories. English contains 11 stressed, monophthongal vowels, or vowels that are not produced in conjunction with a second or third vowel, whereas Spanish only has 5. Aside from this contrast, the two systems are similar in the sense that they do not have contrastive rounding, length or nasalization (Bradlow, 1995, p. 1917). The monophthongal inventories of the two monolingual systems are illustrated below in Figure 3:

Figure 3: Spanish and English Vowels[4] (adapted from Kester et al., 2009).



It is clear that English has a larger and more diverse inventory of monophthongal vowels. The disparity becomes even greater when diphthongs, or the expression of two vowels together in one syllable, are considered. According to Deterding (2004), standard English includes 8 diphthongs beyond its 11 monophthongs, and Roach (2000) affirmed the existence of at least 5 triphthongs, or sequences of three vowels, in the language. However, Ogden (2010) cautions that English vowels can vary greatly across dialects. For example, Deterding (2004) asserts that standard British English contains more vowels than the standard American variety.

The Spanish vowel system is much less complex. In addition to its 5 monophthongal vowels, it includes approximately 10 diphthongs. According to Salcedo (2010), triphthongs are very rare in Spanish. Given the clear-cut differences in the vowel systems, it is of high interest to investigate how the English system may interfere with the

Spanish system in heritage bilinguals. Following is an overview of a selection of studies that have been conducted on the vowel production of speakers of Spanish as a heritage language. According to Rao & Ronquest (2015), "While the monolingual Spanish vowel system has traditionally been characterized as symmetrical, HSS' (heritage Spanish speakers) vowels have been found to exhibit a distinct organization that differs from the norms presented in Quilis & Esgueva (1983)" (p.405).

Willis (2005) is a study aimed toward challenging the many assertions that the Spanish vowel system is both uniform and invariable. (Navarro Tomás 1977; Quilis & Esgueva 1973; Barrutia & Schwegler 1993; Hualde 2005). He conducted an acoustic analysis of the vowels of four bilingual women between the ages of 20-30 who had learned Southwest Spanish (SWS) at home, prior to acquiring English in elementary school. As per Willis, all four participants used English and Spanish 40% and 60% of the time (respectively).[5] Willis obtained natural speech data by asking his participants to tell Mayer's 1969 picture story *Frog, where are you?* He also conducted a longer interview in which he asked questions about the students' background, family, etc. Once finished with the recordings, Willis performed an acoustic analysis of vowel tokens that were part of open syllables in order to avoid any potential closed-syllable variation (p. 190). The results of this study indicate that the SWS vowel system is in fact quite variable, contrary to the repeated claims in prior studies. The vowels of SWS are more fronted compared to the monolingual vowels reported by Quilis & Esgueva (1983). Willis also found that the SWS /o/ is lower and more front in the vowel space for monolingual Spanish /a/, and the

[4] This is an approximation designed to provide a general overview of the two systems. It is not based on formant measurements. Figure has been adapted from Kester et al., 2009.
[5] Self-reported information (Willis, 2005, p. 190).

SWS /a/ is significantly fronted to the monolingual Spanish /æ/. Willis concludes that there is vowel quality variation among dialects.

In her doctoral dissertation, Rebecca Ronquest (2012) sought to provide an acoustic description of the heritage Spanish vowel system and analyze the effect of linguistic and extra-linguistic variables on said system. The participants included 16 heritage Spanish speakers from the Midwest, and each completed two questionnaires, a proficiency test, and three speech elicitation tasks. Ronquest calculated F1 and F2 frequencies, the Euclidean distance from the center of the vowel space as well as the duration of each speaker's vowels. The F1 frequency is inversely correlated to the height of the vowel (the lower the frequency, the higher the vowel is pronounced in the vocalic space) and the F2 frequency is correlated to backness (the lower the frequency, the further back the vowel is produced in the vocalic space and vice versa). The Euclidean distance, or the shortest distance that can be measured in a straight line, was measured to show relative distance of each speaker's vowels from the center of the vowel space. Marta asked you to define Euclidean distance; I would just say something about how it's calculated and/or used to define/illustrate vowel spaces. She also coded for several linguistic and extra-linguistic variables in order to determine their effects on vowel production. Her results indicated a significant difference between the heritage and monolingual Spanish vowel systems. Per Ronquest, there was an effect on F1 as well as F2, revealing that "the /i/ is produced far front in the vowel space, the /e/ is raised and more central than what is typically described for Spanish, and the /u/ is much farther front than what would be expected in a Spanish vowel system" (Ronquest, 2012, p. 237). In terms of the linguistic factors that had an effect on vowel production, Ronquest indicates

that the syllable-type (open vs. closed) was not consistent. However, she does affirm that speech style had a significant effect. Ronquest affirms that "the vowel tokens extracted from the spontaneous speech showed greater variability (i.e. were more centralized) than those that were produced in the controlled speech task" (p. 64).

Ronquest (2013) examines unstressed vowel reduction in heritage Spanish, with the primary objective being to determine whether or not lexical stress impacts vowel quality in heritage Spanish (via F1 and F2 measurements); whether or not tonic and atonic vowels exhibit quantitative and qualitative differences; and, if unstressed vowel reduction is determined to be present, how said reduction should be characterized (as quality reduction, centralization, etc.) (p. 160). The participant group consisted of 13 female heritage Spanish speakers between the ages of 18 and 22 who were either enrolled in or who had recently completed an intermediate-level course in Spanish as a heritage language. The instrument utilized was a semi-spontaneous picture identification task in which the students responded to a question based on an observed picture sequence. Ronquest's acoustic analysis revealed the manifestation of unstressed vowel reduction both qualitatively and quantitatively. The low and mid vowels /a/, /e/ and /o/ showed significantly lower F1 values, which indicate they were produced higher in the vowel space than expected when produced in atonic syllables. Furthermore, all vowels except /a/ showed some migration toward the center of the vowel space. Lastly, a difference in the duration of atonic and tonic vowels was noted, with the atonic vowels being significantly shorter than those of the tonic vowels.

As has been shown by the results of the aforementioned studies, there exists variability in the Spanish vowel system, particularly in the vocalic production by speakers of Spanish as a heritage language. In the following section, variability in consonantal production will be presented.

1.4.2 Consonantal production

In simple terms, and for the purpose of this study, a consonant is defined as a sound which is "produced by blocking or obstructing in some manner the flow of air coming out of the lungs" (Hualde 2005, p. 41). They are further characterized in terms of place and manner of articulation, as well as whether or not the sound involves vibration of the vocal cords.

The consonant inventories of Standard English and Standard Spanish[6] contain 15 of the same (or similar) phonemes, like /t/ and /d/ (for example). Standard Spanish has an additional five consonants that are not in Standard English ([R], [β] [ð] [ɣ] and [n]), and Standard English has nine that do not occur in Standard Spanish (Frederick, 2005). Frederick (2005) provides some examples on how they differ, including (but not limited to) the phonemic distinction between /tʃ/ and /ʃ/ which correspond to the graphemes <ch> and <sh> in Standard English, respectively, where Spanish has only one phoneme /tʃ/, which may be produced allophonically as [ʃ] in some dialects; the /v/ and /b/ distinction in English, which does not exist in Spanish[7]; and the /s/ and /z/ distinction in English that does not exist in Standard Spanish. Furthermore, the voice onset time (VOT) for the voiceless consonants /p t k/ is

[6] Unless otherwise noted, all further references to English and Spanish refer to Standard American and Mexican varieties, respectively.

> a widely used and informative phonetic measure for assessing phonology in people's first language and in L2 acquisition...Simply put, the VOT refers to the time from the release of a stop consonant to the onset of the voicing of the following vowel. (Au et al, 2002, p. 239).

Au et al. (2002) continue with an assertion that the VOT in /p/ /t/ and /k/ in Standard English is typically 30-50ms longer than in Spanish (p. 239). In their 2002 study conducted to determine the extent to which overhearing a language in childhood contributes to a native-like production of that language, it was determined that bilinguals who overheard the language in childhood were more likely to produce voiceless stops /p/ /t/ and /k/ with a VOT comparable to native speakers, while those who did not overhear Spanish in childhood produced the stops with a longer VOT (much like in English). The study also confirmed that that those with exposure to Spanish in childhood pronounced the voiced stops /b/ /d/ and /g/ as lenited consonants in intervocalic contexts much more reliably than L2 learners of the language. The data was gathered by asking 11 childhood overhearers of Spanish, 12 monolingual Spanish speakers, and 12 typical L2 learners who had not been exposed in childhood to read 36 Spanish target words within the carrier phrase *"diga _____ por favor."* Each of the 36 sentences was shown three times to each person and always in a random order.

In a slightly expanded version of this study that included 15 participants per group, Knightly et al. (2003)[8] also concluded that having overheard a language during

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[7] In Spanish, the graphemes <v> and <b> both correspond to the phoneme /b/.

[8] Au et al. (2002) and Knightly et al. (2003) were conducted and written by the same 4 researchers.

childhood contributes greatly to a more native-like pronunciation in adulthood. The same instrument was used, and the results were statistically significant.

Au et al. (2008) again conducted a study using the same instrument; however, in this updated version a second instrument and a fourth group was added. In addition to the typical L2 learners, the childhood Spanish overhearers as well as the monolingual speakers, a group of childhood speakers were analyzed as well. The childhood speakers used Spanish almost exclusively for at least three years of life before the age of 7, at which point their English acquisition began and their use of Spanish dropped dramatically. These speakers then began to re-learn Spanish at around 14 years of age. The total number of participants included 39 typical L2 learners, 20 childhood overhearers, 10 childhood speakers and 25 monolingual speakers.[9] The instrument was identical to that used in Au et al. (2002) and Knightly et al. (2003). Additionally, investigators elicited more natural speech in an instrument that included the picture book *Frog, where are you?* The results indicate that the childhood overhearers and childhood speakers of Spanish pronounce the language in a more native-like way than L2 learners, and that childhood speakers may have an advantage over childhood overhearers in terms of producing native-sounding Spanish.

Kim (2011) examined the production of voiceless stop consonants /p,t,k/ and their voiced counterparts /b,d,g/ in heritage speakers of Spanish who were English dominant in order to determine whether or not their stop consonants in Spanish were influenced by those in English. In order to obtain the data, a group of heritage speakers of Spanish

[9] Au et al. (2008) confirm that approximately half of their data was previously reported in Au et al. (2002) and Knightly et al. (2003): 13 of the 25 native speakers, 13 of the 20 childhood overhearers, and 14 of the 39 L2 learners.

pronounced words in both languages that began with voiced and voiceless stops. She then measured VOT values and compared them with those of monolingual speakers of Spanish and monolingual speakers of English. The results show that there was no statistical difference in the way in which these speakers and the monolingual English control group produced English stop consonants; however, they do differ in Spanish from the monolingual Spanish control group. Kim concludes that heritage speakers of Spanish do experience phonetic interference from their dominant language.

A study conducted by Amengual (2012) expanded the investigation into VOT of several Spanish-English bilingual groups along the bilingual continuum by examining whether or not cognates enhance phonetic interference. The groups included heritage speakers of Spanish (n = 10), heritage speakers of English who were raised and educated in Spain (n = 9), advanced L2 Spanish learners (n = 10) as well as advanced L2 English learners (n = 10). The instrument consisted of four groups of 40 sentences exclusively in Spanish. The sentences consisted of a carrier phrase *yo puedo decir* _____ (I can say_____) and a target word. Each group of words contained 10 cognates and 10 non-cognates. Amengual's findings suggest that "there are no significant differences in the Spanish VOT values between highly proficient early and late learners of Spanish and English when the production data is elicited entirely in monolingual Spanish mode" (p. 528). Furthermore, Amengual found that there is a significant effect of cognate status on the VOT when a /t/ appeared in a cognate versus when it did not. The /t/ was more English-like in cognate words, in the sense that the VOT was longer.

Rao (2014) is a study of the realization of voiced bilabial stop /b/ in English and Spanish by speakers of Spanish as a heritage language. Rao analyzed the production of

two groups of heritage Spanish speakers, with one group self-reporting a more balanced bilingualism and who had more exposure to Spanish throughout their lives (Group 1); and the other group self-reporting a dominance in English (Group 2), having had more exposure to English than Spanish and considering themselves to be more receptively functional in Spanish. The objective of the study was to determine if the production of /b/ differs between these two groups of students, and to evaluate whether or not the phonological context, orthographical representation and/or task type have an effect as well.

The instrument used in this particular study involved a reading task as well as a picture description task. The reading task involved word lists and some paragraphs from Morgan (2010) and the picture description task was administered via a series of Powerpoint slides that contained images of items that had /b/ in the word. Rao states "Including various images on each slide allowed speakers to not only talk about each object individually, but also compare objects, which helped increase token counts" (p. 41). In the end, Rao performed an acoustic analysis on every occurrence of /b/, whether or not it occurred within a specific stimulus, and categorized them as *pure approximant* (PA), *tense approximant* (TA), *stop* or *fricative.* One of the many conclusions Rao was able to draw from the results are that learners greatly benefit from exposure to Spanish in childhood. Group 1 showed a significant advantage in producing a target-like intervocalic /b/ compared to Group 2.

Rao (2015) is an expanded study in which intervocalic /b d g/ in both reading and the spontaneous speech of heritage speakers of Spanish was analyzed with the objective of answering a number of questions, the most relevant for the current study being

whether or not differences in each speaker's social experience play a role in their articulation. Eight participants took part in the study, all between the ages of 18-21. A language history questionnaire was administered, and each participant was labeled as a regular speaker of Spanish, a childhood speaker, a childhood addressee or a speaker with minimal exposure to Spanish. Reading data was collected using word lists and paragraphs, and 7-10 open-ended questions to elicit spontaneous speech were also employed. An acoustic analysis was performed on the recorded data.

Results of this study show an important link between each participant's experience with Spanish. The 'regular speakers' performed in the most native-like fashion, and the primary feature which distinguished those speakers from the rest was that they used and felt a connection with Spanish in various aspects of their lives beginning in childhood and continuing through their young adulthood. Rao (2015) affirms that this research builds on previous research, and asserts that

> continuous use of Spanish has allowed P1/P2 [P1 and P2 refer to two participants in Rao's study; specifically, speakers who spoke Spanish regularly until the age of 14] o effectively separate the phonological rules and phonetic categories of their two languages, thus avoiding any substantial language contact influence and, at least with respect to voiced stops, evidence of what might be termed a 'heritage accent' (p. 66).

The aforementioned studies render it evident that both the vocalic and consonantal systems of heritage language learners vary significantly depending upon several factors, including the individual's experience with the language itself. There have

been few studies conducted on a prosodic level, however, and they will be outlined in the following section.

1.4.3 Prosodic Aspects

Prosodic phonology, or *prosody*, is an area of phonology that accounts for "important sound patterns by reference to structure above the phonological segment" (Ohala et al, 1984). These sound patterns include such aspects as tone, stress, intonation and rhythm. For as little research as there may be about certain phonological characteristics of the Spanish of heritage speakers, the prosodic features have garnered the least amount of attention. The following is a summary of four recent studies of prosody in the Spanish of heritage bilinguals.

Bunta et al. (2007) is a study of the acquisition of rhythm in Spanish/English bilingual children. The objective of the study was to determine whether or not these 4- and 5-year-old children display similar rhythm patterns as their monolingual peers; whether any separation becomes more pronounced with age; and the extent to which age plays a factor in rhythm production. Ten Mexican-American children, 10 functional monolingual English-speaking children, 10 functional monolingual Spanish-speaking children as well as 18 adults (6 English monolinguals, 6 Spanish monolinguals as well as 6 Spanish/English bilinguals) were recruited. The participants were asked to produce 26 target sentences based on photos in a loose-leaf binder. The sentences were recorded and acoustic analyses were performed. Following the acoustic analysis, the rhythm measure developed by Grabe & Low (2002), the Pairwise Variability Index, was applied. The findings indicate that rhythm is not completely acquired by the age of 5, and that bilingual children tended to "start out with a more equal vocalic timing in their English

than their monolingual English-speaking peers" (Bunta et al, 2007, p. 1011). Essentially, this means that the rhythm of these bilingual children's English was more Spanish-like because, for example, there was less neutralization of unstressed vowels that commonly occurs in English.

Hoot (2012) is a doctoral dissertation that was developed to evaluate presentational focus, or stress, in heritage Spanish and determine whether or not (and how) it differs from monolingual Spanish. The participants included 22 monolingual speakers of Mexican Spanish, 22 high proficiency heritage speakers of Spanish, as well as 22 low proficiency heritage speakers of Spanish. Hoot included a linguistic background questionnaire, proficiency tests in both Spanish and English and a judgment task which "consisted of 50 critical stimuli divided into three *conditions*: the subject focus condition, the object focus condition, and the modifier focus condition…" (p. 163). In sum, the groups did not differ significantly in their expression of presentational focus.

Robles-Puente (2014), another doctoral dissertation, includes an investigation of the rhythm in Spanish/English bilinguals in Los Angeles. His participants included both English and Spanish control groups, as well as a group of adult early bilinguals who were Mexican immigrants in childhood, Los Angeles born bilinguals, and adult late bilinguals who were Mexican immigrants in adulthood. In the rhythm study, the participants were asked to read a passage called "The North Wind and Sun" in both English and Spanish versions. Robles-Puente concludes that all groups try to "accommodate their rhythm to that of the target language" (p. 43) but that the first languages have a clear influence. He also indicates that at times, the L2 can influence the L1, suggesting a process of attrition may be at play.

Kim (2015) is an evaluation of perception and production of lexical stress in both speakers of Spanish as a heritage language, and as a second language. The objective of the study is centered on two research goals: 1. Determine whether or not English-dominant heritage speakers have similar challenges to L2 Spanish learners in terms of the perception of Spanish stress contrasts and 2. Evaluate whether or not heritage Spanish speakers are able to distinguish between stress minimal pairs when producing Spanish.

There were a total of 83 participants in this study; 25 monolingual Spanish speakers, 11 heritage Spanish speakers, and 47 L2 Spanish learners. The perception involved a list of 28 stress minimal pairs differing solely in verbal inflection. The verbs were regular *ar* Spanish verbs, and were shown in the form of the first person (singular) present indicative as well as the third person (singular) preterit tense. The minimal pairs, then, were pairs such as *hablo* and *habló*. A forced-choice identification task was then administered, in which the participants listened to a sentence which included either form of a verb and selected whether or not the subject of that verb was *yo* or *él* based on how they perceived the stress. The heritage speaker group did not differ significantly from the monolingual group in terms of their stress perception, while the L2 speakers performed best with the first-person, present-indicative verbs with the stress on the penultimate syllable.

The second experiment in this study involved a smaller sample of the 83 participants in the first experiment. Ten monolingual speakers, 11 heritage speakers and 12 second-language speakers participated. The participants were asked to read the sentences from the perception instrument out loud, and with the subject highlighted. The readings were recorded, and acoustic analyses performed in order to measure where each

speaker placed the stress in each token. Unlike in the first experiment with no significant difference in perception between heritage and monolingual speakers, in the production task the English-dominant heritage Spanish speakers did show similar vowel-lengthening tendencies as L2 Spanish learners when producing verbs that contained stress on the last syllable. Kim (2015) concludes that there "may be a discrepancy between HSs' perception and production of lexical stress in Spanish" (p. 123) and recommends further inquiry into the topic.

1.5 The present study

Given the gap in available literature about the prosodic aspects of heritage Spanish, this study aims to fill an important void with respect to the rhythm production of speakers of Spanish as a heritage language (from now, SHL). The objective of this study is to evaluate the rhythm systems in the English and Spanish of heritage bilinguals and determine whether or not a bilingual speaker maintains a separation in rhythm production along a bilingual continuum based on a number of factors, including language capacity and linguistic dominance. The language capacity will be determined based on the students' placement level in the program in Spanish for heritage speakers at the University of Houston. The placement test was developed and implemented by Fairclough et al. (2010). The linguistic dominance factors will be evaluated by way of a bilingual language profile developed by Birdsong et al. (2012).

There are six primary research questions I will be addressing:

1. Is there a significant difference in the rhythm of monolingual Spanish and bilingual Spanish in each of the other 4 levels?

2. Does the rhythmic production differ between the two languages in the beginning, intermediate and advanced bilingual groups?
3. If there is a significant separation, do advanced bilinguals separate the two rhythm systems more so than the intermediate and beginning bilingual groups?
4. Do late bilinguals separate their English and Spanish metrics?
5. Do balanced bilinguals behave more like monolinguals in each language than the other groups?
6. What are the factors that contribute to the differences between monolingual and bilingual speakers?

This dissertation will consist of five chapters. The first chapter includes the introduction and background information, the purpose of the study as well as the research questions and relevant hypotheses. The second chapter will consist a theoretical framework for rhythm studies and will include a description of which metrics were chosen, and why. The third chapter will provide a detailed methodology, including an overview of the participant group, instruments, equipment and metrics utilized to conduct the study.

Chapter four will include the results obtained and analyzed per level of matriculation as well as per the language dominance scores obtained in the bilingual language profiles. Statistical analyses such as ANOVA and correlations will be used to test for significance of said results, and a discussion will be included. Chapter five will include concluding remarks, along with a discussion of limitations of the study, implications for the fields of phonology and Spanish as a heritage language, as well as provide insight into potential future studies.

2. THEORETICAL FRAMEWORK

2.1.1 Summary of Rhythm Studies

As previously indicated, prosodic phonology is an area of phonology that goes beyond the individual sounds in a language, to include concepts such as stress, intonation and rhythm (Fox, 2000, p. 9). With respect to rhythm, Fox (2000) affirms:

> Rhythm is a matter of timing, but it is more than this; it involves regularity, such that there is a pattern of recurrence of some particular event. In speech, this 'event' may be identified with some particular salient point in utterances, especially accent, but it may also be interpreted as coinciding with the beginning of a speech unit, such as a syllable (p. 87).

Pike (1945) was the first researcher to propose a basic typology of languages based on *isochrony,* or the equal division of time in a given language. According to Pike, there exist two rhythm categories that a given language can belong to – *stress-time,* and *syllable-timed.* Thus, according to Pike's isochrony theory, equal divisions of time in *stress-timed* languages occur between stressed syllables. English, Russian and Arabic are all examples of languages considered to be *stress-timed.* On the other hand, *syllable-timed* languages, such as French, Yoruba and Spanish are defined as exhibiting equal divisions of time between syllables, regardless of stress.

Decades later, Ladefoged (1975) proposed a third category – isochrony based on the *mora.* Nespor et al. (2010) defines a *mora* as a sub-syllabic constituent that includes

an onset and either a nucleus or a coda. According to Hisagi (1998), a mora may have any of the three following manifestations:

1. (C)V
2. The first part of a long consonant (or the first part of a geminate)
3. Syllable final, or "moraic" nasal /n/ (p.3)

There are not many known languages that are considered to be *mora-timed*, and there is not much literature written about the topic, but Japanese and Tamil are two that belong to this category (Nespor et al., 2010).

