

PROSODIC DIFFERENCES BETWEEN ENGLISH MONOLINGUALS AND
SPANISH-ENGLISH BILINGUALS

by

Eduardo E. Hernandez, B.S.

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Committee Members:

Kristen Tooley, Chair

Jennifer M. Clegg

Peter Golato

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LIST OF ABBREVIATIONS

Abbreviation	Description
IPB	Intonational Phrase Boundary
MINT	Multi-Lingual Naming Test
MELICET	Michigan English Language Institute College English Test
DELE	Diplomas de Español como Lengua Extranjera

ABSTRACT

The assumption of an individual that speaks two languages equally is no longer sufficient and thus there are other factors that must be considered. Prosody refers to acoustic-phonetic properties of a word, or statement, over large chunks of speech production. Additionally, it can also serve as a signal, or cue, to the listener from the speaker that may provide aid necessary for language comprehension. For instance, Intonational Phrases Boundaries (IPBs) are pauses in speech used to separate the sentence into different groups of words so the listener can clarify the syntax intended by the speaker. When presented with certain types of syntactic ambiguity, an instance where a sentence may be interpreted in more than one way due to ambiguous sentence structure, the listener is sometimes able use Intonational Phrase Boundaries, or pause during speech, to resolve the ambiguity of a relative clause (Jun, 2003). Similarly, speech rate is another aspect of prosody that can provide the listener with cues such as the speaker's emotional state such as stress, anger, and exhaustion. The current study determined whether the prosody used by Spanish-English bilinguals varies due to their proficiency in Spanish. The experiment tested whether speakers would produce a pause when prompted to produce syntactically structured high/low attachment sentences as well as evaluating whether bilinguals spoke at a faster rate than monolinguals. All participants partook in a recorded dialogue with the experimenter, a sentence task, three language proficiency assessments, and a language history questionnaire. Overall, there were no real differences between monolingual and bilinguals' speakers in terms of the way they produce pause when presented with sentences of high and low attachment interpretation. Additionally, there were no real differences between languages groups for three out of the four language proficiency assessments that were administered. The DELE assessment did show a difference between language groups with bilingual speakers showing a higher level of proficiency in Spanish than monolingual speakers, which was expected. Lastly, measures of speaking rate did not reveal differences between language groups.

Nevertheless, there was a trend where bilinguals tended to produce more pauses when compared to monolingual speakers, which suggested that with fewer limitations and a larger sample size would reveal more significant differences.

I. BACKGROUND INFORMATION

Bilingualism

Bilingualism is a difficult construct to define. The most common and mainstream definition where an individual is able to speak both languages with equal proficiency, is no longer sufficient. There are several factors that one must account for when determining an appropriate operational definition depending on the context and background of the individual. According to Grosjean (1989), one cannot simply define bilinguals as those who can speak two languages equally well. This definition isn't enough since it does not account for a number of central factors such as proficiency (ability to speak in language), fluency (speaking freely/easily without unnecessary pauses), age of acquisition, social functions, communication competence, among others (Grosjean, 1989). All these factors must be considered to appropriately define what it means to be a bilingual, since some speakers are able to communicate in a second language but are not a fluent speaker. Perhaps, the individual only uses the second language in a professional setting and speaks in his native language, or first language, at home. Additionally, there are several levels of language processing such as the semantic, lexical, and phonological components of language. For bilingual speakers, this may suggest an integrated language processing system where both languages are co-activated and thus both are represented during language processing.

Bilinguals possess a lexicon (mental dictionary) for both of their languages. One mental lexicon stores all the words of one language and another one for the words in the other language (Desmet & Duyck, 2007). However, there is not a clear explanation on

whether these lexicons are separated or integrated with each other. A previous study found that a word's neighborhood size will impact the speed at which a word is read (Van Heuven, Dijkstra, & Grainger, 1998). A word's neighborhood size refers to the amount of words that can be created by replacing one letter of that word and generating a new word from it. For instance, the word "lamp" can be changed into "lamb" or "camp." The more words that can be generated, the larger the neighborhood size of the word, and some words have larger neighborhood sizes than others. Van Heuven et al. (1998)'s experiment focused on word recognition tasks administered to bilingual speakers. The results of the experiment suggested that the response time was influenced by the neighborhood size of both languages, which can be an indication of the activation of both lexical representations between the two languages. This interaction at the lexical level of processing provides evidence that the two languages are perhaps both active during processing instead of the previous theory that one language system would be suppressed while the other is used.