Although the concept of rhythm classes continues to be very common in rhythm studies, several linguists have rejected the notion of isochrony for several reasons in recent decades (Fox, 2000, p. 91-93). Bertinetto (198, 1989) and Dauer (1983) were two of the first researchers to reject the isochrony theory. Dauer demonstrated that *stress-timed* and *syllable-timed* languages do not differ in isochrony, but rather in their syllable variation. In other words, so-called stress-timed languages actually differ from syllable-timed languages in that they exhibit different tendencies (such as vowel reduction or lack thereof, diphthongization or lack thereof, etc.) that affect the duration of a whole syllable or the vocalic and intervocalic intervals that comprise the syllables. Bertinetto (1981) provided a list of 8 other factors that could affect the isochronic dichotomy that determines the rhythm class of a given language, which he later limited to two primary factors that affect rhythm in language: 1. Vocalic reduction versus complete articulation in unstressed syllables and 2. A complex syllabic structure without well-defined boundaries versus a simpler structure with better defined boundaries (Bertinetto 1989). These factors partner well with Dauer's (1983) proposal, that suggests that the rhythm

categories are not absolute, but rather a continuum that goes from *syllable-timed* to *stress-timed.*

Returning to the basic concepts of *stress-timed* and *syllable-timed,* English has been considered a *stress-timed* language for a long time, and Spanish has been considered *syllable-timed.* Dauer (1983) affirms, then, that

> In English, a syllable may contain a short vowel, long vowel, or diphthong as its nucleus and may be closed by as many as four consonants. In Spanish, the syllable nucleus contains a single vowel or diphthong, and a syllable may be closed by at most one consonant word-finally and two consonants medially. If we assume that segments have minimum and maximum durations, then based on structure alone syllable length is bound to vary more in English than in a syllable-timed language such as Spanish (p. 55).

It is clear that Dauer does not reject the idea that languages may pertain to different rhythm classes, but the idea of isochrony itself. As Dauer asserts, English and Spanish differ greatly with respect to their syllabic structure and phonetic properties, which is what results in the rhythmic differences between the two.

Syllable structure is universally analyzed as consisting of an onset and a rhyme, which in turn contains a nucleus and a coda (Gut 2014). However, the rules that govern the syllables themselves vary from language to language. English (in theory) requires that the nucleus is always occupied by a vowel, while the onset and the coda can only contain consonants or glides. However, English also contains syllabic consonants which serve as the syllable nucleus in lieu of a vowel. An example is the /l/ in the word ‘bottle.’

Furthermore, neither an onset nor a coda is necessary in English; only a nucleus is required. As an example, Gut (2014) provides the English words *I, a* and *oh* as examples of monosyllabic words without an onset nor a coda. On the other hand, English words can contain onsets with up to three consonants, such as in the word *splat* and codas can have up to four, such as the word *firsts.*

The structure of the syllable in Spanish is has more restrictions than that of the English syllable. As Dauer (1983) mentions, in Spanish the nucleus contains a single vowel or a diphthong, and codas can contain either two consonants (word-medially) or one (word finally). Onsets can contain one or two consonants, but if it has two it is limited to an occlusive or an /f/ followed by a liquid (Núnez-Cedeño et al, 1999). It is clear, then, that the consonant groups and what is permitted in onsets and codas in each language is quite different. The vocalic systems are even more distinct.

Yoshida (2012) provides a snapshot of the vocalic paradigm of Standard American English. Table 1 represents the monophthongs as well as diphthongs, and the vowel-like sounds such as the ones in 'bird' and 'her.' She also provides the different symbols that may be used to depict the sounds. These symbols sometimes vary depending upon the author.

Table 1: The monophthongs of British English

Example	**Symbols**	**Example**	**Symbols**
beat	/iy/ /i:/	boot	/uw/ /u:/
bit	/ɪ/ /i/	book	/ʊ/ /u/
bait	/ey/ /eɪ/	boat	/ow/ /ou/
bet	/ɛ/ /e/	bought	/ɔ/ /ɔ:/
bat	/æ/ /æ/	box	/ɑ/ /a/
but	/ʌ/ /ə/	by	/ay/ /ai/ /aɪ/
sofa	/ə/ /ə/	cow	/aw/ /au/ /aʊ/
her	/ɚ/ /ɝ/ /ər/ /ɜr/	boy	/oy/ /ɔy/ /ɔi/ /ɔɪ/

However, as Ogden (2010) points out, English vowels vary greatly depending upon the dialect. Aside from the monophthongs and diphthongs, there also exist at least five triphthongs in English (Roach 2000).

Unlike the English vowel system, the Spanish vowel system is quite a bit simpler. As Salcedo (2010) mentions, Spanish only has 5 vowels, as well as some diphthongs. Following are two tables which show the Spanish vocalic paradigm as presented by Salcedo (2010, pg. 199):

Table 3: The monophthongs of Standard Spanish

1.	High front [i] as in *piso*
2.	Mid front [e] as in *peso*
3.	Low central [a] as in *paso*
4.	Mid back [o] as in *poso*
5.	High back [u] as in *puso*

Table 4: The diphthongs of Standard Spanish

Semi-vowel before	i	e	a	o	u
i	*	bien	hacia	adiós	ciudad
u	cuido	bueno	cuando	cuota	*
Semi-vowel after					
i	*	seis	aire	boina	*
u	*	Europa	auto	*	*

Triphthongs in Spanish are not as common as they are in English, but they do exist and normally occur in the second person plural verb form (i.e. *averiguáis*) or in other words such as *buey* (Salcedo 2010, p. 199).

What affects the rhythm of a language does not have to do solely with the existence of its vowels and consonants, but also the way in which they behave in different contexts. This is another point of divergence of the systems of English and Spanish. English vowels, no matter the variety, undergo changes depending on their phonetic context. For example, vowel reduction is a well-established concept in most dialects of Standard English. In unstressed syllables, native speakers of English tend to reduce vowels of any type to a schwa: [ə], as Ogden (2010, p. 74) demonstrates in the fragment 'to the park.' In this phrase, the stress falls on the word *park.* In careful speech, it is possible that the speaker produces every vowel and says [t^hu ðʌ] park; in colloquial speech, however, people tend to reduce these vowels and say, for example, [t^hə ðə] park.

Vowel reduction is very common in English (in some varieties more than others). It typically occurs in unstressed syllables, and renders the pronounced vowels to be "weaker, quicker and less clear than vowels in stressed syllables" (Yoshida 2012, p. 11). However, it is not as common in Spanish. Although it does exist in some varieties, such as that of the Andes or of northern Mexico (Delforge 2008), it is not as prominent as it is in English. According to Delforge (2008), previous studies of vowel reduction by Lope Branch (1963) and Gordon (1980) indicate that vowel reduction in Spanish is inconsistent in the sense that not all speakers of a dialect characterized by vowel reduction actually reduce the vowels. Furthermore, the people who do reduce vowels do not do it consistently. Delforge (2008) states, "For example, Lope Branch reports that one of his

informants devoiced the final vowel in *tesis* in one sentence but pronounced the word with a fully voiced vowel several seconds later in the following utterance" (p. 108). It is also likely that the more complex coda allowances in the English language impose more restrictions on the timing of the rest of the syllable, such as the nucleus that generally includes a vowel. Spanish does not allow for as many segments in the coda, which may explain why there is less vowel reduction overall than in English.

Considering the above, if rhythm is thought of as a characteristic affected by the phonotactics of a language, the fact that Spanish is simpler than English (with respect both to phonetic structure as well as the behavior of its sounds), would indicate that the rhythm systems will also be different.

The topic of measuring the rhythm of a language has been investigated by several people in recent decades. As a matter of fact, there are around fifteen published metrics designed to measure or evaluate the rhythm of a language ("Comparing dialects", n.d., http://www.phon.ox.ac.uk/speech_rhythm). In the subsequent section, a brief description of each of these metrics will be given. It is important to point out that each of the following metrics take into account vocalic and intervocalic intervals of a language, but simply measure them differently.

2.1.1.1 *Ramus, et. a. 1999: %V, ΔV & ΔC*

The objective of Ramus et al. (1999) is to explain how babies perceive contrasting rhythms from birth, and according to the authors, "…since the infant cannot be expected to know anything specific *a priori* about the language to be learned, we would like to argue that a viable account of speech rhythm should not rely on a complex and language-dependent phonological concept such as stress" (p. 6). As such, the authors present three

metrics, based loosely on the vocalic/intervocalic segmentation of 8 different languages. The metric %V measures the ratio of vocalic segments to intervocalic segments in a given utterance, and the ΔV and ΔC represent the mean of the standard deviation of vocalic and intervocalic intervals, respectively. The authors conclude that the %V and ΔC formulas were able to properly distinguish between languages with different rhythmic classifications. There was no significant difference in the ΔV metric.

Ramus et al. affirm that %V and ΔC are directly related to the syllabic structure of a language. As a result, the more diverse a syllable paradigm in a language, the more variance in the number of consonants and syllable duration, resulting in a higher ΔC. They also conclude that since there is a higher proportion of consonants to vowels, the %V ends up being lower (p. 8). Finally, the authors insist that more empirical studies are needed to determine what exactly the ΔV shows, as it only served to distinguish Polish from the rest of the languages included in this study.

2.1.1.2 *Deterding 2001: VI*

Deterding (2001) sought to compare the rhythmic properties of British English and Singapore English utilizing his proposed method, the Variability Index (heretofore VI). The VI calculates the mean of the variability of the duration of consecutive syllables, eliminating the final syllable in order to eliminate the possibility that lengthening of the final syllable didn't affect the data. The formula normalizes the data in order to neutralize the effect of the rate of speech on the results, because faster speech rates tend to shorten the lengths of vocalic and intervocalic intervals. The formula is as follows:

$$\frac{1}{n-2}\sum_{k=1}^{n-2}|d_{k+1}-d_k|.$$

According to his study, the VI was able to distinguish between both dialects of English and was able to show that British English is more *stress-timed* and Singapore English is more *syllable-timed.* The differences were statistically significant.

2.1.1.3 *Grabe & Low 2002: VnPVI, CnPVI, CrPVI*

The *Pairwise Variability Index* (heretofore 'PVI') was developed by Grabe and Low (2002). There are two variants of the formula: rPVI and nPVI. The rPVI formula is as follows:

$$PVI = \left[\sum_{k=1}^{m-1}|d_k - d_{k+1}|/(m-1)\right]$$

This variant of the formula is known as the *raw Pairwise Variability Index* and expresses the grade of variability in consecutive segments, either vocalic or intervocalic when m= the number of intervals, d= the duration of said intervals and k = any interval. It is not normalized for speech rate. However, its counterpart, nPVI (normalized PVI), is:

$$\text{nPVI} = 100\left[\sum_{k=1}^{m-1}\left|\frac{d_k - d_{k+1}}{(d_k + d_{k+1})/2}\right|/(m-1)\right]$$

The nPVI formula calculates the average difference in duration of consecutive intervals (and multiplies them by 100) when m= the number of intervals, d = duration and k= any interval. The act of dividing the durational difference of two intervals by the average duration of the two ($(d_k + d_{k+1})/2$) eliminates the problem of varying speech rates within the tested population. Grabe & Low (2002) affirm that vowels are most affected by speech rate, which is why they initially proposed a non-normalized, '*raw'* version for use with the intervocalic, or consonantal, intervals. However, they concluded that using the

nPVI for intervocalic intervals was not significantly different than using the rPVI. Furthermore, Wiget et al. (2010) determined that the normalized metric better discriminated between languages and was more stable in situations of varied speech velocity.

As the nPVI is based on differences in interval duration, the larger the number, the more *stress-timed* a language is considered to be, while lower numbers indicated a language belongs in the *syllable-timed* category. This difference is due to the fact that *stress-timed* languages such as English result largely from the final vowel lengthening and reduction or elimination of unstressed vowels.

2.1.1.4 *Barry & Russo 2003: VDur/Cdur*

Barry & Russo (2003) looked to determine if it were possible to separate rhythm from speech rate when comparing the rhythm of German to that of Italian. To analyze the rhythm, they measured the proportion of vocalic intervals to intervocalic ones between pauses in segments that contain more than 4 syllables. Also, they divided the speech samples according to velocity to determine if the speech rate affected the rhythm metrics. Results show that there is a negative correlation between the ratio and the rate of the syllables, indicating that the faster one's speech, the less variability exists between syllables.

2.1.1.5 *Barry et al. 2003: PVI-CV*

Based on the PVI by Grabe & Low (2002), the method of Barry et al. (2003) looked to calculate the durational variability between consecutive CV (consonant-vowel) intervals. Grabe & Low (2002) separate vowels and consonants, but Barry et al. (2003) assert that separating them does not maximize the capacity of the formula. They conclude

that their PVI-CV along with the %V of Ramus (1999) better capture different aspects of the relationship between vowels and consonants. It is also important to mention that Barry et al. (2003) do not use the normalized formula.

2.1.1.6 *Ferragne & Pellegrino 2004: med VnPVI & med CrPVI*

In this study, Ferragne & Pellegrino evaluated various metrics to calculate the rhythm of British English. Two of the metrics they use are almost identical to the nPVI and rPVI of Grabe & Low (2002); however, instead of calculating the index using the mean of the durational differences of consecutive intervals, they calculate it using the median. However, an explanation of the logic behind this change is missing from the article. The results were not different from those obtained in the original formulas by Grabe & Low (2002).

2.1.1.7 *Wagner & Dellwo 2004: YARD*

The YARD metric by Wagner and Dellwo is another rhythm metric. The name itself, YARD, is an acronym for "yet another rhythm determination" because the authors recognize that there have been many attempts to develop the best metric for classifying languages. The YARD index is similar to the PVI by Grabe & Low (2002); however, it differs in the sense that normalization comes in the form of a *z* transformation. Essentially, they made the mean of a given duration equal to 0, and the standard deviation equal to 1 in order to eliminate the effect of speech rate. As a result, a normalized syllabic duration appears as units of standard deviation:

$$z_i = \frac{x_i - \overline{x}}{\sigma}$$

The YARD formula, then, is similar to the PVI but based on this *z* transformation:

$$\text{YARD} = \sum_{i=1}^{n-1} / \, sylldur(i) - sylldur(i+1) / \Big/ n-1$$

According to the authors, the %V and ΔC from Ramus et al. (1999) were a good start, as they were able to distinguish between languages based on rhythm classes, but they were lacking a representation of the sequential nature of rhythm.

2.1.1.8 *Asu & Nolan 2005: nCVPVI*

The study of Asu & Nolan was designed to measure the rhythm of the Estonian language. The formula they use is yet another adaptation of the nPVI of Grabe & Low (2002); however, given the complexity of the syllabification of Estonian, they adapted the nPVI to include segments with a vowel and all the consonants that preceded it. This metric was part of a larger analysis of Estonian with various PVI measures (nFPVI (foot), nSPVI (syllable), etc.) and it was determined that the foot and syllable indices may be more appropriate in dealing with languages that have more complex onsets and codas consisting of more than 3 consonants. They also stress the importance of using a normalized formula.

2.1.1.9 *Dellwo 2006: VarcoΔC & VarcoΔV*

In this study, Dellwo analyzes the rhythm of three languages: French, English, and German. The author chooses to use the VarcoΔC and VarcoΔV formulas, which measure the coefficient of the variance of the mean of the standard deviation of vocalic and intervocalic intervals. For him, it was important to consider the relative changes to ΔC and ΔV given the tendency of speech rate to affect intervocalic intervals in English and German.

These metrics that have been developed through the years have some similarities and some differences. According to Loukina et al. (2010), they tend to differ in three aspects. First, they sometimes use different intervals. At first, they were based on the durations of vocalic or intervocalic intervals, since according to Ramus et al. (1999) babies are able to recognize speech as a succession of unanalyzed sounds. Also, explanations such as that of Dauer (1983) indicate that rhythm is affected by differences in vocalic reduction and syllabic complexity (Loukina et al. 2010). However, recently it has been argued that treating vowels and consonants separately results in the loss of the combined effect of the vocalic and consonantal structure. For this reason, researchers such as Barry et al. (2003) and Deterding (2001) suggest measuring entire syllables. On the other hand, Liss et al. (2009) measure the duration of VC sequences (Loukina et al., 2010).

The second way in which these metrics differ has to do with the globality or locality of the forms. If the metric is "global," it captures the variation in the duration of particular intervals in an entire phrase. However, "local" forms focus on the differences between consecutive intervals and later calculate the mean of the differences throughout the entire phrase. According to Barry et al. (2003), local measurements tend to discriminate better between patterns of long and short intervals (Loukina et al. 2010).

The third way in which these metrics are different has to do with the normalization (or non-normalization) of the durations. As Loukina et al. (2010) show, the non-normalized metrics ('raw') are more affected by speech rate while the normalized ones are not.

As it is rather difficult to know which of these metrics best serve the purpose of evaluating the rhythm of a language, Loukina et al. (2010) looked to investigate the reliability of these 15 formulas. In order to do this, they applied said metrics to data from five languages: British English, Standard Greek, Standard Russian, Standard French, and Mandarin Taiwanese. They asked their participants to read from a group of 42 texts that were taken from various places. Every text was the same, but translated into each respective language. The ultimate objective of this study was to determine which metric(s) is best to distinguish between languages and whether or not different measurements work better for different languages.

When employed individually, only eight of the 15 metrics correctly distinguished the five languages: %V and Vdur/Cdur, the two proportional measurements, all the normalized vocalic metrics and all of the normalized CV metrics. Among these 8, there was no significant difference in their effectiveness.

The authors arrived at three important conclusions following this study, the first being the fact that different languages have different durational patterns. They affirm that intra-language variation can be very high, and for that reason it is almost impossible to identify a language based on one paragraph alone, and that a large sample size is needed to properly identify a language.

The second important conclusion is that no metric or combination of metrics was the best at identifying all pairs of languages. The most effective measurement (or combination) varies from language pair to language pair. According to Loukina et al., and in agreement with White and Mattys (2007) and Wiget et al. (2010), the normalized vocalic metrics in general were more successful than intervocalic and/or non-normalized

ones. The authors assert that it is not surprising that some metrics are better than others in terms of distinguishing between languages, as the durational variance of each is a product of many different factors including stress, syllable complexity, pronunciation of individual sounds, differences in the prosody of individual phrases, speech rate and topic-specific patterns.

The third conclusion was that it is useful to employ at least three metrics in order to identify all the languages at the same time. According to the authors, this is a logical assertion as there was no one single metric that achieved distinction of all languages. However, they report that the number of necessary metrics depends upon the group of languages being studied. Furthermore, they mention that there are several combinations of 3 metrics that were effective in separating languages (Loukina et al., 2010, p. 25).

2.1.2 Rhythm studies of English and Spanish

There have been several rhythmic studies of English, and several others in Spanish. Some are studies of the individual languages, and others compare them with languages from other rhythm classes. One of the first rhythm studies (using the previously mentioned metrics or a variant of them) was conducted by Low et al. (2000) in a comparative analysis of British English with Singapore English. In this study, the authors looked to prove that Singapore English was more *syllable-timed* than British English. To obtain their results, Low et al. applied two metrics to data from both dialects, including a variability index to measure changes in vowel duration throughout full utterances. [10]

[10] The variability index used in this study was essentially the same as the nPVI developed in Grabe & Low (2002), but in this article it was not explained in detail in conjunction with the *raw* version of the formula.

Low et al. (2001) was a study that analyzed two groups of different phrases – one in which the speakers produced complete vowels and the other in which there was a certain degree of vocalic reduction. An example that they give to highlight the differences is as follows:

(1)	Full Vowel Set:	*John came back through France last Sunday.* /dʒɒn keɪm bæk θru: frɑ:ns læst sʌndeɪ/
	Reduced Vowel Set:	*John was sick of Fred and Sandy.* /dʒɒn wəz sɪk əv fred ən sændɪ/

The results of this study clearly demonstrate that Singapore English is more syllabic than British English. There was no difference in the production of the full vowel set and the reduced vowel set in Singapore English. The PVI value of the complete vowels was 40, and the reduced vowels produced a PVI value of approximately 45 (actual numbers not reported). However, British English produced very different results. The PVI value of the full vowel set group was around 37, and the PVI value of the reduced vowel set was approximately 80. This difference was significant ($p<.001$).

Grabe & Low (2002) also analyzed British English, along with 17 other languages including Spanish.[11] In this study, the authors utilized the nPVI to measure vocalic intervals and the rPVI to measure intervocalic ones. The nPVI values of English and Spanish were significantly different ($p<0.05$); the English result was around 57.2 and that of Spanish, 29.7.

Contrary to what the authors expected, the rPVI values of the intervocalic intervals did not show a significant difference between English and Spanish. The rPVI of

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It is likely that this is the reason Grabe & Low (2002) is the article that is cited with respect to nPVI and rPVI.

[11] They do not specify the variety of Spanish included in this study.

English was 64.1, and the rPVI of Spanish at 57.7. Despite this, the measurements taken by Grabe & Low do classify English and Spanish as two rhythmically different languages. It is important to note that the authors state that it is not necessary to use the *raw* PVI with intervocalic intervals; according to them, they did so because consonants are typically not as affected by speech rate. However, their results were not conclusive.

White & Mattys (2007) conducted a comparative study in which two groups of languages were compared – one group considered *syllable-timed,* and the other *stress-timed* – utilizing several of the metrics mentioned in the previous section. Among the evaluated languages were British English and the Peninsular Spanish. In line with the results of Grabe & Low (2002), the nPVI of British English of White & Mattys study was 73 and that of Spanish from Spain was 36. However, the results of the rPVI measurements of intervocalic intervals contradicted the results of Grabe & Low, as English showed an rPVI of 70 and Spanish of 43. It is imperative to note that White & Mattys had 6 speakers per language group, whereas Grabe & Low (2002) had only one.

In addition to the PVI formulas, White & Mattys (2007) applied the ΔV, ΔC, %V, VarcoV and VarcoC to their data. All of these metrics served to distinguish between English and Spanish, with the exception of VarcoC. The ΔV of Spanish was 32, and that of English was 49; the ΔC of Spanish was 40, and that of English was 59; the %V (proportion of vowels to consonants) of Spanish was 48, and 38 in English. This difference can certainly be explained by the vowel reduction tendencies in English. The VarcoV resulted in 41 in the Spanish language, and 64 in English. Finally, VarcoC in Spanish was 46, and 47 in English. Every measurement except VarcoC showed a significant difference between English and Spanish.

Prieto et al. (2012) compared the nPVI-V, the ΔV and the VarcoV of British English, Peninsular Spanish as well as Catalan. As was expected, the three metrics distinguished well between English and Spanish as *stress-timed* and *syllable-timed,* respectively. All differences were statistically significant.

O'Rourke (2008) provides a rhythmic study that compares the rhythm of Spanish from Lima, monolingual Spanish of Cusco, as well as the Spanish of Spanish-Quechua bilinguals in Cusco, Peru. To measure the rhythm data, the author applied the nPVI-V and the rPVI-C. Between Lima Spanish and the two variants from Cusco, there was a significant difference. The nPVI-V from Lima resulted in a 39, and the rPVI-C in a 37. The nPVI-V of monolingual Spanish from Cusco was 33, and the rPVI-C was a 45; lastly, the nPVI-V of bilingual Spanish in Cusco resulted in a 31, and the rPVI-C at 43. Although there was a significant difference between the Lima Spanish and the two Cusco varieties, there was no difference between the two Cusco varieties.

A very interesting study from Shousterman (2014) evaluates the rhythm of English spoken by Puerto Ricans in New York. She expected that this variety of English would fall between *syllable-timed* Spanish and *stress-timed* English on the rhythm continuum. In order to conduct the study, she measured the rPVI-V.[12] The results indicate that, in fact, the English spoken by Puerto Ricans (who are not native English speakers) is more *syllable-timed* than monolingual European/American English, but not as *syllable-timed* as monolingual Spanish. Shousterman states that this might indicate an influence by Spanish as a substrate on English. She notes, however, that her group of young

[12] The author did not indicate her rationale for not using the normalized version of this formula.

subjects showed a higher rPVI in general than the older subjects, which could indicate a shift toward a more *stress-timed* Puerto Rican English in New York.

To date, there have not been many studies about Spanish-English bilinguals in the United States. Fortunately, there are two that provide a jumping-off point for future studies in rhythm of languages in contact. Bunta & Ingram (2007) is a rhythm study that applies the PVI to investigate rhythm acquisition in bilingual children in theU.S.and compares the results to their monolingual counterparts as well as a group of monolingual adults in each language. Bunta & Ingram applied the nPVI for both vocalic and intervocalic intervals. The most relevant aspect of their study to the present study are the results of the adult monolinguals. The nPVI-V of monolingual English was 79.68; for monolingual Spanish, 39.43. The results of bilingual adults showed that this particular group separates the rhythm systems of both languages well, as they achieved an nPVI-V in English of 74, and in Spanish 41.72.

In addition to the vocalic intervals, Bunta & Ingram analyzed intervocalic intervals and the results were similar. The nPVI-C of monolingual English was 74.35, and 67.8 in monolingual Spanish. In the bilingual varities, the nPVI-C of Spanish was 65.25, and 73.4 in English. There was no significant difference in the vocalic nor the intervocalic results of the monolingual and bilingual groups.

Another study that evaluates the rhythm production of bilingual speakers of English and Spanish is the dissertation of Robles-Puente (2014) that examines the rhythm of bilingual residents of Los Angeles. Robles-Puente's study has several interesting aspects. First, he studies the speech of five groups in Los Angeles: an English control group, a Spanish control group, a group of early bilinguals, a group of late bilinguals as

well as a group of L.A.-born bilinguals. There is some contradictory information in his work, however, as in the methodology he specifically explains that monolingual speakers would only read in their own language; however, the results section presents data for both languages in each of the 5 groups.

Robles-Puente applied the nPVI-V to try to distinguish between the varieties. His results show that the rhythm of monolingual English, the English of early bilinguals as well as the group of L.A.-born bilinguals is more *stress-timed* than the late bilinguals, or Spanish monolinguals.[13] He mentions that these groups have spent little to no time in the United States, so it is unclear how they were able to produce enough English to be measured.

In Spanish, the English control group and the early bilingual group produced a rhythm that was less *syllable-timed* than that of the L.A.-born bilinguals, late bilinguals or the monolingual Spanish control group. Robles-Puente affirms that his results indicate that the rhythm of a language can change when it is in contact with another language.

This is a panoramic view of the existing rhythm studies of Spanish and English. There are more; however, what remains clear is that English and Spanish show obvious rhythmic differences, even without controlling for dialectal differences in both languages. It is also apparent that the nPVI-V, the nPVI-C, %V, ΔV and ΔC have shown to be useful for distinguishing between these languages. As has been done in various studies and as is recommended by Loukina et al. (2010), it appears to be better to use more than one

[13] In the methodology section, Robles-Puente reports that the monolinguals would only read in their own language.

metric in rhythm analyses. Furthermore, there is a lack of rhythm studies that focus on North American language varieties, both in contact and isolated.

Taking into account all previously mentioned studies and their results, the present study will conduct an analysis of the rhythm production of speakers of Spanish as a heritage language in Houston, TX who fall along the bilingual continuum proposed by Valdés (2001).

There are six primary research questions in the study:

1. Is there a significant difference in the rhythm of monolingual Spanish and bilingual Spanish in each of the other 4 levels?
2. Does the rhythmic production differ between the two languages in the beginning, intermediate and advanced bilingual groups?
3. If there is a significant separation, do advanced bilinguals separate the two rhythm systems more so than the intermediate and beginning bilingual groups?
4. Do late bilinguals separate their English and Spanish metrics?
5. Do balanced bilinguals behave more like monolinguals in each language than the other groups?
6. What are the factors that contribute to the differences between monolingual and bilingual speakers?

The following section will provide a detailed explanation of the methodology utilized in this study, along with the stated hypotheses in response to the proposed research questions.

3. METHODOLOGY

3.1 Introduction

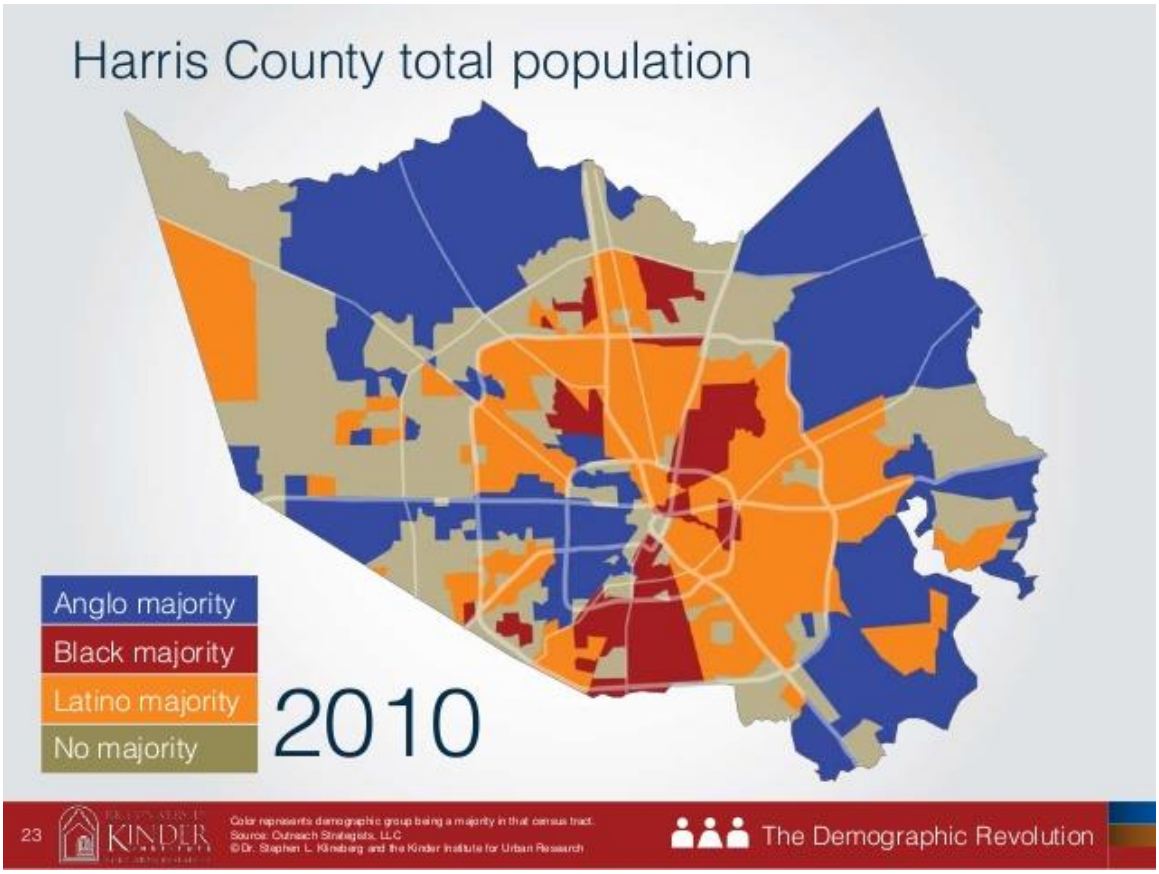
This chapter serves as a detailed explanation of the participants and procedures utilized in this study, alongside the participants and procedures from the pilot study that preceded it. Section 3.2 provides an explanation of the different participant groups and the criteria that serve to classify each subject in each study. Section 3.3 provides an explanation of the questionnaires administered to each participant in both studies. Section 3.4 explains the instrument in detail and highlights the reasons for its design, as well as the changes that were implemented from the pilot study to the larger one. Section 3.5 outlines the data collection and analysis procedures from both as well. Section 3.6 details the results of the pilot study and expectations for the present one.

3.2 Participant Groups

3.2.1 Area demographics

Houston is a large city that is both racially and ethnically diverse and, according to the 2010 U.S.Census, the Hispanic population comprised approximately 43% of the total population (919,668 out of the total Houston population of 2,099,451), making it the largest ethnic group in the city, followed by the Caucasian only population at 522,590 of the total population, and then the African American only community at 12,510[14] (US Census, 2010). Figure 1 provides a visual representation of the racial and ethnic breakdown of Harris County, which engulfs the majority of the city of Houston:

Figure 1: Harris County Demographics



Given the proximity of Houston to Mexico as well as the shared history between Texas and Mexico, it is not surprising that within the Houston Hispanic community the Mexican and/or Mexican-American group is the largest at 673,093 of the total Hispanic population in Houston (or approximately 73%). This demographic information is well represented in the classroom at the University of Houston, given that a majority of our Hispanic students identify as Mexican or Mexican-American. As such, taking into

[14] Given the racial diversity of the Hispanic community, it is important to note that the use of 'only' signifies that the respondents identified themselves as white or black but not Hispanic.

consideration the need to control for regional variation as much as possible, the decision was made to include only speakers of Mexican Spanish in the study.

3.2.2 Dialectal variation

As does any language, Spanish varies between dialects particularly in terms of its lexicon and phonological system. The variation in phonological production across dialects can have a profound impact on rhythmic analyses, particularly when we consider that metrics such as the *Pairwise Variability Index* offer a quantitative representation of syllabic variance. As such, the PVI results of a speech sample from a Dominican speaker might be largely different from that of a Mexican speaker, for example, given the dialectal differences between the two.[15] For example, Dominican speakers tend to elide intervocalic /d/ and words like *salado*, pronounced as [salaðo] in many regions, including Mexico, are pronounced [salao]. This greatly affects the PVI metric because the elision of the [d] results in the measurement of two consonantal durations (the [s] and any preceding consonant, as well as the [l]) and two vocalic ones (the initial [a] and the longer [ao], in addition to any vowels that follow). In a dialect where the intervocalic [d] is not omitted, the PVI metric would include the durational variability of three consonants (the [s] and any preceding consonant, the [l] as well as the [ð]) and three vowels (the initial [a], the second [a] as well as the final [o] and any vowel that may come after). If one were to apply the PVI to the same word in each of the two dialects, it is likely that the Dominican dialect would appear to be more *stress-timed* than the Mexican dialect given that the analysis would show more variability from syllable to syllable in

[15] For further information on dialectal variation, see Lipski 2008.

Dominican dialects, as opposed to Mexican dialects which show more similarity from one syllable to the next.

3.2.3 Groupings

3.2.3.1 The Pilot study

The pilot study included 5 groups: an English monolingual group, a Spanish monolingual group, and three groups of Spanish/English bilinguals who belong to different levels of the bilingual continuum proposed by Valdés (2001). The groups were determined based on the results of a placement exam developed by Fairclough et al. (2010) and are considered to be beginning, intermediate or advanced bilinguals, depending on their placement. Both monolingual control groups contained data from 2 participants, and each bilingual group contained data from 3 participants.

Each participant in the pilot study identified as either Mexican or Mexican-American, with the exception of the monolingual English speakers. There are two primary reasons for this makeup. First, the convenience of access to Mexican and Mexican-American speakers of Spanish is unparalleled to any other Hispanic group given the demographic makeup of the area. Second, and most importantly, the necessity of consistency in dialect is especially important in a rhythm study. All participants were between the ages of 20 and 25 years old, with the exception of the monolingual population in Guadalajara, Mexico due to logistical complications with the local university. The monolingual population included participants between the ages of 40 and 60, all of whom are university educated. Guadalajara was selected as a site for data collection for a couple of reasons. First, Guadalajaran Spanish is relatively neutral in the sense that it typically does not exhibit particularly marked features that may arise in other

varieties, such as Chihuahuan Spanish, for example, where /tʃ/ is often pronounced as [ʃ]. Furthermore, professional connections in the city facilitated access to a group of speakers that were willing and able to participate.

3.2.3.2 The Present Study

The sample in the present study includes a total of 30 participants: 5 groups, 4 with 5 subjects and one with 10, the reason for which will be explained below. The groups include beginning bilinguals who were placed into Beginning Spanish for Heritage Speakers (SPAN 1507) at the University of Houston; intermediate bilinguals, who placed into an intermediate level Spanish class for heritage speakers at UH (SPAN 2307 and/or 2308) and advanced bilinguals, who placed into any 3000 level Spanish class at the University of Houston. Language proficiency was based on the placement exam for speakers of Spanish as a heritage language designed by Fairclough, et al. (2010). The placement test was administered to the students prior to the development of this study, and it is imperative to mention that each participant in the three bilingual groups tested in the semester during which they placed into their respective courses. In other words, all students from the beginning level placed directly into 1507 via the placement test; all students in the intermediate levels placed into 2307 or 2308; and all students at the advanced level placed into an advanced level Spanish course. This was done to ensure consistency in participant identification, as there is no currently known research on phonetic or phonological development of heritage Spanish speakers as they progress through their coursework. Typically, this is not a pedagogical focus, as this group of learners arrives in the classroom with a certain level of implicit knowledge – phonetics and phonology included – and pronunciation does not generally obstruct understanding

between interlocutors. However, it is not known the extent to which being in a classroom setting with an instructor and classmates who likely speak an array of dialects might affect one's pronunciation. In assuring that each participant placed into the level they were in during data collection, we can be certain that the phonetic and phonological systems of the Spanish of each student have not been affected by instruction in the language. Table 5 outlines the learning outcomes for the levels into which heritage Spanish speakers can place:

Table 5: Learning outcomes for each group level

Level (group)	**Description**
BEG (1507)	Literacy development in Spanish with emphasis on vocabulary. Intensive reading, writing, and speaking.
INT (2307)	Basic skills in reading, spelling, and composition.
INT (2308)	Continued development of reading and writing skills, and control of formal Spanish.
ADV (3000+)	This level includes courses such as Advanced Grammar Review (3305), Introduction to the Study of the Spanish Language (3306), Written communication for Hispanic Heritage Leaners (3308), which is a prerequisite for SPAN 3306, among others. Students can place into 3308, or AL (all levels) in which case they can take 3306.

A fourth group consists of late learners of English who were born in Mexico, lived there until at least age 10, speak Spanish as a first language, have attended primary school in Spanish, and who began learning English at or after the age of 10. This group replaces the English language monolinguals in the pilot study as a result of the additional research questions which were detailed in the previous chapter. Lastly, the fifth group of

participants includes a group of monolingual Spanish speakers from the University of Guanajuato in Guanajuato, Mexico. Guanajuato was selected for similar reasons as Guadalajara was utilized in the pilot study. Guanajuatense Spanish is quite neutral and does not exhibit many features that are noticeably marked. Furthermore, a professional connection within the University of Guanajuato system allowed for the collection of data with a group of students whose demographics were as similar as possible to the participants in Houston

Each group consists of both males and females between the ages of 23 and 35, and all have completed or are in the process of completing a university-level education. As mentioned in the previous section, each participant identifies as either Mexican or Mexican-American, which is reflected in their production of Spanish. The Internal Review Board of the University of Houston approved the collection of data within the University, and a letter of consent was provided by the University of Guanajuato, waiving the necessity of a review board for the collection of data on site. All data was collected between October 2016 and June 2017.

Of the 30 participants, 10 (33%) were men and 20 (67%) were women. A complete breakdown of participant genders is shown in table 6:

Table 6: Gender Distribution per group

Levels	Women (%)	Men (%)
Beg HL	5 (100)	0(0)
Int HL	4 (80)	1(20)
Adv HL	2 (40)	3 (60)
Late ELL	3 (60)	2 (40)

Mono Span.	6 (60)	4(40)
Totals:	20 (67)	10(33)

3.3 Questionnaires

In both the pilot study and the present study, a brief background questionnaire was administered to each participant in order to gather basic demographic information. It is attached as appendix A. It gathers very basic information about each subject such as age, gender, country of origin and total years of schooling. It also obtains contact information should the need for a follow-up meeting arise.

In the larger study, an additional survey was administered. This second questionnaire is an analytical tool called the Bilingual Language Profile (henceforth 'BLP'), developed by Birdsong et al. (2012). It is "…an instrument for assessing language dominance through self-reports that is concise, quick and easy to use. The BLP is intended to produce a continuous dominance score and a general bilingual profile taking into account a variety of linguistic factors" (Birdsong et al. 2012, n.p.). The BLP consists of 19 total items, divided among four equally weighted modules which address different aspects of language dominance: language history, language use, language proficiency and language attitudes.

The language history module consists of 6 questions, each of which are scored on a scale of 0-20. The first two items are scored in reverse (if a student selects "20", a score of 0 is assigned; a response of "19" is scored a "1", etc. The language use module consists of 5 questions, each of which are worth between 0 and 10. Every item is worth the numerical value given in the response.

The language proficiency module contains 4 questions, worth between 0 and 6 points. Each response is worth the numerical value given in the response. Lastly, the language attitudes module consists of 4 questions, each worth between 0 and 6 points. Each item is also worth the numerical value given in the response.

Once each item is answered, the individual language scores in each module are multiplied by a factor that ensures equal weighting of the four modules when calculating a global language score. The language history module is multiplied by a factor of .454; language use, 1.09; language proficiency, 2.27; and language attitudes, 2.27. The module scores for each language are then added up individually to arrive at a global score for both; one language is then subtracted from the other to calculate the total language dominance score, which ranges from -218 to + 218. A score of 0 signifies a balanced bilingual, whereas a positive or negative number indicates relative language dominance (Birdsong, et al. 2012). The BLP is a free, open-source resource available at https://sites.la.utexas.edu/bilingual/. This survey is attached as Appendix B, and includes both the English and Spanish versions of the BLP.

3.4 Instrument

3.4.1 The Pilot Study

Three instruments were initially developed for data collection: a reading, which included a short children's story in each language; a concatenation exercise, which required each participant to memorize two halves of a sentence and then record the utterance without reading it; and lastly, a brief monologue on a given topic in each language. In Spanish, the students were asked to speak for 1-2 minutes about their family, and in English they were asked to speak about a typical day at school. Suffice it to say

that the monolingual populations only completed the activities in their mother tongue. Due to a time constraint, only the data from the guided speech task was used.

3.4.2 The Present Study

Despite the fact that many rhythm studies employ reading tasks in order to measure rhythm in a manner which is uniform across its sample, the majority of those studies were conducted with monolingual, native speakers of the languages under investigation. The present was a study of the rhythm interaction in bilingual speakers of English and Spanish along the bilingual continuum. Colantoni et al. (2016) affirm that spontaneous speech is the best way to obtain speech samples from bilingual speakers (p.20). In addition to the affirmations of Colantoni et al. (2016), it was apparent during collection of pilot data that much of the data obtained with the reading and concatenation tasks could not be used, as acoustic analyses require the omission of pauses and hesitations of any type. Reading can be difficult for anybody and is particularly challenging to beginning bilinguals who may have just begun to learn reading skills in their heritage language. As such, these instruments were discarded completely in the large study. The instrument utilized was a Powerpoint slide instructing the participants to speak freely about a given topic in each language. The topics remained unchanged: in Spanish, the speakers were asked to describe their family for 1-2 minutes, and in English they were asked to discuss a typical day at school for the same amount of time. The objective of this task was to facilitate speaking for all participants, especially bilinguals on the more extreme ends of the bilingual continuum who may not be as comfortable reading in Spanish (beginning-level heritage speakers) or English (late learners of English as a second language), or for people who may speak clearly and eloquently but

are challenged by a reading disability (such as dyslexia). Furthermore, the given topics were chosen specifically due to the likelihood of use of each language in each specific context: Spanish as a heritage language is typically learned at home with family members, and formal education in the U.S. is largely given in English.

3.5 Data collection and analysis

The data collection aspect of the methodology remained unchanged from the pilot study to the present one. The analysis portion was amended, however, and this process will be explained below.

All speech samples were recorded in an isolated interior room in a building at the University of Houston, with the exception of the recordings completed with students at the University of Guanajuato. In Guanajuato, the interviews were conducted in a quiet room above a coffee shop in the central part of the town, right next to the University itself. Due to the informal nature of the conversations, it is unlikely that the setting had a significant effect on the rhythm of the speech; however, with a microphone present there is no way to be absolutely certain. In order to conduct acoustic analysis, though, a quiet atmosphere as well as a microphone are imperative to properly analyzing speech data. It was imperative that the space be isolated in order to avoid showing interference from background noise in the spectrograms. The recordings were conducted with a "Snowball Ice" USB microphone from the Blue company and a Lenovo Edge 2 15.6" 2-in-1 touch-screen laptop. A program called *Audacity* was used to record the speech samples. *Audacity* is an open-source software that is available for free on the internet. Once recorded, the sound files were saved as .wav files and *Praat* was used to conduct acoustic

analysis. *Praat* is used specifically for phonetic and phonological studies as it allows for spectrograms to be viewed and annotated, facilitating the process of acoustic analysis.

In *Praat,* TextGrids were generated alongside the spectrograms to be able to mark the boundaries between vocalic and intervocalic intervals. The spectrograms were set with a frequency range of 0-5000 Hz to have a clear picture of the formants. At this point, an acoustic analysis was conducted on each speech sample based on the guidelines established in Grabe & Low (2002). It is imperative to note that the analysis was conducted not based on orthographic vowels and consonants, but rather on the acoustic properties of each sound. Vocalic intervals were measured from the onset of a vowel until the onset of the next consonant, depending on the behavior of the formants. Vowel onset and offset were determined based on the beginning and end (respectively) of formant structure, not simply by the beginning of voicing. For example, in fricative-vowel sequences, the onset of the vowel was determined to be at the beginning of the second formant. Nasal-vowel sequences were separated at the observable fault transitions between the nasal and the vowel. The number of vowels in each interval did not matter, provided there was no interruption from a consonant.

The intervocalic intervals were measured from the onset of the consonant until the onset of the next vowel without regard for how many consonants were produced in each interval. In vowel-voiceless fricative sequences, for example, the vowel was rendered terminated at the onset of the noise pattern of the fricative observable in the spectrogram. In vowel-voiced fricative sequences, the vocalic interval was considered to be finished at the beginning of the high-frequency energy observable in the spectrogram.

In accordance with Grabe & Low (2002), the

> …approach to glides was based on acoustic, not phonetic or phonological criteria. In initial glides, the formant movements continue seamlessly from glide to vowel. We excluded initial glides from vocalic portions if their presence was indicated by clearly observable changes in formant structure or in the amplitude of the signal. Otherwise, glides were included in the vocalic portion (p 16).

Pauses and hesitations by the speakers were not included. Grabe and Low (2002) affirm that although this is not completely ideal, it does allow for a continuous sample of speech to be analyzed. Following is an example of an annotated spectrogram with TextGrid of the Spanish word *Hidalgo* [iðalgo]. The durations are shown in seconds:

Figure 1: Spanish example *hidalgo*

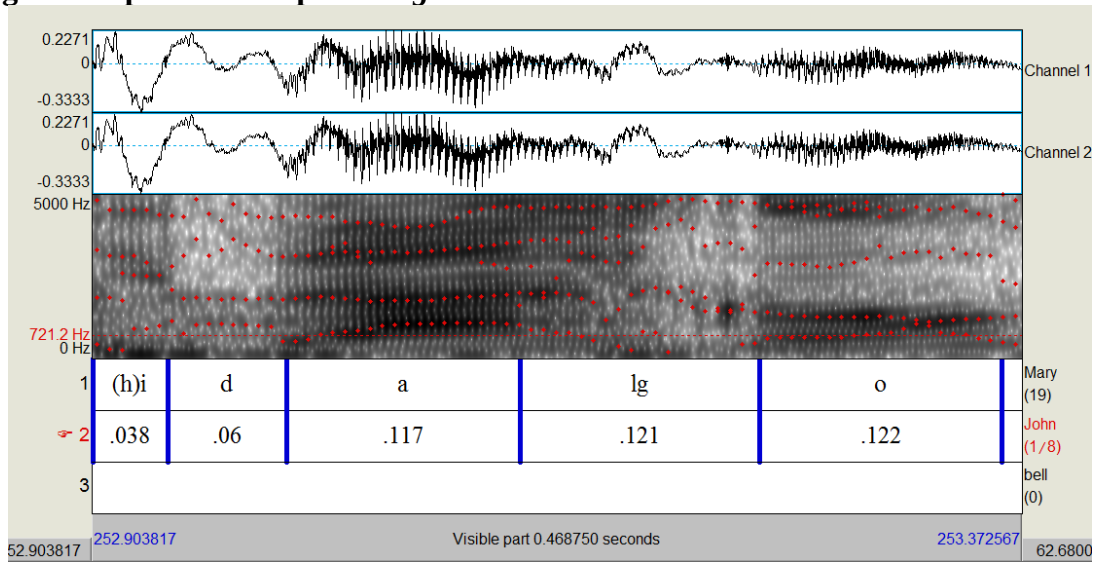
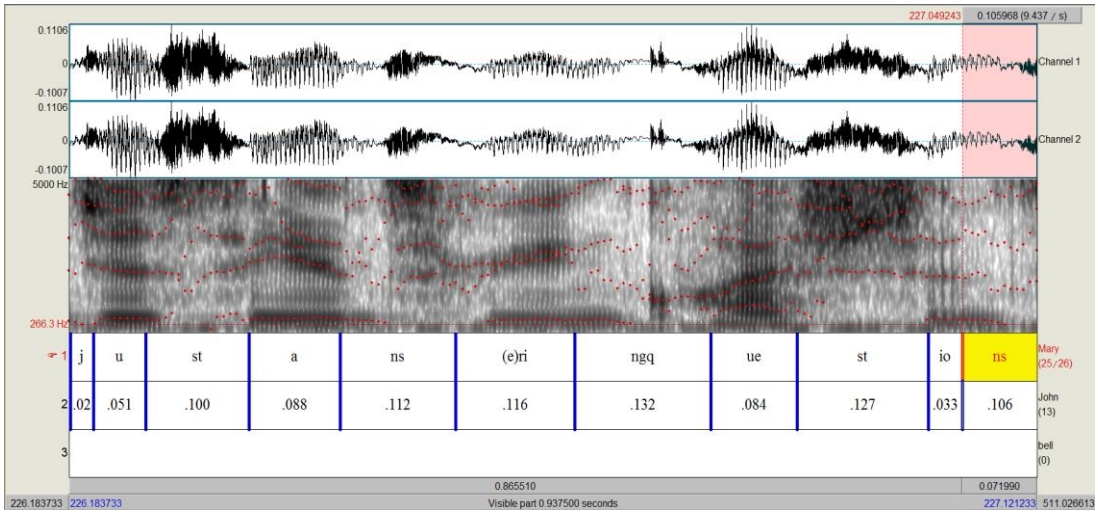


Figure 2: English example *just answering questions*



After each durational boundary was marked, a script was run which extracted each duration and exported it to a text file. The text file, then, could be copied and pasted wherever necessary. Each duration was copied directly into an Excel spreadsheet. A total of 100 vocalic and 100 intervocalic intervals were measured per speaker in each language, except for the monolingual Spanish speakers who only completed the Spanish language instrument. In the pilot study, a total of 4,400 intervals were measured; in the current study, 10,000 intervals were measured. A complete breakdown of interval type and number per group is shown as follows in Tables 7 (Pilot Study) and 8 (Present Study):

Table 7: Number of intervals per person, per language (PILOT)

	# Participants	SPAN #V/Person	ENG #V/Person	SPAN #C/Person	ENG #C/Person	Total
Beg HL	3	100	100	100	100	**1200**
Int HL	3	100	100	100	100	**1200**
Adv HL	3	100	100	100	100	**1200**
Mono Eng.	2	0	100	0	100	**400**

Mono Span.	2	100	0	100	0	**400**
Totals:	**13**	**1100**	**1100**	**1100**	**1100**	**4400**

Table 8: Number of intervals per person, per language (PRESENT)

	# Participants	SPAN #V/Person	ENG #V/Person	SPAN #C/Person	ENG #C/Person	Total
Beg HL	5	100	100	100	100	**2000**
Int HL	5	100	100	100	100	**2000**
Adv HL	5	100	100	100	100	**2000**
Late ELL	5	100	100	100	100	**2000**
Mono Span.	10	100	0	100	0	**2000**
Totals:	**30**	**3000**	**2000**	**3000**	**2000**	**10000**

Once each duration of each interval in both languages for all participants was entered into an Excel spreadsheet, the numbers were analyzed. This is the point of divergence between the initial study and the current one. While the normalized Pairwise Variability Index was applied in both studies, the data was analyzed only two ways in the pilot study, whereas it was analyzed three ways in the larger one. To refresh, the nPVI formula is as follows:

$$PVI = 100 \times \left[\sum_{k=1}^{m-1} \left| \frac{d_k - d_{k+1}}{(d_k + d_{k+1})/2} \right| / (m-1) \right]$$

Developed by Grabe & Low (2002), the Pairwise Variability Index calculates the average difference in duration of consecutive intervals (and multiplies them by 100) when m= the

number of intervals, d = duration and k= any interval. The act of dividing the durational difference of two intervals by the average duration of the two ($(d_k + d_{k+1})/2$) eliminates the problem of varying speech rates within the tested population. Grabe & Low (2002) affirm that vowels are most affected by speech rate, which is why they initially proposed a non-normalized, '*raw'* version for use with the intervocalic intervals. However, they concluded that using the nPVI for intervocalic intervals was not significantly different than using the rPVI.

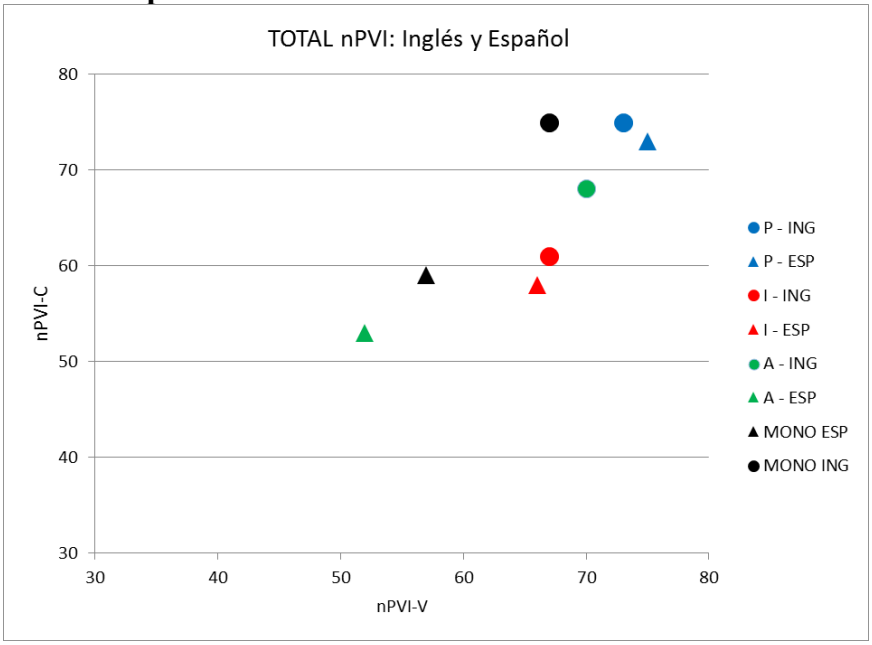
In the pilot study, the Pairwise Variability index was applied separately to vocalic and intervocalic intervals as Grabe & Low did in their 2002 study. Durations were listed in separate columns whether they were vocalic or consonantal, and the formula was applied appropriately to each.

In this larger study, however, the formula was also applied to CV intervals, an application largely based on Barry et al. (2003). In Barry et al. (2003), the *raw* version of the PVI formula was applied to CV intervals. According to the authors, separating C and V intervals did not maximize the effectiveness of the formula and chose to group C and V intervals together, "…thus capturing the varying complexity of consonantal + vowel groupings in sequence within an interpause stretch" (p. 2694). Deviating slightly from the Barry et al. (2003) methodology, however, the normalized version of this formula was used in this study in order to maintain consistency and continue to control for speed given the findings of Grabe & Low (2002).

3.7 Pilot Study Results

While the sample size of the pilot study was not large enough to warrant a statistical analysis of the data, the results showed some exciting tendencies. Figure 3 shows the rhythmic analysis results per group:

Figure 3: nPVI Group Results



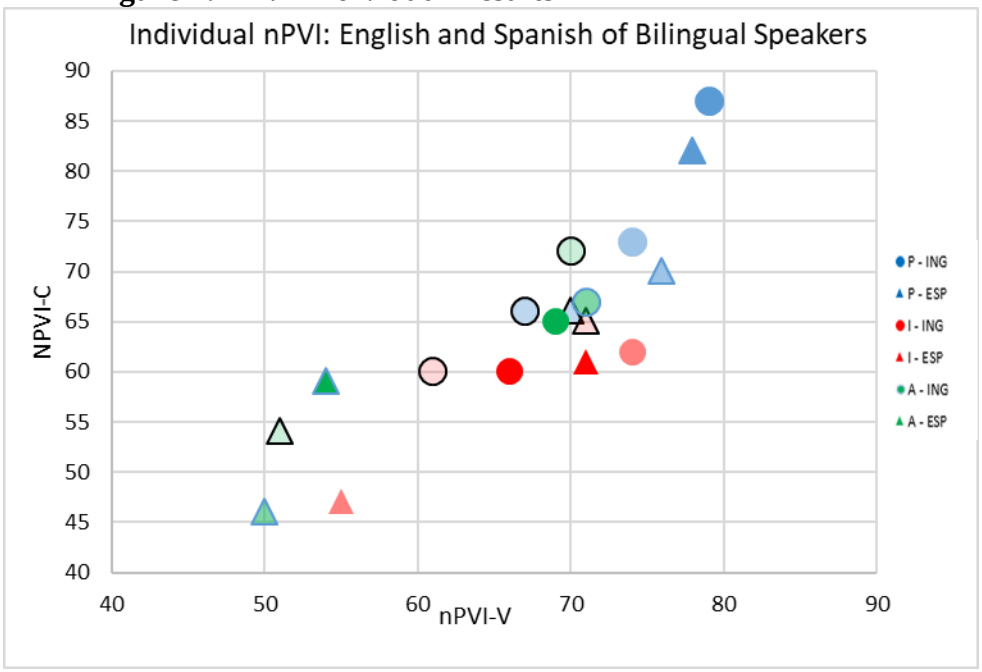
The nPVI-V average of the monolingual group in Spanish was 57; the nPVI-C of the same group was 59. The monolingual English group saw an nPVI-V at 67, while the nPVI-C was calculated at 75, showing a possible difference between the two groups. With only two participants per group, however, a statistical analysis was not conducted at this stage.

In terms of the bilingual groups, the beginners saw an nPVI-V (English) of 73 and an nPVI-V (Spanish) of 75; their English nPVI-C showed a 75, and in Spanish a 73. The advanced bilingual group showed very different tendencies. The nPVI-V (English) was 70, while the nPVI-V (Spanish) only 52. The nPVI-C (English) calculated at 68, while that of Spanish was 53. It must be reiterated that no statistical analysis was conducted;

however, these propensities could indicate that there would be no rhythmic difference between the English and Spanish of beginning bilinguals in a larger-scale study, while there may be in a group of advanced bilinguals.

The intermediate group showed some different inclinations. The average English nPVI-V was 67, and in Spanish was 66. The nPVI-C (English) was 61, and that of Spanish was 58. While the average numbers don't appear to be very different, the individual results show that there may actually be much more variation in this group when compared to the other two. Following, Figure 4 shows the individual results of each participant in the three bilingual groups:

Figure 4: nPVI Individual Results



As is shown by Figure 4, while the beginning and advanced bilingual individuals show similar tendencies in their respective groups, there appears to be much more variance in the intermediate one. For example, there is one participant who appears to belong to the advanced group according to their results. That participant obtained an nPVI-V of 74 and

an nPVI-C of 62 in English, but an nPVI-V of 55 and an nPVI-C of 47 in Spanish. On the other hand, the results of the other two intermediate bilingual participants indicate that their English may be slightly more syllabic than their Spanish, given that in each scenario the nPVI-V and the nPVI-C of their Spanish is slightly higher.

With such a small sample size, it is not possible to arrive at concrete conclusions, given the substantial amount of variation in a study of this nature. However, the tendencies of the three groups of heritage language speakers seem to indicate that there may be differences between the groups. The beginning bilinguals did not show a separation in the rhythms of their English and Spanish, and their production of both appears much more like monolingual English than it does monolingual Spanish. In other words, because of their dominance in the English language, they speak Spanish in a way that is much more accentual than it is syllabic.

Unlike the beginner group, the advanced bilinguals demonstrated a clear separation of rhythms, which aligns with the findings of Bunta & Ingram (2007) and Robles-Puente (2015). It would seem that these speakers produce both Spanish and English as if they were monolingual speakers of each. In other words, their Spanish is clearly much more syllable timed and their English stress-timed. This tendency suggests that there is not as much mixing of the two systems in bilingual speakers who are more balanced.

With respect to the group of intermediate speakers, when we consider only the averages of all participants it would appear that these speakers do not separate English and Spanish rhythmically as the advanced speakers do, and speak both with a more syllabic rhythm than the beginning speakers. However, when individual results are

considered it is clear that this is group is profoundly heterogeneous in nature and it becomes evident that group averages do not tell the whole story.

The pilot study served as the base upon which this doctoral thesis was developed. In more than doubling the sample size from 13 speakers to 30 (4400 durations to 10,000), removing the monolingual English group and including a group of late learners of English, adding the Bilingual Language Profile and calculating the normalized Pairwise Variability Index not only on vocalic and intervocalic intervals separately but also continuously, it is hoped that some light will be shed on the six research questions presented in the previous chapter.

The following chapter will present the results of the present investigation as they pertain to each of the six research objectives.

4. RESULTS AND ANALYSIS

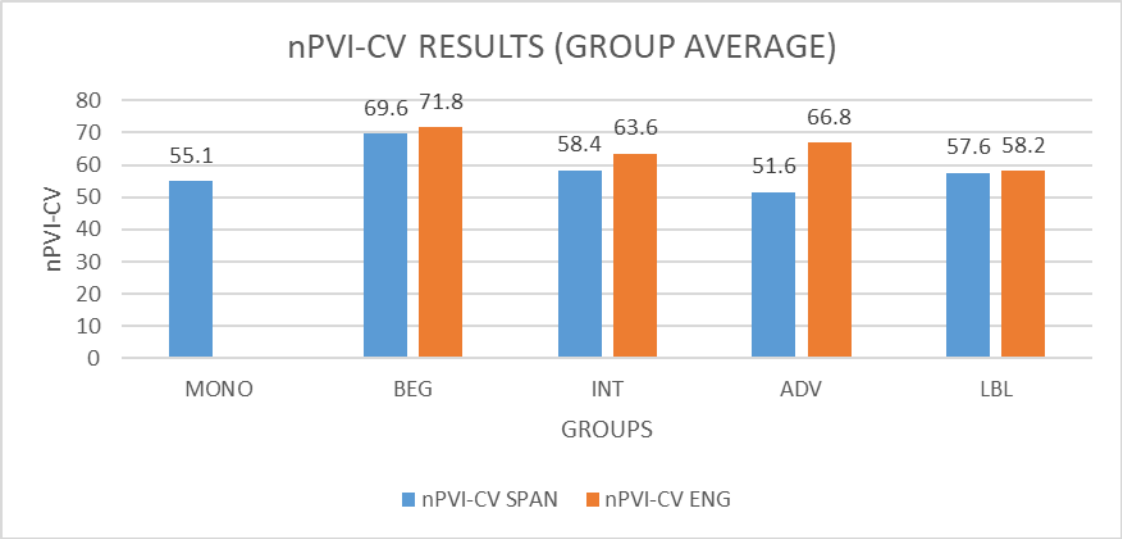
This chapter is divided into two primary sections. Section 4.1 illustrates the average results of each metric in each language per group.[16] Section 4.2 provides analyses of said results, containing six subsections that correspond directly to the research questions posed in the previous chapters. Each subsection will include statistical analyses along with contrasting examples in order to provide a visual representation of the results.

4.1 RESULTS

The first rhythm metric, nPV-CV, represents the average difference in duration between consecutive speech intervals with a CV (consonant-vowel) structure for beginning bilinguals (BEG); intermediate bilinguals (INT); advanced bilinguals (ADV); late bilinguals (LBL) and monolingual Spanish-speakers (MONO). These results are illustrated in Figure 5. The monolingual Spanish- speaking subjects did not participate in the English portion of the study; as such, there is no corresponding orange bar in the monolingual group.

[16] A complete list of all individual results is shown in Appendix C.

Figure 5: nPVI-CV Results Per Group



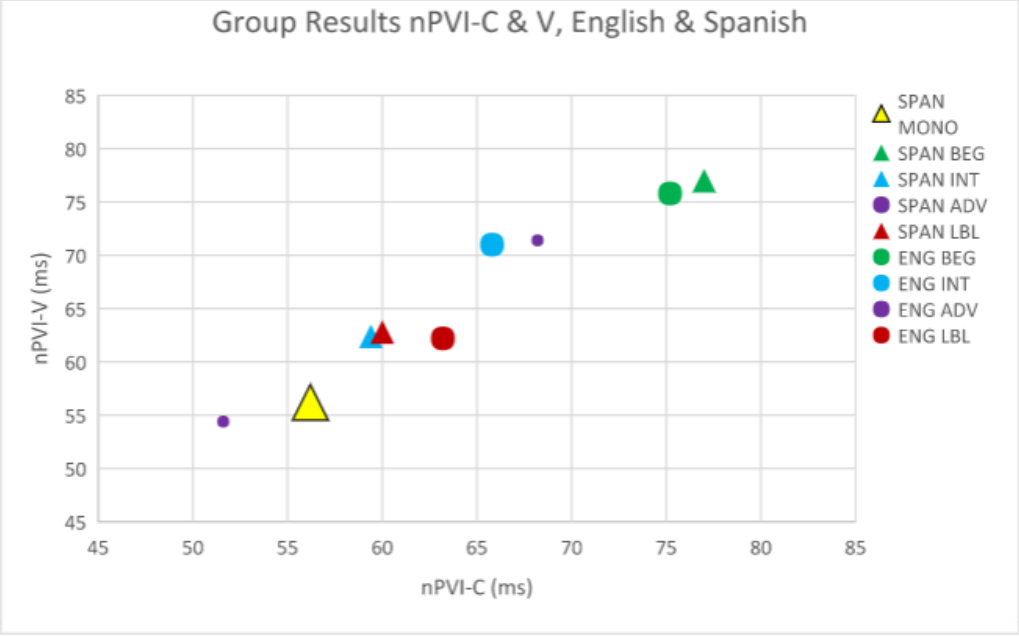
To review, the nPVI –or the *normalized Pairwise Variability Index* – measures the average variation in duration of consecutive intervals, be they of CV, C or V structure. The calculated results are presented in milliseconds. The average nPVI score for CV intervals among the group of monolingual Spanish speakers is 55.1 milliseconds; the average calculated nPVI-CV of the beginning bilinguals group is 71.8ms in English and 69.6ms in Spanish. The next group, intermediate bilinguals, showed a calculated nPVI-CV of 63.6ms for English and 58.4ms for Spanish; the advanced bilingual group averages are 66.8ms in English, and 51.6 ms in Spanish. Lastly, the nPVI-CV for the late bilingual group averaged out to 58.2ms in English and 57.6ms in Spanish.

A one-way ANOVA was implemented to compare the effect of Spanish language ability on the nPVI-CV production of the subjects. An analysis of variance showed that the effect was significant, [$F(4,25)=19.065$, $p<.01$]. Post-hoc Tukey's HSD tests indicate

that that the difference between the Spanish of monolingual speakers and beginning bilinguals is significant, as is the difference between beginning bilinguals and intermediate bilinguals; beginning bilinguals and advanced bilinguals; and beginning bilinguals and late bilinguals. Furthermore, there is a significant difference between the Spanish language nPVI-CV of intermediate bilinguals and advanced bilinguals. No other comparisons were found to have significant difference.

In order to truly understand the way in which the Spanish rhythm varies among the groups it is imperative to look at the C and V structures individually. While Figure 5 presents the nPVI calculations for consonant-vowel intervals, Figure 6 illustrates the nPVI calculations for consecutive intervocalic intervals (x-axis) and vocalic intervals (y-axis).

Figure 6: Group nPVI-C & V, English & Spanish



The monolingual Spanish nPVI-C was 56.2ms; the beginning bilingual group showed an nPVI-C average of 77ms; the intermediate bilingual group, 59.4; the advanced bilingual group, 54.4; and lastly, the late bilingual group had an nPVI-C of 60. A one-way ANOVA was conducted to compare the effect of language level on the variation in duration of consecutive intervocalic intervals in spoken Spanish. The results were found to be significant [$F(4,25)= 13.797$, $p<.01$]. A Tukey HSD post-hoc exam revealed that the only significant difference lies between the beginning bilingual group and each of the remaining four groups. Among the monolingual, intermediate, advanced and late bilingual groups, the difference was insignificant.

The nPVI-V measurement for the monolingual Spanish-speaking group was 56.2ms; for the beginning bilingual group, 77ms. The intermediate bilingual group averaged 62.4ms; the advanced bilingual group, 54.4ms; lastly, the late bilingual group averaged 62.8ms. A one-way ANOVA was implemented to compare the effect of Spanish language ability on the nPVI-V production of the subjects. An analysis of variance showed that the effect was significant, [$F(4,25)=24.5111$, $p<.01$]. The Tukey HSD post-hoc tests revealed that the differences are significant between the beginning bilingual group and each of the other four groups (monolingual, intermediate, advanced and late). It also showed a significant difference between the intermediate level bilinguals and the advanced bilinguals, as well as between the advanced bilinguals and the late bilinguals. No other difference was found to be significant. In Appendix D, the table shows each instance of significance (or not) for each metric between all groups.

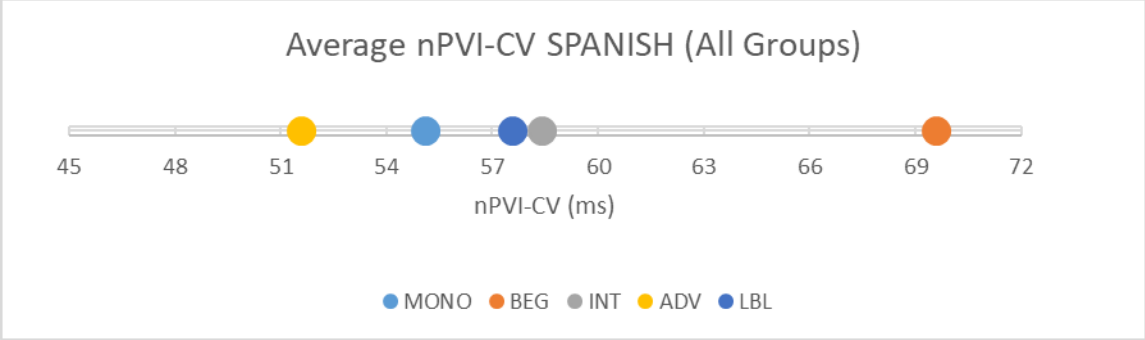
Taken all together, several assumptions can be drawn from these results. The following section will return to the stated research questions and address each one individually.

4.2 ANALYSIS AND DISCUSSION

4.2.1 **Question 1:** *Is there a significant difference in the rhythm of monolingual Spanish and bilingual Spanish in each of the other 4 levels?*

To answer this question, an analysis of the Spanish language nPVI-CV, nPVI-C and nPVI-V was conducted and compared across groups. The results of the nPVI-CV measurements are respresented on a continuum Figure 8:

Figure 8: nPVI-CV Spanish Results per Group



In order to truly understand the way in which the Spanish rhythm varies among the groups it is imperative to look at the C and V structures individually. The results of the nPVI-C and nPVI-V measures as continuous variables are shown in Figures 9 & 10, respectively:

Figure 9: nPVI-C Spanish Results per Group

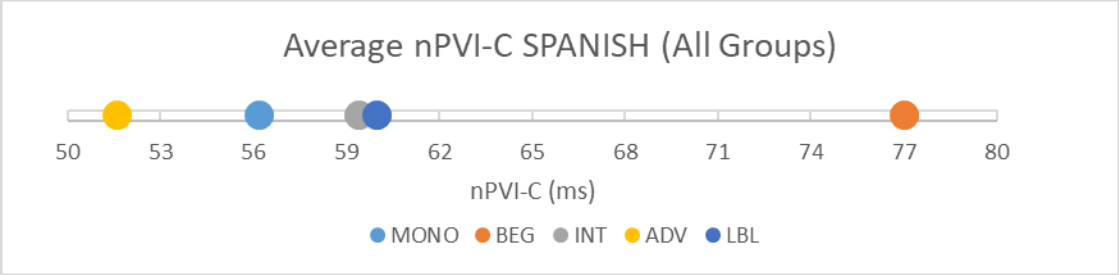
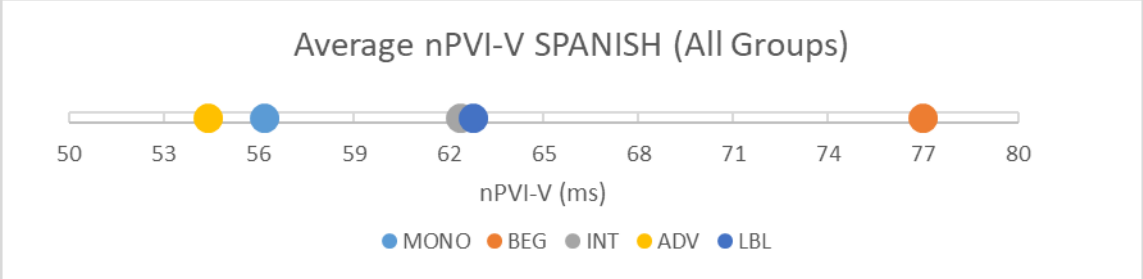


Figure 10: nPVI-V Spanish Results per Group



First and foremost, it is without question that the beginning bilingual group has a rhythm in Spanish that greatly differs from all the other groups. This is in line with previous research on beginning bilinguals who tend to have more issues with language production than do their more advanced peers. Following are examples of Spanish speech utterances from a beginning and advanced bilingual speaker in figures 11 and 12, respectively:

Figure 11: Speech sample, Spanish, Beginning Bilingual (F)

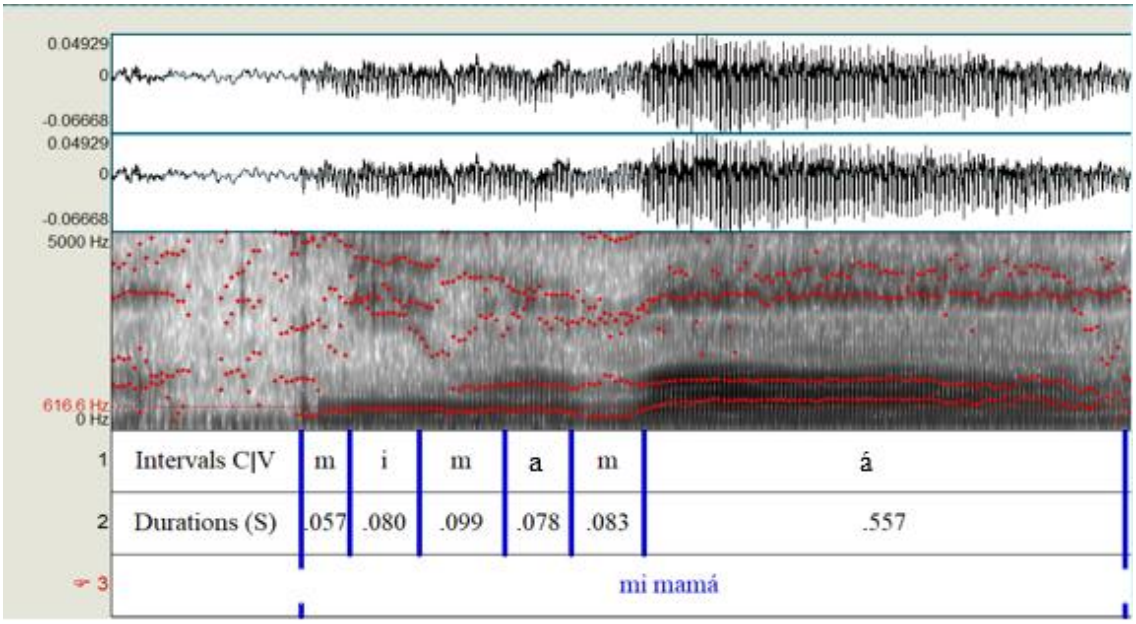
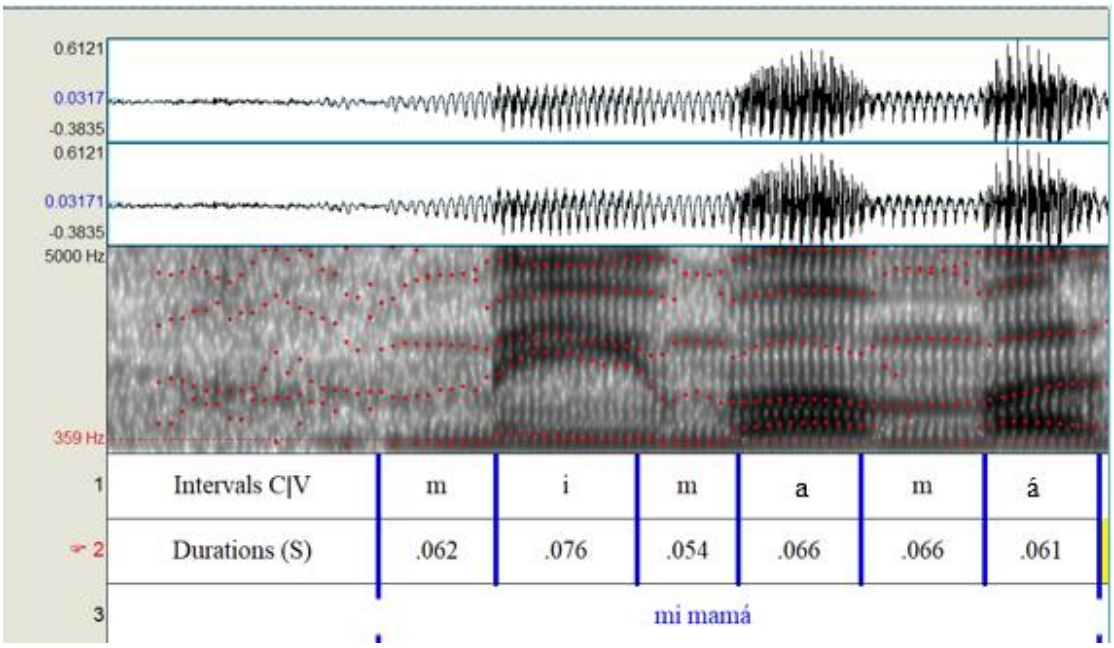


Figure 12: Speech Sample, Spanish, Monolingual (F)



As can be seen in the spectrograms, both of which provide the example of the utterance "mi mamá" the beginning bilingual lengthens the word-final /a/ quite significantly,

whereas the monolingual speaker does not. This is consistent with findings from Wightman et al. (1992), among others, that show word-final vowel lengthening as a common characteristic of English. The lengthened /a/ at the end of the Spanish word "mamá" produced by the beginning bilingual is likely a result of said speaker being English-language dominant.

The monolingual does produce two slightly different vowels in the word "mamá"; in her case, formant 2 is lower in the unstressed syllable than it is in the stressed one; formant 2 is related to backness and roundedness of a given vowel. The unstressed vowel in the word "mamá" is further back than the stressed one, showing centralization of this unstressed vowel. It is likely for that reason that the durations of the first and second /a/ varied greatly in the beginning bilingual speaker, but varied very little with the monolingual speaker.

Another interesting result of this study as it pertains to the spoken Spanish of all the groups is the lack of significant difference between monolingual speakers and intermediate, advanced and late bilingual speakers. With respect to the advanced and late bilinguals, this was to be expected. The advanced bilingual speakers in this sample tested into advanced-level Spanish courses, indicating a high proficiency of Spanish, which could correlate with a more native-like phonological grammar. Given that they are heritage speakers and grew up speaking and hearing the language, it would be expected that their pronunciation is native-like as well. The late learners of English group consists of subjects who were born in Mexico and received most of their elementary education there in their native tongue. They did not learn English until after 10 years old. As such,

these speakers had a chance to dominate the language in many contexts and acquire the phonological system of Spanish long before they moved to the United States and began learning English.

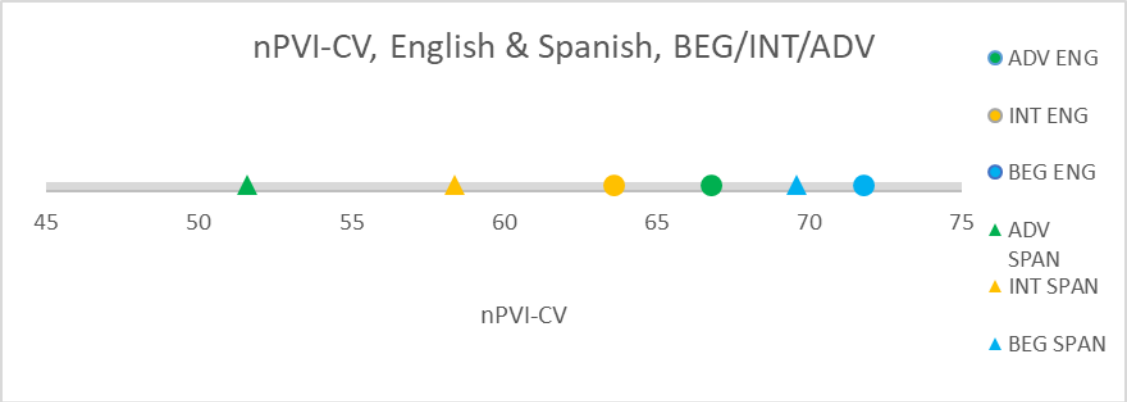
The fact that the intermediate group does not differ from the monolingual group is contrary to what was expected, however. This result is likely due to a smaller sample size of 5 subjects. Given the large number of intervals that were measured in each sample, the sample size typically doesn't have as significant of an effect on the outcome of the rhythm calculations. However, intermediate-level speakers of Spanish as a heritage language comprise the most heterogenous population of bilingual speakers, so a larger sample size could possibly illustrate slightly different results. The intermediate levels of heritage Spanish language classes are notoriously heterogenous in their makeup, given that the students arrive with a plethora of different abilities and strengths. Some students produce the language with native-like ease, while other still may struggle in certain contexts to produce the language.

4.2.2 **Question 2**: *Does the rhythmic production differ between the two languages in the beginning, intermediate and advanced bilingual groups?*

Now that we have a better understanding of where each group lies on the durational variation continuum and that the intermediate and advanced speakers do not differ significantly from monolingual speakers of Spanish, the extent to which each of these three groups separates the rhythmic qualities of each language can be analyzed. Following in figure 13 is a visual representation of both the aforementioned average

English and Spanish nPVI-CV results for the beginning, intermediate and advanced bilingual groups:

Figure 13: nPVI-CV ENG/SPAN Averages, BEG/INT/ADV Groups



Following, the nPVI-C and nPVI-V measures for both English and Spanish are shown in figures 14 and 15, respectively:

Figure 14: nPVI-C ENG/SPAN Averages, BEG/INT/ADV Groups

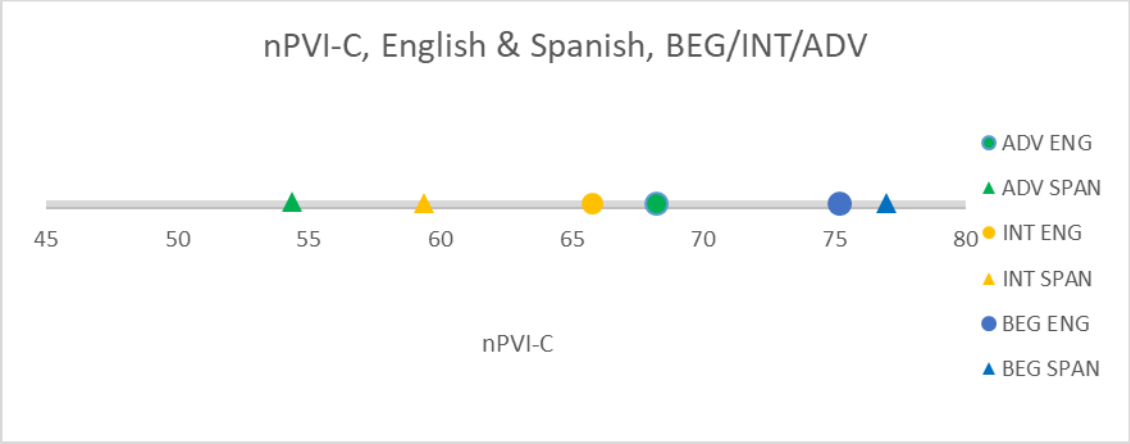
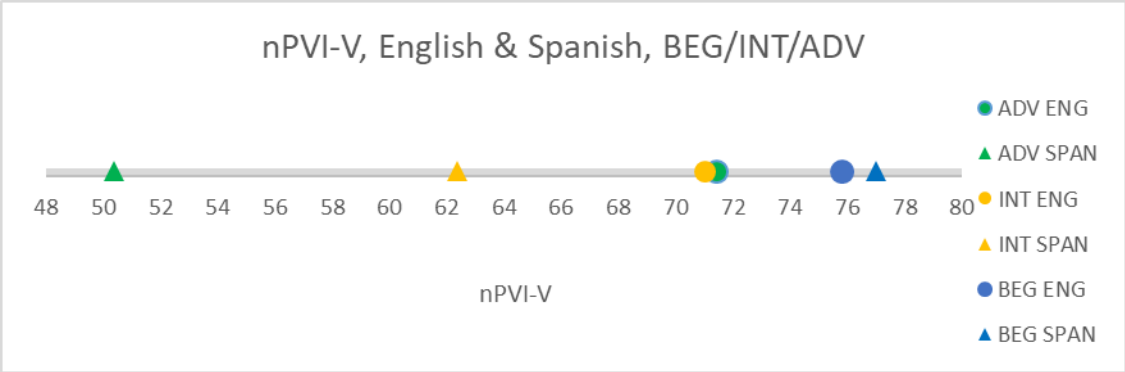


Figure 15: nPVI-V ENG/SPAN Averages, BEG/INT/ADV Groups



Taken all together, it is clear that advanced bilingual speakers separate the rhythms of the two languages at the CV, C and V levels. This is consistent with previous findings by Kim (2011) on the production of voiced stops /b d g/ and voiceless stops /p t k/ in Spanish by English-dominant heritage speakers. Her results showed that these consonants were not significantly different than the ones produced in English in that particular group, in that the voice onset time (VOT) was higher (and therefore more "English-like") than the stops produced by monolingual speakers. Amengual (2012) corroborated these findings, concluding that heritage speakers of Spanish have a higher VOT especially with voiceless stop /t/ than monolingual Spanish speakers do. In order to illustrate how these phenomena appear in a spectrogram, Figures 16 and 17 show waveforms and spectrographs of a Spanish voiceless stop /t/, both in onset position and following a pause, the first from a monolingual Spanish speaker and the second from an intermediate level bilingual:

Figure 16: /t/ in Onset Position, Monolingual Spanish

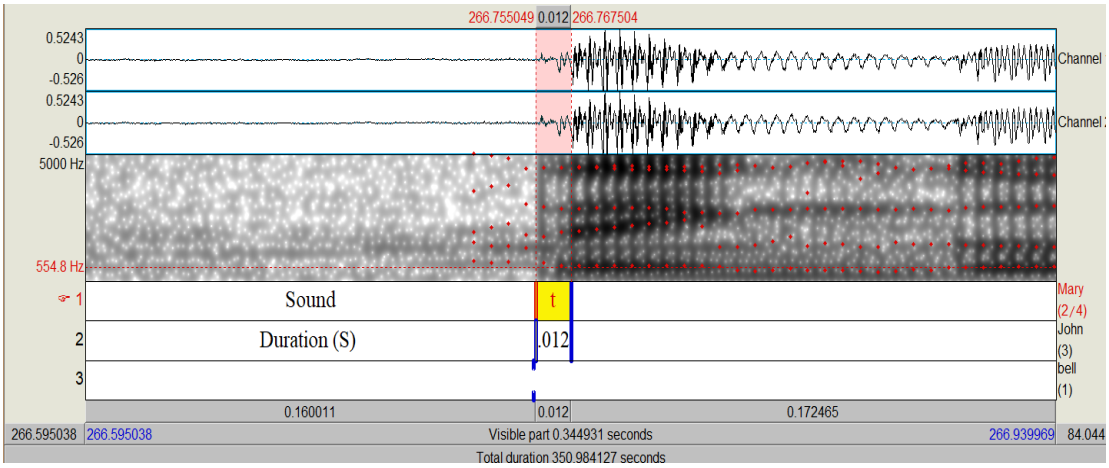
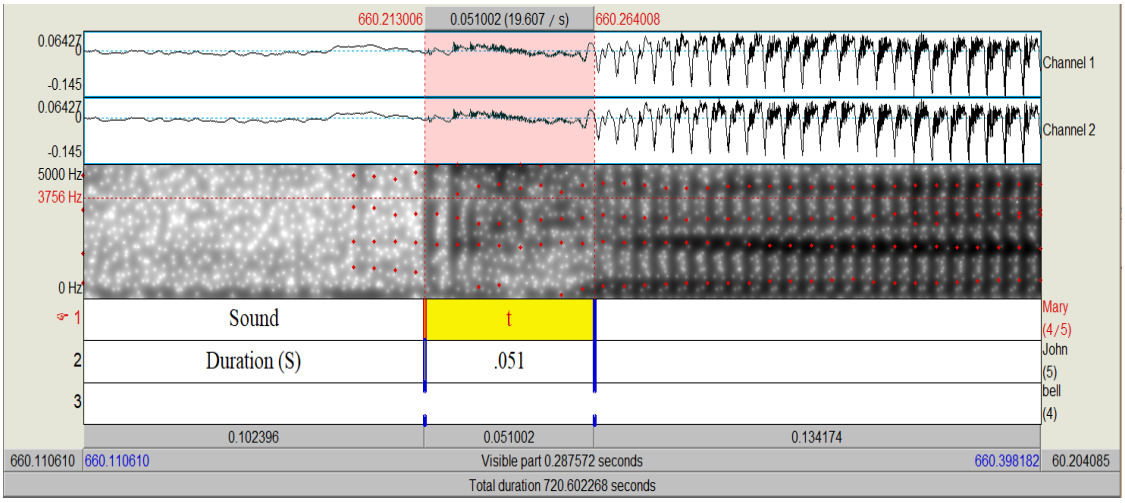


Figure 17: /t/ in Onset Position, Intermediate Spanish



As shown, the total VOT for the monolingual, measured from the transient, indicating the release of the closure, to the onset of the vowel is .012 seconds, whereas the intermediate bilingual speaker aspirated much more in this similar context. In this particular utterance, the VOT measures at .051 seconds. The variance in VOT in these stops accounts for much of the durational variability in intervocalic intervals throughout the longer samples of speech in the heritage language bilinguals.

Guion (2003) concluded that simultaneous bilinguals, or bilingual speakers who acquired two languages at the same time, were more easily able to produce the languages in a native-like way – more so than early or mid-bilinguals. Here the intermediate bilingual group also significantly separates their rhythms at the CV and V levels. The nPVI-C variation, however, was not significant. This could be explained by several factors. It may be related to the actual utterances used by the individual speakers. Since the utterances were not uniform in order to remove the challenge of heritage language literacy from the study, there simply may not have been a large variety of consonantal variation among these subjects.

The beginning bilinguals did not show a difference in the rhythmic characteristics of each language. While many of them indicated that they began learning Spanish at birth, as Grosjean (2010) affirms, it is often the case that English replaces Spanish as the dominant language. This is particularly true if the speakers begin formal schooling in English. As Kim (2011) states, her findings imply that there is a strong relationship between language dominance and the direction of phonetic interference. Given that beginning bilinguals tend to be much more English-dominant than their intermediate and advanced bilingual counterparts, it is not surprising that their English and Spanish rhythmic features are not significantly different. Results of the Bilingual Language Profile will be evaluated in a subsequent section.

4.2.3 **Question 3**: *If there is a significant separation, do advanced bilinguals separate the two rhythm systems more so than the intermediate and beginning bilingual groups*?

To answer this question, it was necessary to determine if the average difference in the values of the nPVI-CV, nPVI-C and nPVI-V for English and Spanish in the advanced and intermediate bilingual groups is significant. The beginning bilingual group is not included as there was no significant difference between their English and Spanish when the nPVI metrics were applied. The nPVI-C is not compared in this particular research question, given that the intermediate bilinguals did not show a significant difference in the durational variation of their Spanish and English intervocalic intervals. They did, however, show a significant difference in the nPVI-V metric.

When viewed altogether, it can be concluded that the advanced bilinguals certainly separate their English and Spanish rhythm systems more so than the intermediate and beginning bilingual groups. It can also be concluded that the intermediate bilinguals separate their CV and V durational variability more than the beginning bilinguals do, as they showed a significant difference in the two averages, and the beginning bilinguals did not show significant differences in anything. As far as the nPVI-C is concerned, the intermediate bilinguals did not have a statistically significant separation in the two languages. However, given that there is a significant difference between the Spanish nPVI-C of the intermediate group and the beginning group, it is important to elaborate as to why this may be.

Several studies have shown that LI and L2 sound systems are not completely independent of one another (Flege, 1995; Fowler et al.., 2008, Grosjean, 2010, among others). As such, it is not abnormal for these sound systems to influence each other. In the case of the intermediate bilinguals, a group which is famously heterogenous in terms of

linguistic capacity, it is plausible that at any given time one linguistic system could influence the other. Amengual (2012) found that the primary difference between heritage bilinguals and monolingual speakers was the increased VOT of /t/ in words that have an English cognate. Given that the present study does not analyze uniform utterances (so as not to sacrifice the natural flow of speech) it is also possible that the intermediate bilinguals use more Spanish words with English cognates than the advanced or monolingual group does. Furthermore, despite not having categorized his bilingual subjects in accordance with their language dominance, Carter (2005) confirms that the English of many Spanish/English bilinguals often displays evidence of "Spanish substrate influence on the English of the Hispanic group, as evidenced by the intermediate rhythm production of the bilinguals" (73). This is consistent with the data of the intermediate bilingual group, given that despite the significant separation in their CV and V interval durations, their English is not as high on the continuum as the English of the more English-dominant bilingual groups. This is also consistent with Shousterman (2014) who confirmed that the English spoken in Spanish Harlem (characterized by the Puerto Rican dialect) is also more "syllable-timed" than the English spoken by monolingual English speakers. In both Carter (2005) and Shousterman (2014) the nPVI metric was used to measure the rhythm of open guided speech just as in the present study, which substantiates the use of such speech in the current study as the closest representation of natural speech possible in a controlled environment.

In the section that follows, the results of the fifth group of speakers – late bilinguals – will be analyzed. Finally, we will address the question of whether or not

more advanced bilingual speakers tend to be have more like monolinguals in each language than do the less balanced speakers.

4.2.4 **Question 4:** *Do late bilinguals separate their English and Spanish metrics?*

The late bilingual group consists of 5 subjects who did not begin learning English as a second language until they had a substantial education in their native tongue in Mexico. All subjects were monolingual until at minimum the age of 10. Figure 18 that follows illustrates the nPVI-CV of each bilingual group, this time with the data from the late bilinguals included:

Figure 18: nPVI-CV, English & Spanish, Beg/Int/Adv/Late

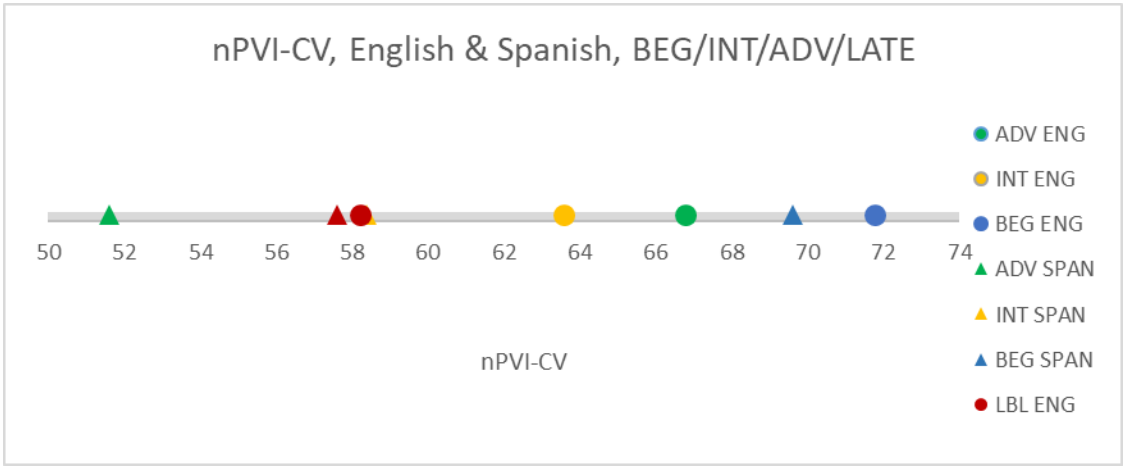


Figure 19 illustrates the results of the nPVI-C of all bilingual groups, this time including the late bilingual group, and Figure 20 shows the results of the nPVI-V of all bilingual groups.[17]

Figure 19: nPVI-C, English & Spanish, Beg/Int/Adv/Late

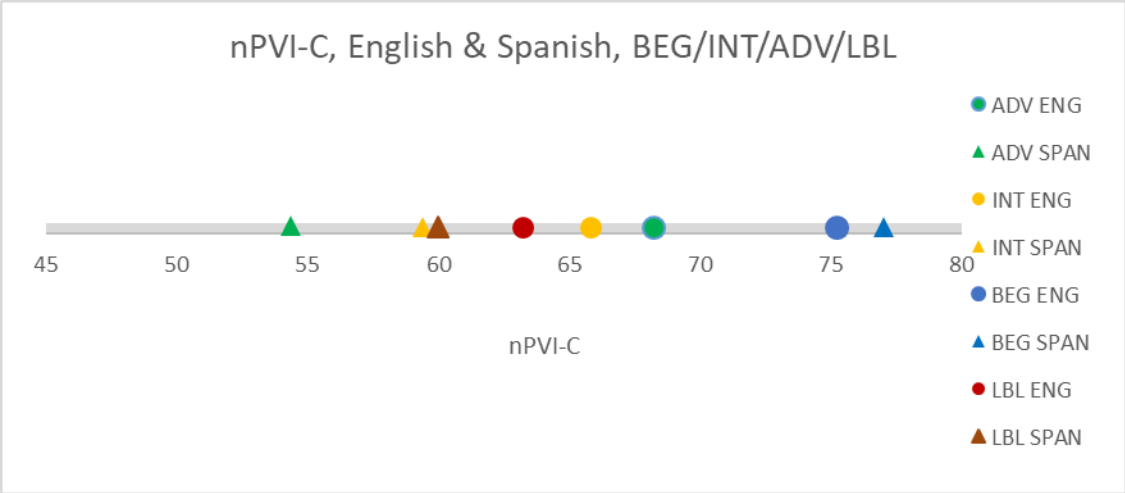
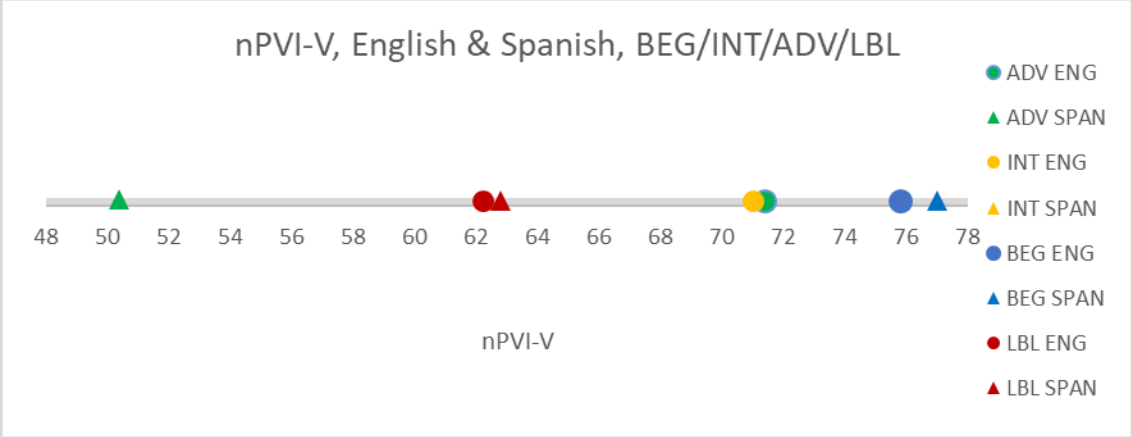


Figure 20: nPVI-V, English & Spanish, Beg/Int/Adv/Late



Reviewing the results from the late bilingual group, it can be concluded that they do not separate the rhythm systems of their Spanish and English. This is not unlike the phenomenon that cause beginning bilinguals not to separate the rhythm of their Spanish from that of their dominant language, English. This is the same phenomena, but the dominant language for the late bilinguals is Spanish, whereas the dominant language of

[17] Note that in Figure 20, the LBL English and Spanish results are quite close together and cover up the

the beginning bilinguals is English. As such, it can be asserted that the same tendencies that apply to beginning bilinguals in Spanish apply to late bilinguals in English, once again consistent with Kim (2011) who asserted that there is a strong relationship between language dominance and the direction of phonetic transfer. As will be evaluated in a subsequent section, the late bilinguals are Spanish dominant and the beginning bilinguals English dominant, and this is reflected in their scores both in terms of total separation as well as position on the continuum.

In the following section, the results and from sections 4.2.2 and 4.2.3 will be tied together in order to analyze the extent to which each group's speech patterns mimics dominant speakers in both languages.

4.2.5 **Question 5:** *Do balanced bilinguals behave more like monolinguals in each language than the other groups?*

The extent to which each group behaves (or does not) like monolingual speakers of each language is relatively clear in terms of the results in Spanish, at minimum in terms of their rhythmic production. To refresh from section 4.1.2, only the beginning bilingual group showed a significant difference in their CV, C and V interval durations from those of the monolingual Spanish-speaking group. The intermediate, advanced and late bilingual groups did not show a significant difference. One must be cautious when discussing whether a bilingual speaker behaves like a monolingual in any given language, because to truly behave as a monolingual speaker one would need to be able to converse fluently in all the normal contexts and registers of a true monolingual. It is for this reason

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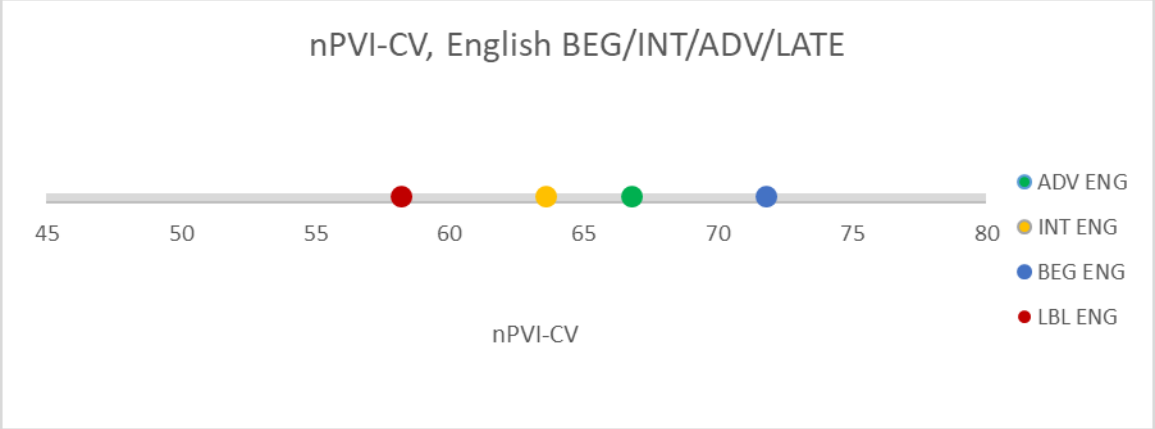
advanced bilingual Spanish results.

that Valdés (2000) asserts that the idea of a bilingual person essentially being two monolingual speakers in one is, at best, wishful thinking. This was the basis of her proposed bilingual continuum that was discussed in chapter 1. However, with respect to phonological production, the results of this study would indicate that well-balanced bilinguals and bilinguals who are heavily dominant in Spanish do behave like Spanish monolinguals.

In English this is a harder question to answer given that there is no monolingual English control group. However, the language dominance profile scores indicate that beginning bilinguals are very much English dominant. As such, one way to approach this question without a true monolingual English group is to compare the English results of all other bilingual groups to those of the beginners.

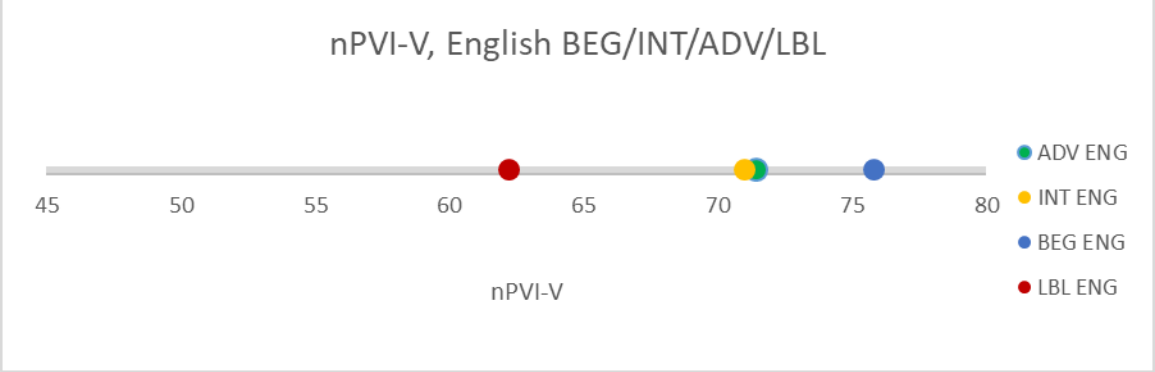
Beginning with CV intervals, the English of the intermediate, advanced and late bilingual groups will be compared with the English of the most English dominant group, the beginning bilinguals. Figure 21 illustrates the average nPVI-CV of the English of each of the four groups:

Figure 21: nPVI-CV, English, Beg/Int/Adv/Late



Following, figure 23 provides the average results for all bilingual groups English nPVI-V:

Figure 23: nPVI-V, English, Beg/Int/Adv/Late



When considering all the compared English metrics, it is clear that the advanced bilinguals, the most balanced bilingual group of all 4, certainly appears to behave phonologically like monolinguals in each language. Their Spanish metrics did not differ from those of the monolingual Spanish-speakers, and their English metrics did not differ from those of the heavily English-dominant beginning bilingual speakers.

The late bilinguals, heavily Spanish dominant as per the results of the Bilingual Language Profile scores, indubitably behave as monolinguals in Spanish; however, the results of their English scores do not differ from their Spanish ones.

The intermediate bilinguals provide an interesting case, because they differ from the beginning bilinguals only in terms of their nPVI-CV and nPVI-C results. Their nPVI-V metrics, however, were not significantly different from the beginning bilingual speakers at all. One possible explanation for this is that, according to Strange (2011) who asserts that vowels are more perceptible than consonants because they are more dynamic and have stronger acoustic cues; this could explain why the intermediate bilinguals nPVI-V in English does not differ from the English dominant beginning bilinguals, and why their nPVI-V in Spanish does not differ from that of monolingual Spanish speakers.

In addition to Strange's assertion, these characteristics of the intermediate bilingual group may also be attributed to having a more balanced bilingualism than the beginners (which is logical, given the differences in the BLP averages of the two groups) but not as balanced as the advanced bilingual group; this could explain why the intermediate bilinguals differ in terms of their nPVI-CV and and nPVI-C metrics as compared to beginning bilinguals in English, but do not differ from advanced bilinguals in the same manner.

In sum, groups with an unbalanced language dominance will behave more like monolinguals in their dominant language, whereas groups with more balanced dominance are more likely to behave like monolinguals in both languages. The differences in

production by the intermediate group may also be related to their BLP scores. This will be discussed further in the section that follows.

4.2.6: **Question 6**: *What are the factors that contribute to the differences between monolingual and bilingual speakers?*

There are several factors that can contribute to the differences between monolingual and bilingual speakers of any given language(s). First and foremost, it can be assumed that the bilingual speaker has some degree of ability in a language other than his or her mother language. As we have seen in the bilingual continuum proposed by Valdés (2000), a bilingual individual can be perfectly fluent in one language and only receptively fluent in a second; or a person can be very fluent in both languages. A bilingual individual can also find themself anywhere in between these two extremes of the bilingual continuum.

The BLP – or *Bilingual Language Profile* – calculates a continuous dominance score that indicates in which language a speaker is more dominant, given a pair of languages. The version of the BLP used in this study juxtaposed English and Spanish. A positive number indicates English dominance, and the higher the number, the more English dominant the speaker; conversely, a negative number indicates Spanish dominance and the larger the negative number, the more Spanish dominant the speaker. A score of 0 would indicate equal dominance in both languages.

The BLP determines these results by considering several different factors that can have an effect on language acquisition in order to represent the speaker's dominance in a well-rounded way. In addition to basic biographical information, it includes 4 equally-

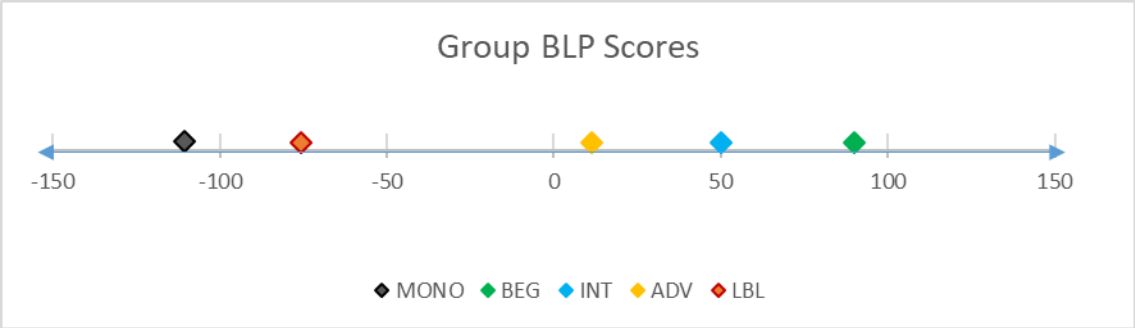
weighted modules that address language history, language use, language proficiency and language attitudes. For more detailed information about the survey, please refer to section 3.3 in the previous chapter. Per the BLP developers,

> A first step in creating the BLP was to clarify that dominance is conceptually distinct from proficiency, though they are easily conflated and often correlated. Dominance is a construct that derives from the nature of bilingualism, of having two languages in one's mind. It involves the relationship between competencies in two languages, and is thus inherently relativistic. Proficiency, on the other hand, does not require a bilingual context for its definition. Even a monolingual can receive a score on a proficiency test. (Bilingual Language Profile, n.p.)

It is important to recognize that dominance and proficiency are not one in the same. For that reason, when testing for a correlation between BLP scores and the speaker groups, we will be looking for correlations between the BLP scores and the nPVI metrics. The nPVI metrics are not necessarily telling of language proficiency; however, the group categorizations are. The purpose of comparing the BLP scores to the nPVI scores in Spanish is to determine if, and to what extent, one's experience with a language can predict the acquisition of a phonological system.

Figure 7 shows the average BLP scores plotted on a number line to show each groups position in relation to one another:

Figure 7: Group BLP Scores



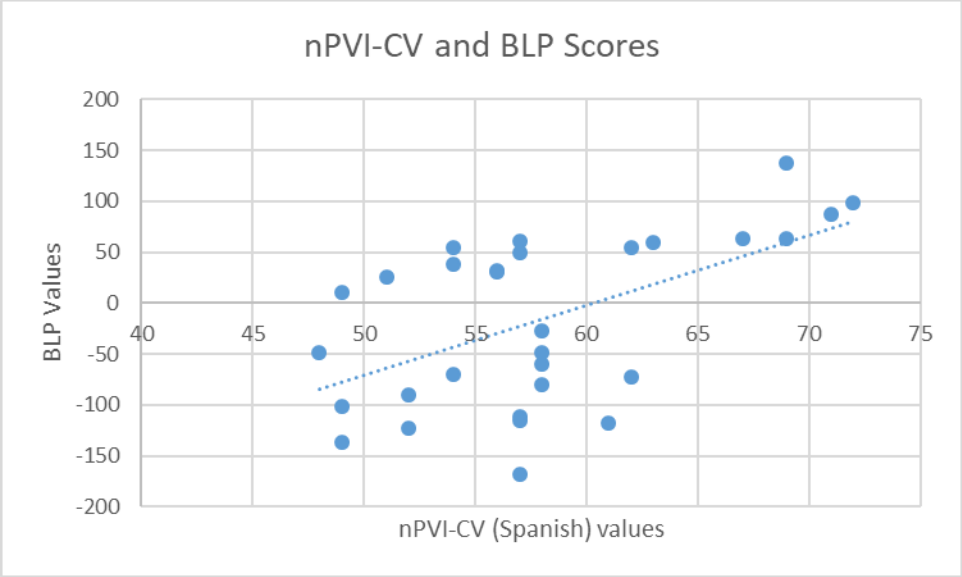
In the case of the monolingual group, the average BLP score shows strong Spanish dominance at -100.3. The beginning bilingual group exhibited a strong English dominance score of 90; the intermediate group BLP score is 50, showing English dominance that is not as strong as the beginning group. The advanced bilingual group BLP is 11.4; late bilingual, -75.6 and the monolingual group score is -100.3. A one-way ANOVA was conducted to compare the effects of bilingual capacity on BLP score and the differences between groups was shown to be significant [$F(4,25)=39.898$, $p<.000001$]. Post hoc comparisons using the Tukey HSD test indicated that the mean score for the monolingual group ($M = -100.3$, $SD = 34.93$) differed significantly from the beginning bilingual group ($M = 90$, $SD = 31.03$), the intermediate bilingual group ($M = 50$, $SD = 10.79$), and the advanced group ($M = 11.4$, $SD = 34.66$). However, there was not a significant difference between the monolingual group and the late bilingual group ($M = -75.6$, $SD = 40.32$). The post-hoc test also showed a significant difference between the beginning bilinguals and both the advanced and late bilingual groups; however, the effect was not significant between the beginning bilingual group and the intermediate bilingual group. Furthermore, the differences between the intermediate group and late bilingual group were significant, but not between the intermediate and advanced group.

Lastly, there is a significant difference between the BLP scores of the advanced and late bilingual groups. These comparisons are shown in Appendix D.

Taken together, these results suggest that there is no significant difference in the self-reported language profiles of the monolingual speakers and the late English learners; furthermore, the difference between beginning and advanced speakers is significant, but the difference between the intermediate group and both beginning and advanced speakers is not. This is possibly due to the heterogeneity of the intermediate group, in which many students are closer to the beginning side of the bilingual continuum and many others are closer to the advanced end of the continuum.

In order to determine the effect language dominance may have on the rhythmic production of these heritage bilinguals, a Pearson product-moment correlation coefficient was computed to assess the relationship between BLP score and nPVI-CV (Spanish). There was a moderate positive correlation between the two variables, r=.5628, n=30, p=<.01. Figure 24 illustrates the correlated values:

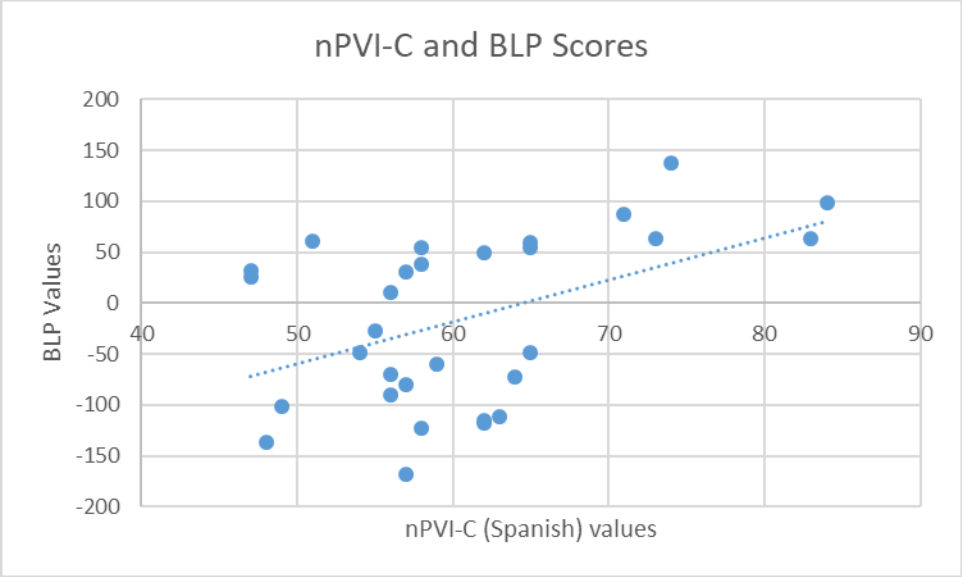
Figure 24: nPVI-CV(Spanish) & BLP Correlation



This correlation is moderate, but it is positive. Worth noting is that when the monolingual, intermediate bilingual and late bilingual groups were removed, the Pearson product-moment correlation coefficient increases dramatically: r=.8665, n=10, p=<.01. Because high X variables tend to correlate to high Y variables, it is not surprising that the beginning and advanced bilinguals would show this high correlation, given that both groups were on the extreme ends of the nPVI-CV continuum where Spanish was concerned.

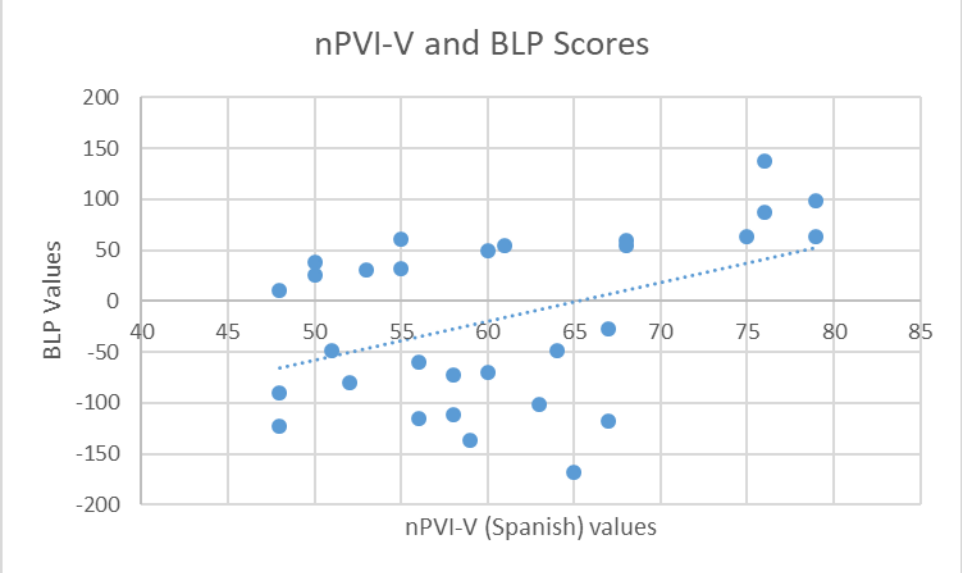
A Pearson correlation was also computed to determine the effect of the BLP score on the nPVI-C result in Spanish. Similarly to the nPVI-CV scores, the correlation was moderately positive: r=.5187, n=30, p<.01. Figure 25 illustrates this correlation on a scatter plot:

Figure 25: nPVI-C (Spanish) & BLP Correlation



A comparison of the BLP scores and the nPVI-V results show a correlation that is moderately positive: r=.4729, n=30, p<.01. Figure 26 illustrates these results below:

Figure 26: nPVI-V (Spanish) & BLP Scores



It is clear that there is a relationship between language dominance and rhythmic production, particularly as it relates to extreme variables. The BLP and nPVI relationship

is the strongest in the beginning and advanced bilingual group, and that is to be expected given that the beginning bilinguals exhibit a very lopsided relationship between English and Spanish (heavily dominant in English) and the advanced bilingual group has a very well balanced relationship. Their average BLP of 11.4 is very close to the center point of the language dominance continuum; this is the result of an English module score that is a high positive number added to a Spanish module score that is a low negative number. The cancellation of the two numbers renders a result that is very close to 0 (the mythical bilingual).

The following chapter will summarize the results of this study as well as discuss implications for the fields, limitations of the current study as well as propose potential future studies.

5. CONCLUSION

5.1 Introduction

The study of the phonological production of speakers of Spanish as a heritage language has only recently become of interest to scholars. It has long been assumed that since these speakers have grown up in homes where Spanish was spoken, the phonetic system of their native language was not an aspect of their fluency that required attention.

While this is partially true – heritage speakers tend to have a better handle on the phonological system of their heritage language than do second language learners – it should not be a foregone conclusion that all heritage speakers sound the same way a monolingual speaker does, as is asserted by Willis (2005), who showed that, contrary to previous assumptions, the Spanish vowel system of the Spanish spoken in the U.S. Southwest is not uniform and is variable. The same can be said for the consonant inventory. As such, the recent inquiries that have come to light about the production of consonants and vowels detailed in Chapter 1 only serve to corroborate Willis' findings. At the suprasegmental level, which includes features such as intonation, pitch, and rhythm, there have been even fewer studies conducted, which renders the current study of utmost importance to the field. This study was conducted with the goal of answering the following six research questions related to the rhythm production of speakers of Spanish as a heritage language. Following is a recap of the six questions, and the conclusions that were drawn from the results:

1. Is there a significant difference in the rhythm of monolingual Spanish and bilingual Spanish in each of the other 4 levels?

This study shows that there is a significant difference in the production of Spanish by beginning bilinguals. The nPVI-CV, nPVI-C and nPVI-V measurements of their Spanish were all very similar to their English measurements, and much higher on the continuum than was the Spanish of the monolingual group, the advanced bilingual group, the intermediate bilingual group, as well as the group of late learners of English. This is not surprising, given that the results of the BLP show the beginning bilingual group to be the most English dominant group of the 5.

There is no significant difference in the Spanish of the monolingual group, the advanced bilingual, intermediate bilingual and late learners of English group. The lack of difference among the MONO, ADV and LBL group was to be expected, but the fact that the intermediate group did not differ was contrary to initial expectations. Upon reexamination, though, this result is likely due to a sample size of 5 subjects. The intermediate level heritage Spanish groups are notoriously heterogeneous in their linguistic capacities, including aural ones. As such, it is possible the results would be different given a larger sample of intermediate level speakers.

2. Does the rhythmic production differ between the two languages in the beginning, intermediate and advanced bilingual groups?

In general terms, this study showed that indeed, heritage speakers of Spanish who exhibit more balance with regard to their language dominance are better able to separate the phonological systems of each language than heritage speakers who exhibit a stronger dominance in English. The advanced bilingual group, for example, separated the rhythms

of the two languages at the CV, C and V levels. This is likely due to the fact that they are the most balanced group in terms of their dominance in both English and Spanish.

The intermediate bilingual group significantly separates their languages at the CV and V levels; however, there was no significant difference in their nPVI-C. This could suggest that vowels are more easily acquired given their acoustic features, which are more robust and thus easier to perceive than consonants. Voiceless stops, for example, typically exhibit a higher Voice Onset Time (VOT) in English; however, this is a feature that is not as easy to recognize with the naked ear as, for example, the production of a particular vowel sound.

The beginning bilingual group did not show a significant difference between their English and Spanish production. As Kim (2011) asserted, there is a strong relationship between language dominance and the direction of phonetic transfer. As such, it can be assumed that because the beginning bilingual group was strongly dominant in English, the transfer of English phonology in their Spanish would be equally strong.

3. If there is a significant separation, do advanced bilinguals separate the two rhythm systems more so than the intermediate and beginning bilingual groups?

The average difference in values of two of the three rhythm metrics in English and Spanish was significant between the ADV and INT groups. The advanced bilingual group separated their two languages at the CV and V levels more so than the intermediate group did. In other words, the distance between the two languages on the continuum was greater for the advanced bilinguals than it was for the intermediate bilinguals. The nPVI-C was not considered, given that there was no significant difference in the nPVI-C of English and Spanish for the intermediate bilingual group. The beginning bilingual group

was not included in this particular question, because (as mentioned in the second research question) there was no significant difference in the production of their English and Spanish.

This result was expected, given the results of the BLP metric that showed advanced bilinguals to have a balanced dominance between the two languages; the intermediate group was slightly more English dominant than the advanced group, and the beginning bilingual group was highly English dominant. This result goes hand-in-hand with the BLP results.

4. Do late learners separate their English and Spanish metrics?

The late learners of English results show no significant difference in their English and Spanish metrics. However, whereas the beginning bilinguals (English dominant) showed much English interference in their production of Spanish, the opposite is true for the late learners of English. In their case, given that Spanish is their dominant language, the interference was reversed. When they speak English, they tended to do so using Spanish phonology. As an example, whereas a vowel might typically be diphthongized in native English, a heavily Spanish-dominant speaker may not pronounce it as such if a similar diphthong does not exist in native Spanish. Another example would be that of VOT, mentioned previously. In monolingual Spanish, the VOT of voiceless stops (for example) is significantly shorter than the VOT of English; so, whereas a longer VOT is expected in English, it is likely that a late learner of English would produce a shorter VOT for voiceless stops than a monolingual English speaker.

5. Do balanced bilinguals behave more like monolinguals in each language than the other groups?

One must be cautious when answering this question, because as Valdés (2001) asserts, the idea that a bilingual person is two monolingual speakers in one is not likely, given that for a speaker to behave truly like monolinguals in each language they would need to be able to use each language in all of the same contexts and registers as a true monolingual. However, from a purely phonological standpoint the results of this study would indicate that well-balanced bilinguals, as well as bilinguals who are heavily dominant in Spanish, have a more 'native-like' rhythm structure in Spanish.

6. What are the factors that contribute to the differences between monolingual and bilingual speakers?

There are any number of factors that can contribute to these differences. The Bilingual Language Profile that was used in this study compresses aspects of language dominance (such as age of acquisition, frequency of use, context of use, etc.) into four equally weighted modules designed to help determine the relative dominance of a bilingual in two languages. The difference in language dominance scores was significant between all groups except between the monolingual group and the late learners of English. Furthermore, there was a positive correlation between the BLP scores and the nPVI-CV, C and V measurements, which further corroborates the general understanding of how language acquisition and maintenance work. Further investigation is needed to determine if individual modules or specific items in the BLP show a stronger correlation than others to actual language production and if other factors, such as gender, may be pertinent to rhythm studies.

This chapter is further divided into 4 sections: section 5.2 will address implications for the field of phonology; 5.3 will explore the pedagogical implications of

this study; section 5.4 will delve into the limitations of the study, and section 5.5 will propose ideas for future studies.

5.2 Implications for the field of Phonology

Studying rhythm is one of the many ways to not only understand the features of a given language; it also allows an additional method by which we can examine how languages in contact interact with one another. This study has certainly shown that the dominant language tends to prevail in terms of how the less-dominant language is pronounced. Furthermore, it has shown that when a bilingual speaker dominates both languages at a similar level, they are able to distinguish rhythm in each language much better than can a speaker who is heavily dominant in one language or the other.

The study is imperfect, however, given the longstanding tradition of trying to classify rhythm based on Kenneth Pike's postulation of isochrony. Isochrony, with respect to language rhythm, is defined based on perceived equal divisions of time within a language. As was mentioned in Chapter 1, Pike determined that equal divisions of time in a language could happen at every point of stress (as in stress-timed languages such as English); at every syllable (as in syllable-timed languages such as Spanish) or at every mora (as in mora-timed languages, such as Japanese).

Isochrony theory is problematic, however, given that Dauer (1983) discovered that said equal divisions of time actually do not exist. Instead, she proposed that rhythm exists on a continuum that allows for the collocation of languages at the "maximally stress-timed" or "maximally syllable-timed" end, or anywhere in between.

Dauer's idea of a rhythm continuum has gone largely undisputed over the years, and many of the rhythm metrics developed since her initial proposal calculate rhythm on

a continuum. For example, the nPVI (Grabe & Lowe 2001) used in this study does exactly that. However, the notion that we continue to use "stress-timed", "mora-timed" and "syllable-timed" to define a language rhythm is quite misleading. Dauer herself presented the idea that the durational variability of consecutive syllables (or other intervals) is what truly measures the rhythm of a language. However, she chose to continue utilizing the terminology proposed by Kenneth Pike. This is where the problem arises.

In the context of music, the primary area from which the concept of rhythm was developed, rhythm is defined as the "placement of sounds in time…an ordered alteration of contrasting elements" (Crossley-Holland, 2017). The aspect of time mentioned in this definition is marked by a beat, which is an equal division of time that drives how the elements of rhythm are situated, and at what pace (Crossley-Holland, 2017.). Based on the fundamental definition of these two concepts, it is clear that Pike was attempting to locate a beat in language – and decided that it occurs at every syllable, mora or point of stress. Dauer (1983) showed that there is no evidence to support equal divisions of time happening at these certain points, and the rhythm studies that have come since then have concurred in the sense that rhythmic variation can vary within one language and within one dialect (Dimitrova 1998; Grabe & Lowe 2000; among others). However, the continued utilization of the terminology proposed by Pike creates a logical fallacy, because we continue to use rhythm class names that were born of a theory that has since been disproven.

If, then, as Dauer (1983) has shown, there are no equal divisions of time (beat) happening in a given language, and rhythm metrics such as the Pairwise Variability Index

are in fact a measurement of durational variability of syllables or other intervals, it is imperative to push for a change in terminology to more accurately represent what is taking place at the prosodic level in languages. Changing the terminology will clarify confusion and will allow a bridge to be drawn to connect studies on individual sounds in languages to the rhythm as a whole. For example, the previously mentioned studies on vowels and consonant production in heritage speakers can give an initial idea of how the rhythm of a bilingual variety of a language may manifest.

As such, I am proposing that instead of the currently used class names, the continuum upon which any language or dialect can be placed should take center stage to avoid the impossible task of truly "classifying" languages into separate categories. A single referential name, the Durational Variability Index (DVI) would allow for an immediate understanding of the overall interval structure of a language. The index, presumably a number, would immediately refer to the language's position on the continuum. It would be understood without question that the lower the number on said continuum would mean a language has less variation in its syllabic structure (or vocalic/intervocalic structure, however the researcher chooses to assess it) and the higher on the continuum, the more variability in the syllabic structure of a language. Currently established metrics such as the PVI would maintain their importance to the field while the new name would more appropriately represent what is being measured. A new understanding of rhythm in this way would lend itself to a better grasp on other areas of phonology, such as the pedagogical implications for second language or heritage language learning.

5.3 PEDAGOGICAL IMPLICATIONS

With a new understanding of how monolingual speakers and bilingual speakers of a given language produce rhythm, as well as the recognition of the existing phonological studies that address individual sounds, the study of rhythm can even further inform the fields of pedagogy of second-language and heritage-language learners.

It was previously assumed that rhythm could not be taught; this idea is naturally based on the original postulation of Kenneth Pike that rhythm was defined as equal divisions of time at certain points in a given language, and that as humans we were presumably not conscious (nor in control) of timing between syllables, stress peaks or moras. However, through the years it has become ever more clear that rhythm happens at the syllabic level and is directly affected by how consonants and vowels are produced. As a result, it can be hypothesized that rhythm in fact can be taught and learned. While undoubtedly this would be more useful in an L2 classroom (or in a beginning heritage classroom where many students are receptively bilingual but do not produce the language themselves), the ability to teach a more native-like rhythm as a byproduct of a more native-like production of consonants and vowels could well serve heritage bilinguals in professions such as newscasting, which often requires monolingual native speakers to take diction classes to neutralize their accents.

The newfound possibilities could have major implications in both the fields of teaching Spanish (or any language) as a heritage language, or even as a second language. In the world of teaching and learning a second language, one of the overarching goals is intelligibility in the language. However, pronunciation often takes a backseat to other language aspects such as grammar and lexicon and is not stressed except as it relates to intelligibility. However, phonology is not inconsequential for language learners. After all,

it is not uncommon for a person to judge another for how the way the pronounce a language deviates from the 'norm'. This could help second language learners as they acquire an additional language and use it in their personal and professional lives. If improved pronunciation of segmental characteristics of a language (for example) could indeed affect the overall rhythm of a speaker's linguistic production, it could be used in practice in the classroom to help second language learners reach the next level of language fluency as perceived by native speakers.

With respect to teaching phonology to heritage speakers, there is likely to be some debate as to whether or not trying to change how they pronounce Spanish would be the same as trying to "fix" an aspect of their language that is "broken." This is a concern that should always be addressed. In this regard, it would be imperative to consider critical language pedagogy when deciding if phonological instruction is important in the heritage language classroom.

In 1997, Guadalupe Valdés proposed four specific goals for teaching Spanish to Heritage Speakers: to promote Spanish maintenance among U.S.Latinos; to help students acquire the prestige variety of the Spanish language; to expand the bilingual range of said speakers to include more formal registers; and to build literacy skills in Spanish. This was a paradigm shift away from the previous goals of "fixing" the way heritage speakers spoke Spanish.

Valdés' idea has been further developed over the years, and is now referred to as critical language pedagogy, which aims to welcome the home varieties of these speakers into the classroom (Leeman 2005). According to Leeman, previous "expansionist" approaches to teaching Spanish a heritage language that focused on prestige varieties ran

the risk of eradicating the students' home dialects. Critical language pedagogy seeks to avoid home dialect erosion, while exploring the

> "possibility of resisting both micro- and macro-level hierarchies which stigmatize those features, as well as the potential for using stigmatized language and varieties for positive effects. In other words, key objectives for critical SNS pedagogy, in addition to awareness of formal features and sociolinguistic principles, are an understanding of the linguistic subordination of groups and the recognition of students' own choices to either conform with or to contest sociolinguistic conventions both in their own interactions and in society at large" (Leeman, p. 41).

This concept is typically applied to the areas of linguistics that are more commonly addressed in heritage language study- production on the lexical, morphological, semantic, pragmatic and syntactic levels. However, the same can and should apply for the phonological aspects of a language. Take, for example, a heritage speaker of Cuban Spanish. Cuban Spanish is known for various marked phonological features: syllable-final and word-final /n/ is often velarized to [ŋ]; the trill /r/ is often devoiced; and /l/ and /ɾ/ are often neutralized or geminated in Cuban Spanish, depending upon their position in a syllable as well (Lipski, 2009). If a Cuban-American speaker of Spanish as a heritage language were to apply for a job in another Spanish-speaking country, or even within the United States, it is possible that they may be turned away or chastised for having an accent that deviates from the "norm." Critical language pedagogy would call for the student to understand language prestige and discrimination, while providing an opportunity for them to acquire an accent that is considered more "neutral" and that

would at minimum allow them to have the choice to use it in specific contexts, and understand why.

5.4 LIMITATIONS OF STUDY

This study, while informative, also had several limitations that could have improved the results and subsequent interpretation. First and foremost, the tedious nature of measuring hundreds of interval durations in one or two languages for each speaker puts a strain on one's ability to include data from a larger sample size. While the data here was calculated based on tens of thousands of total measured durations, the time it took to do so did not allow for more subjects to be included. In the future, perhaps with more intelligent software or some assistance with durational measurements, it would be favorable to repeat the study with a bigger population.

A second limitation of the study involves the nature of the speech samples. Most rhythm studies that have been conducted in one language have required the participants to read a passage so that their utterances are lexically uniform. This presents a problem with respect to bilingual students at the lower end of the bilingual continuum, as Spanish-language literacy is not a skill that has been fully developed (if at all) among these speakers. As such, it was important to choose a task that would allow for open speech on a topic that was easy enough for even the speakers on the lower end of the Spanish language dominance continuum. The benefit of a guided speech activity such as this is that it more closely represented natural speech than reading would; however, doing so did not allow for complete control of the variation in word choice, sentence structure and other factors that would otherwise be helpful to control.

A third limitation of the study is related to the speech task. While the Pairwise Variability Index is the most commonly used rhythm metric and allows for different types of utterances to be analyzed, there are other well-established metrics like %V and %C mentioned in the third chapter that require speech samples to be identical so that the ratio of vocalic to intervocalic intervals can be faithfully determined.

An additional limitation of this study was the decision to not include a group of monolingual English speakers. Having a group of monolingual Spanish speakers who speak roughly the same variety as the late and heritage bilingual participants in this group allowed for some comparison of how "native" a bilingual sounds depending upon his or her language dominance; however, the lack of a monolingual English speaking group did not allow for the same comparison of the English rhythms. In future studies, the monolingual English group that was included in the pilot study should be included in the larger study as well.

5.5 Future Studies

This study has provided some very useful and interesting information as it pertains to the rhythmic production of speakers of Spanish as a heritage language. Furthermore, it has opened the doors to many possibilities for future investigations.

One potential future study would be to research other varieties of Spanish in contact with other varieties of English to see exactly how certain dialects respond in contact with other ones. This would require a large-scale data collection across the United States where large populations of people that speak similar dialects reside. For example, that could include samples of Cuban and Puerto Rican varieties in Florida; Puerto Rican and Dominican varieties in the Northeast; Central American varieties in the western

region such as California; as well as additional studies on Mexican Spanish in the South/Southwest and the Midwest. A study of this nature could inform the field of prosodic phonology in such a way that we could understand if there are certain tendencies that occur between language varieties that contain certain characteristics. For example, how would a geminated /ɾ/ in a Caribbean dialect interact with the oft neutralized word-final / ɹ / in the English of the Northeast?

By the same token, an additional future study that would be of use would be to conduct rhythm testing on other monolingual varieties of Spanish to understand where they tend to lay on the rhythm continuum. As an example of how they can vary from one variety to the next, in certain Caribbean varieties of Spanish there is a tendency to glide coda liquids: *mujer<mujei*, *salga<saiga.* These changes would affect the calculation of an nPVI metric, because the coda liquids that have been pronounced as glides would extend the measured vocalic interval and shorten (or even eliminate) the subsequent intervocalic interval.. At present there are not many studies on monolingual Spanish that use the same instruments and the same rhythm metrics, without which it becomes difficult to understand where each of these varieties exists on the continuum relative to one another.

A second possible study would be an empirical study to understand whether explicit phonetic instruction in the classroom can affect the overall Index of Durational Variability (rhythm) of the Spanish of heritage language speakers., or even L2 speakers of Spanish. Lord and Harrington (2013) found that explicit instruction (manner and place of articulation of certain sounds) in classes in Spanish as a Second Language drastically improved the pronunciation of Spanish language learners in comparison to the control

group that did not receive the same level of instruction. Given what we know about how rhythm is manifested in terms of durational variation, odds are that similar results would be obtained in a heritage language classroom. However, given the implicit knowledge with which the heritage speakers arrive in the classroom, it may prove to be more difficult given the previous existence of natural tendencies in their heritage language. Furthermore, studies should be conducted in the L2 classroom to determine if said explicit instruction would have an effect on the IDV as a whole instead of individual sounds.

A third future area of study would involve perception tasks to try and identify at which point on the IDV continuum does one truly sound "native." Such knowledge would allow for the quantification of language fluency at the phonological level and provide a numerical target by which phonological fluency could be evaluated.

Still another area for future research would evaluate language rhythm when a speaker is discussing certain topics. As an example, perhaps a heritage speaker of Spanish may speak more fluidly on a topic with which he or she is most comfortable conversing in Spanish – such as home, family, or work-related themes. However, within a different topic such as science, celebrities, money-related themes perhaps the rhythm production changes as a speaker associates different registers with particular topics of discussion.

The field of rhythm in language, particularly as it pertains to multilingualism and languages in contact is wide open for future studies. In particular, phonology in the context of speakers of Spanish as a heritage language continues to provide opportunities for studies that will not only help us better understand heritage speakers of Spanish, but

also provide them with additional tools they can use when they use Spanish in contexts outside of the school or home.

APPENDIX A

DATOS DEL HABLANTE

Nombre: _____

Dirección: _____

_____

Teléfono: _____ Fecha de nacimiento: _____

Ocupación: _____

_____

Instituciones donde ha estudiado: _____

_____

_____

_____

Ultimo año cursado: _____

_____

¿Habla otras lenguas (cuáles)? : _____

_____

Ciudades donde ha vivido:

Ciudad	Desde - hasta
_____	
_____	
_____	
_____	

Países visitados:

País	Cuanto tiempo
_____	

_____

Comentarios:

Variables sociales a considerar

Sexo: hombre, mujer
Edad: 15-29, 30-59, 60→
Educ: 6 o menos, 7-12, 2 años de universidad o más
Clase social:
Ciudad:
País:
Etc.

APPENDIX B

Bilingual Language Profile: English-Spanish

We would like to ask you to help us by answering the following questions concerning your language history, use, attitudes, and proficiency. This survey was created with support from the Center for Open Educational Resources and Language Learning at the University of Texas at Austin to better understand the profiles of bilingual speakers in diverse settings with diverse backgrounds. The survey consists of 19 questions and will take less than 10 minutes to complete. This is not a test, so there are no right or wrong answers. Please answer every question and give your answers sincerely. Thank you very much for your help.

I. Biographical Information

Name _____ Today's Date ____/____/____

Age____ ☐Male / ☐Female Current place of residence: city/state_____ country_____

Highest level of formal education: ☐ Less than high school ☐ High school ☐ Some college ☐ College (B.A., B.S.) ☐ Some graduate school ☐ Masters ☐ PhD/MD/JD ☐ Other: _____

Please cite as :
Birdsong, D., Gertken, L.M., & Amengual, M. *Bilingual Language Profile: An Easy-to-Use Instrument to Assess Bilingualism*. COERLL, University of Texas at Austin. Web. 20 Jan. 2012. <https://sites.la.utexas.edu/bilingual/>.

II. Language history

In this section, we would like you to answer some factual questions about your language history by placing a check in the appropriate box.

1. At what age did you **start learning** the following languages?

English

☐ Since birth ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10 ☐ 11 ☐ 12 ☐ 13 ☐ 14 ☐ 15 ☐ 16 ☐ 17 ☐ 18 ☐ 19 ☐ 20+

Spanish

☐ Since birth ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10 ☐ 11 ☐ 12 ☐ 13 ☐ 14 ☐ 15 ☐ 16 ☐ 17 ☐ 18 ☐ 19 ☐ 20+

2. At what age did you **start to feel comfortable** using the following languages?

English

☐ As early as I can remember ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10 ☐ 11 ☐ 12 ☐ 13 ☐ 14 ☐ 15 ☐ 16 ☐ 17 ☐ 18 ☐ 19 ☐ 20+ ☐ not yet

Spanish

☐ As early as I can remember ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10 ☐ 11 ☐ 12 ☐ 13 ☐ 14 ☐ 15 ☐ 16 ☐ 17 ☐ 18 ☐ 19 ☐ 20+ ☐ not yet

3. How many years of **classes (grammar, history, math, etc.)** have you had in the following languages (primary school through university)?

English

☐ 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10 ☐ 11 ☐ 12 ☐ 13 ☐ 14 ☐ 15 ☐ 16 ☐ 17 ☐ 18 ☐ 19 ☐ 20+

Spanish

☐ 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10 ☐ 11 ☐ 12 ☐ 13 ☐ 14 ☐ 15 ☐ 16 ☐ 17 ☐ 18 ☐ 19 ☐ 20+

4. How many years have you spent in a **country/region** where the following languages are spoken?

English

☐ 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10 ☐ 11 ☐ 12 ☐ 13 ☐ 14 ☐ 15 ☐ 16 ☐ 17 ☐ 18 ☐ 19 ☐ 20+

Spanish

☐ 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10 ☐ 11 ☐ 12 ☐ 13 ☐ 14 ☐ 15 ☐ 16 ☐ 17 ☐ 18 ☐ 19 ☐ 20+

5. How many years have you spent in a **family** where the following languages are spoken?

English

☐ 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10 ☐ 11 ☐ 12 ☐ 13 ☐ 14 ☐ 15 ☐ 16 ☐ 17 ☐ 18 ☐ 19 ☐ 20+

Spanish

☐ 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10 ☐ 11 ☐ 12 ☐ 13 ☐ 14 ☐ 15 ☐ 16 ☐ 17 ☐ 18 ☐ 19 ☐ 20+

6. How many years have you spent in a **work environment** where the following languages are spoken?

English

☐ 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10 ☐ 11 ☐ 12 ☐ 13 ☐ 14 ☐ 15 ☐ 16 ☐ 17 ☐ 18 ☐ 19 ☐ 20+

Spanish

☐ 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10 ☐ 11 ☐ 12 ☐ 13 ☐ 14 ☐ 15 ☐ 16 ☐ 17 ☐ 18 ☐ 19 ☐ 20+

III. Language use

In this section, we would like you to answer some questions about your language use by placing a check in the appropriate box. Total use fo
all languages in a given question should equal 100%.

7. In an average week, what percentage of the time do you use the following languages **with friends**?

	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
English	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Spanish	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Other languages	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

8. In an average week, what percentage of the time do you use the following languages **with family**?

	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
English	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Spanish	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Other languages	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

9. In an average week, what percentage of the time do you use the following languages **at school/work**?

	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
English	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Spanish	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Other languages	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

10. When you talk to yourself, how often do you **talk to yourself** in the following languages?

	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
English	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Spanish	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Other languages	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

11. When you count, how often do you **count** in the following languages?

	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
English	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Spanish	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Other languages	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

IV. Language proficiency
In this section, we would like you to rate your language proficiency by giving marks from 0 to 6.

	0=not well at all						*6=very well*
12. a. How well do you speak **English**?	☐0	☐1	☐2	☐3	☐4	☐5	☐6
b. How well do you speak **Spanish**?	☐0	☐1	☐2	☐3	☐4	☐5	☐6
13. a. How well do you understand **English**?	☐0	☐1	☐2	☐3	☐4	☐5	☐6
b. How well do you understand **Spanish**?	☐0	☐1	☐2	☐3	☐4	☐5	☐6
14. a. How well do you read **English**?	☐0	☐1	☐2	☐3	☐4	☐5	☐6
b. How well do you read **Spanish**?	☐0	☐1	☐2	☐3	☐4	☐5	☐6
15. a. How well do you write **English**?	☐0	☐1	☐2	☐3	☐4	☐5	☐6
b. How well do you write **Spanish**?	☐0	☐1	☐2	☐3	☐4	☐5	☐6

V. Language attitudes
In this section, we would like you to respond to statements about language attitudes by giving marks from 0-6.

	0=disagree						*6=agree*
16. a. I feel like myself when I speak **English**.	☐0	☐1	☐2	☐3	☐4	☐5	☐6
b. I feel like myself when I speak **Spanish**.	☐0	☐1	☐2	☐3	☐4	☐5	☐6
17. a. I identify with an **English-speaking** culture.	☐0	☐1	☐2	☐3	☐4	☐5	☐6
b. I identify with a **Spanish-speaking** culture.	☐0	☐1	☐2	☐3	☐4	☐5	☐6
18. a. It is important to me to use (or eventually use) **English** like a native speaker.	☐0	☐1	☐2	☐3	☐4	☐5	☐6
b. It is important to me to use (or eventually use) **Spanish** like a native speaker.	☐0	☐1	☐2	☐3	☐4	☐5	☐6
19. a. I want others to think I am a native speaker of **English**.	☐0	☐1	☐2	☐3	☐4	☐5	☐6
b. I want others to think I am a native speaker of **Spanish**.	☐0	☐1	☐2	☐3	☐4	☐5	☐6

Bilingual Language Profile: Spanish-English

Nos gustaría pedir su ayuda para contestar a las siguientes preguntas sobre su historial lingüístico, uso, actitudes y competencia. Esta encuesta ha sido creada con el apoyo del 'Center for Open Educational Resources and Language Learning' de la Universidad de Texas en Austin para poder tener un mayor conocimiento sobre los perfiles de hablantes bilingües independientemente de sus diversos orígenes y en diferentes contextos. La encuesta contiene 19 preguntas y le llevará menos de 10 minutos para completar. Esto no es una prueba, por tanto no hay respuestas correctas ni incorrectas. Por favor conteste cada pregunta y responda con sinceridad, ya que solamente así se podrá garantizar el éxito de esta investigación. Muchas gracias por su ayuda.

I. Información biográfica

Nombre _____ Fecha de hoy ____/____/____

Edad____ ☐ Hombre / ☐ Mujer Lugar de residencia actual: ciudad_____ País_____

Nivel más alto de formación académica: ☐ Menos de la escuela secundaria ☐ Escuela Secundaria
☐ Un poco de universidad ☐ Universidad (diplomatura, licenciatura.)
☐ Un poco de escuela graduada ☐ Máster
☐ Doctorado ☐ Otra: _____

Please cite as :
Birdsong, D., Gertken, L.M., & Amengual, M. *Bilingual Language Profile: An Easy-to-Use Instrument to Assess Bilingualism*. COERLL, University of Texas at Austin. Web. 20 Jan. 2012. <https://sites.la.utexas.edu/bilingual/>.

II. Historial lingüístico
En esta sección, nos gustaría que contestara algunas preguntas sobre su historial lingüístico marcando la casilla apropiada.

1. ¿A qué edad **empezó a aprender** las siguientes lenguas?

Español
☐ Desde el Nacimiento ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10 ☐ 11 ☐ 12 ☐ 13 ☐ 14 ☐ 15 ☐ 16 ☐ 17 ☐ 18 ☐ 19 ☐ 20+

Inglés
☐ Desde el Nacimiento ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10 ☐ 11 ☐ 12 ☐ 13 ☐ 14 ☐ 15 ☐ 16 ☐ 17 ☐ 18 ☐ 19 ☐ 20+

2. ¿A qué edad **empezó a sentirse cómodo** usando las siguientes lenguas?

Español
☐ Tan pronto como recuerdo ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10 ☐ 11 ☐ 12 ☐ 13 ☐ 14 ☐ 15 ☐ 16 ☐ 17 ☐ 18 ☐ 19 ☐ 20+ ☐ aún no

Inglés
☐ Tan pronto como recuerdo ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10 ☐ 11 ☐ 12 ☐ 13 ☐ 14 ☐ 15 ☐ 16 ☐ 17 ☐ 18 ☐ 19 ☐ 20+ ☐ aún no

3. ¿Cuántos años de **clases (gramática, historia, matemáticas, etc.)** ha tenido en las siguientes lenguas (desde la escuela primaria a la universidad)?

Español
☐ 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10 ☐ 11 ☐ 12 ☐ 13 ☐ 14 ☐ 15 ☐ 16 ☐ 17 ☐ 18 ☐ 19 ☐ 20+

Inglés
☐ 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10 ☐ 11 ☐ 12 ☐ 13 ☐ 14 ☐ 15 ☐ 16 ☐ 17 ☐ 18 ☐ 19 ☐ 20+

4. ¿Cuántos años ha pasado en un **país/región** donde se hablan las siguientes lenguas?

Español
☐ 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10 ☐ 11 ☐ 12 ☐ 13 ☐ 14 ☐ 15 ☐ 16 ☐ 17 ☐ 18 ☐ 19 ☐ 20+

Inglés
☐ 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10 ☐ 11 ☐ 12 ☐ 13 ☐ 14 ☐ 15 ☐ 16 ☐ 17 ☐ 18 ☐ 19 ☐ 20+

5. ¿Cuántos años ha pasado en **familia** hablando las siguientes lenguas?

Español
☐ 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10 ☐ 11 ☐ 12 ☐ 13 ☐ 14 ☐ 15 ☐ 16 ☐ 17 ☐ 18 ☐ 19 ☐ 20+

Inglés
☐ 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10 ☐ 11 ☐ 12 ☐ 13 ☐ 14 ☐ 15 ☐ 16 ☐ 17 ☐ 18 ☐ 19 ☐ 20+

6. ¿Cuántos años ha pasado en **un ambiente de trabajo** donde se hablan las siguientes lenguas?

Español
☐ 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10 ☐ 11 ☐ 12 ☐ 13 ☐ 14 ☐ 15 ☐ 16 ☐ 17 ☐ 18 ☐ 19 ☐ 20+

Inglés
☐ 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10 ☐ 11 ☐ 12 ☐ 13 ☐ 14 ☐ 15 ☐ 16 ☐ 17 ☐ 18 ☐ 19 ☐ 20+

III. Uso de lenguas

En esta sección, nos gustaría que contestara algunas preguntas sobre su uso de lenguas marcando la casilla apropiada. El uso total de todas las lenguas en cada pregunta debe llegar al 100%.

7. En una semana normal, ¿qué porcentaje del tiempo usa las siguientes lenguas con **sus amigos**?

	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
Español	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Inglés	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Otras lenguas	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

8. En una semana normal, ¿qué porcentaje del tiempo usa las siguientes lenguas con **su familia**?

	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
Español	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Inglés	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Otras lenguas	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

9. En una semana normal, ¿qué porcentaje del tiempo usa las siguientes lenguas en **la escuela/el trabajo**?

	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
Español	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Inglés	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Otras lenguas	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

10. Cuando se habla a usted mismo, ¿con qué frecuencia **se habla a sí mismo** en las siguientes lenguas?

	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
Español	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Inglés	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Otras lenguas	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

11. Cuando hace cálculos contando, ¿con qué frecuencia **cuenta** en las siguientes lenguas?

	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
Español	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Inglés	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Otras lenguas	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

IV. Competencia
En esta sección, nos gustaría que considerara su competencia de lengua marcando la casilla de 0 a 6.

0=no muy bien *6=muy bien*

12. a. ¿Cómo habla en **Español**? ☐0 ☐1 ☐2 ☐3 ☐4 ☐5 ☐6

b. ¿Cómo habla en **Inglés**? ☐0 ☐1 ☐2 ☐3 ☐4 ☐5 ☐6

13. a. ¿Cómo entiende en **Español**? ☐0 ☐1 ☐2 ☐3 ☐4 ☐5 ☐6

b. ¿Cómo entiende en **Inglés**? ☐0 ☐1 ☐2 ☐3 ☐4 ☐5 ☐6

14. a. ¿Cómo lee en **Español**? ☐0 ☐1 ☐2 ☐3 ☐4 ☐5 ☐6

b. ¿Cómo lee en **Inglés**? ☐0 ☐1 ☐2 ☐3 ☐4 ☐5 ☐6

15. a. ¿Cómo escribe en **Español**? ☐0 ☐1 ☐2 ☐3 ☐4 ☐5 ☐6

b. ¿Cómo escribe en **Inglés**? ☐0 ☐1 ☐2 ☐3 ☐4 ☐5 ☐6

V. Actitudes
En esta sección, nos gustaría que contestara a las siguientes afirmaciones sobre actitudes lingüísticas marcando las casillas de 0 a 6.

0=no estoy de acuerdo *6=estoy de acuerdo*

16. a. Me siento "yo mismo" cuando hablo en **Español**. ☐0 ☐1 ☐2 ☐3 ☐4 ☐5 ☐6

b. Me siento "yo mismo" cuando hablo en **Inglés**. ☐0 ☐1 ☐2 ☐3 ☐4 ☐5 ☐6

17. a. Me identifico con una cultura **Hispanohablante**. ☐0 ☐1 ☐2 ☐3 ☐4 ☐5 ☐6

b. Me identifico con una cultura **Anglohablante**. ☐0 ☐1 ☐2 ☐3 ☐4 ☐5 ☐6

18. a. Es importante para mi usar (o llegar a usar) **Español** como un hablante nativo. ☐0 ☐1 ☐2 ☐3 ☐4 ☐5 ☐6

b. Es importante para mi usar (o llegar a usar) **Inglés** como un hablante nativo. ☐0 ☐1 ☐2 ☐3 ☐4 ☐5 ☐6

19. a. Quiero que los demás piensen que soy un hablante nativo de **Español**. ☐0 ☐1 ☐2 ☐3 ☐4 ☐5 ☐6

b. Quiero que los demás piensen que soy un hablante nativo de **Inglés**. ☐0 ☐1 ☐2 ☐3 ☐4 ☐5 ☐6

Appendix C: Individual Results

Monolingual Spanish Results: Individual and Group Average

Speaker	nPVI-CV	nPVI-C	nPVI-V	BLP
MONO1	57	51	55	-61
MONO2	57	57	65	-168
MONO3	52	56	48	-90
MONO4	57	63	58	-111
MONO5	58	59	56	-60
MONO6	58	57	52	-80
MONO7	62	64	58	-72
MONO8	49	48	59	-136
MONO9	49	49	63	-102
MONO10	52	58	48	-123
N	**10**	**10**	**10**	**10**
MEAN	**55.1**	**56.2**	**56.2**	**-100.3**
VARIANCE	**18.76667**	**29.51111**	**32.4**	**1219.78889**
STD. DEV.	**4.33205**	**5.43241**	**5.6921**	**34.92548**

Beginning Bilingual English Results: Individual and Group Average

Speaker	nPVI-CV	nPVI-C	nPVI-V	BLP
BEG1	69	71	73	63
BEG2	74	85	78	99
BEG3	71	75	71	87
BEG4	72	75	76	138

BEG5	73	70	81	63
N	**5**	**5**	**5**	**5**
MEAN	**71.8**	**75.2**	**75.8**	**90**
VARIANCE	**3.7**	**35.2**	**15.7**	**963**
STD. DEV.	**1.92354**	**5.93296**	**3.96232**	**31.03224**

Beginning Bilingual Spanish Results: Individual and Group Average

Speaker	nPVI-CV	nPVI-C	nPVI-V	BLP
BEG1	67	73	75	63
BEG2	72	84	79	99
BEG3	71	71	76	87
BEG4	69	74	76	138
BEG5	69	83	79	63
N	**5**	**5**	**5**	**5**
MEAN	**69.6**	**77**	**77**	**90**
VARIANCE	**3.8**	**36.5**	**3.5**	**963**
STD. DEV.	**1.94936**	**6.04152**	**1.87083**	**31.03224**

Intermediate Bilingual English Results: Individual and Group Average

Speaker	nPVI-CV	nPVI-C	nPVI-V	BLP
INT1	63	70	69	54
INT2	66	63	74	32
INT3	63	65	71	55
INT4	66	67	74	60

INT5	60	64	67	49
N	**5**	**5**	**5**	**5**
MEAN	**63.6**	**65.8**	**71**	**50**
VARIANCE	**6.3**	**7.7**	**9.5**	**116.5**
STD. DEV.	**2.50998**	**2.77489**	**3.08221**	**10.79352**

Intermediate Bilingual Spanish Results: Individual and Group Average

Speaker	nPVI-CV	nPVI-C	nPVI-V	BLP
INT1	62	65	68	54
INT2	56	47	55	32
INT3	54	58	61	55
INT4	63	65	68	60
INT5	57	62	60	49
N	**5**	**5**	**5**	**5**
MEAN	**58.4**	**59.4**	**62.4**	**50**
VARIANCE	**15.3**	**56.3**	**31.3**	**116.5**
STD. DEV.	**3.91152**	**7.50333**	**5.59464**	**10.79352**

Advanced Bilingual English Results: Individual and Group Average

Speaker	nPVI-CV	nPVI-C	nPVI-V	BLP
ADV1	74	67	70	31
ADV2	67	68	73	25
ADV3	61	61	69	-48
ADV4	63	73	74	38

ADV5	69	72	71	11
N	**5**	**5**	**5**	**5**
MEAN	**66.8**	**68.2**	**71.4**	**11.4**
VARIANCE	**26.2**	**22.7**	**4.3**	**1201.3**
STD. DEV.	**5.11859**	**4.76445**	**2.07364**	**34.65977**

Advanced Bilingual Spanish Results: Individual and Group Average

Speaker	nPVI-CV	nPVI-C	nPVI-V	BLP
ADV1	56	57	53	31
ADV2	51	47	50	25
ADV3	48	54	51	-48
ADV4	54	58	50	38
ADV5	49	56	48	11
N	**5**	**5**	**5**	**5**
MEAN	**51.6**	**54.4**	**50.4**	**11.4**
VARIANCE	**11.3**	**19.3**	**3.3**	**1201.3**
STD. DEV.	**3.36155**	**4.39318**	**1.81659**	**34.65977**

Late Bilingual English Results: Individual and Group Average

Speaker	nPVI-CV	nPVI-C	nPVI-V	BLP
LBL1	56	64	62	-27
LBL2	50	57	56	-115
LBL3	61	64	63	-118
LBL4	60	73	63	-48
LBL5	64	58	67	-70
N	**5**	**5**	**5**	**5**

MEAN	**58.2**	**63.2**	**62.2**	**-75.6**
VARIANCE	**29.2**	**40.7**	**15.7**	**1626.3**
STD. DEV.	**5.4037**	**6.37966**	**3.96232**	**40.32741**

Late Bilingual Spanish Results: Individual and Group Average

Speaker	nPVI-CV	nPVI-C	nPVI-V	BLP
LBL1	58	55	67	-27
LBL2	57	62	56	-115
LBL3	61	62	67	-118
LBL4	58	65	64	-48
LBL5	54	56	60	-70
N	**5**	**5**	**5**	**5**
MEAN	**57.6**	**60**	**62.8**	**-75.6**
VARIANCE	**6.3**	**18.5**	**22.7**	**1626.3**
STD. DEV.	**2.50998**	**4.30116**	**4.76445**	**40.32741**

Appendix D: Summary of Statistical Results

Tukey HSD Results, BLP

	Q statistic	p-value	inference
MONO vs. BEG	15.0615	0.0010053	**p<.01
MONO vs. INT	11.8957	0.0010053	**p<.01
MONO vs. ADV	8.8406	0.0010053	**p<.01
MONO vs. LBL	1.9549	0.6281406	**insignificant**
BEG vs. INT	2.7417	0.3239815	**insignificant**
BEG vs. ADV	5.3875	0.0065901	**p<.01
BEG vs. LBL	11.3507	0.0010053	**p<.01
INT vs. ADV	2.6457	0.3587019	**insignificant**
INT vs. LBL	8.609	0.0010053	**p<.01

ADV vs. LBL	5.9632	0.0024073	**p<.01

Significance Among Groups, All Metrics

GROUP	nPVI-CV	nPVI-C	nPVI-V
MONO vs. BEG			
MONO vs. INT			
MONO vs. ADV			
MONO vs. LBL			
BEG vs. INT			
BEG vs. ADV			
BEG vs. LBL			
INT vs. ADV			
INT vs. LBL			
ADV vs. LBL			

Significant differences are highlighted in green, and insignificant differences are indicated in red:

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