Current models of bilingual language processing do offer some insights into the differences between speakers. The *Bilingual Interactive Activation Model* (Dijkstra, Grainger, & van Heuven, 1999) depicts the lexicon words of one language and the words of the second language into one integrated lexicon, where word recognition appears to be non-selective of language since bilinguals possess two different representations for the lexicon, one from each language, that compete during processing. Also, although this model has been particularly successful in providing insight into the linguistic representations across bilinguals, the model only accounts for lexical representations

leaving the nature of phonological and semantic representations unaccounted for.

Another way to understand the differences in linguistic representations between bilingual speakers is to examine the *Revised Hierarchical Model* (Kroll & Sholl, 1992), a prominent model in bilingualism memory. This model was developed to illustrate the interactive relationship between the lexicons and semantic concepts in bilingual speakers (Basnight-Brown, 2014). For instance, semantic representations do not tend to vary across languages; thus, concepts remain consistent (Desmet & Duyck, 2007). Based on the assumption that proficiency in their respective language differs, the Revised Hierarchical Model illustrates bilinguals' lexicon of the first language as bigger than the second language. However, the problem of the model lies in assuming that the connection between lexicons rest on the individual's fluency in each of their languages, as this assumption has been contradicted by past studies. The premise was that words from the speaker's second language are exclusively stored within the lexicon of the second language. However, a new paradigm suggests that the words from the second language can be stored with both a lexical and semantic representation of the word if the grammar, meaning, and context were all emphasized (Basnight-Brown, 2014).

Additionally, there have been results showing differences in phonological representations across bilinguals. Jared and Kroll (2001) tested English and French bilinguals in a word naming task. The results from the study revealed that participants were slower to pronounce words in their second language when a part of that word could be pronounced differently in their native language. For instance, participants were slower to pronounce the word "bait" instead of the word "bump." The sound for "ait" is

pronounced differently in French than in English so this might have led to the delay in pronouncing the word. In contrast, the sound for “ump” does not exist in French, so pronunciation was not delayed (Jared & Kroll, 2001). This delay in response suggests that phonological, lexical representations from both languages can be accessed during processing. Similarly, Haigh and Jared (2007) tested the activation of phonological representation in bilinguals during a lexical decision task. This task had participants read and decide on whether a word was a real word or not in their language. The experiment mixed homophones (words that sound the same), pseudohomophones (non-words that could be pronounced in the language), cognates (words with the same meaning), and homographs (words that are spelled the same, but have different meanings) with the target words. The results from the study showed that participants can be both selective and non-selective when it comes to activation of phonological representations. Specifically, the results indicated that participants could activate representations from both languages, but it is dependent on their proficiency and responses. When lexical decisions are made in their dominant language, defined as their first language, participants also activate the lexical-phonetic responses in their dominant language. However, when participants made lexical decisions in their non-dominant languages, they activated lexical-phonetic responses from both languages. This highlights the influential role of proficiency in bilingual language processing.

Additionally, foreign accents are indicative of a phonological representation of both languages where the native language is actively affecting the other (Van Heuven et al., 1998). Therefore, it is not unreasonable to suggest that bilinguals do not possess two

separate language processing systems, but rather one system where both languages are active, present, and frequently influencing each other in a variety of ways. There is a need for the addition of a better designed model for language processing that does not focus primarily on monolinguals, but instead can adequately explain how language processing happens for all speakers across different levels of processing.

Prosody

Currently, researchers are beginning to assume that there is interactive representation and processing in bilingual speakers. Nevertheless, there has not been much research focused on the prosody of bilingual speakers. The term prosody refers to several components of language such as intonation, pitch, intonational breaks, rhythm, emphasis, and pitch accenting (Wagner & Watson, 2010). Furthermore, prosody only refers to acoustic-phonetic properties (sounds) of a word, or statement, and over large chunks of speech production that are separate from the particular phonemes being produced. In other words, prosody refer to *how* something is said, rather than *what* is said. Additionally, prosody is involved with the acoustic signals that serve as cues, or signals, that provide aid in language comprehension necessary to the listener. Jun (2003) summarized that prosody can provide essential cues for the listener to correctly interpret the speaker's meaning and that some of these linguistic representations can be broken into several components For instance, pauses, often referred to as Intonational Phrases Boundaries (IPBs), are pauses in speech used to separate the sentence into different groups of words, which the listener may use to clarify the syntax intended by the speaker (Wagner & Watson, 2010). Similarly, speech rate is another aspect of prosody that can provide the

listener with cues such as the speaker's emotional state such as stress, anger, and exhaustion. This makes prosody an integral part of language that helps the listener with cues that facilitate spoken communication and is highly influential to a listener's interpretation of the speaker.

Nevertheless, as every spoken language possesses prosody, prosody arrangements vary across languages such as differences in the tones, rhythms of speaking, speaking rate, use of high and low tones, etc. Therefore, if prosody differs between languages, then do individuals who speak more than one language possess different prosodic habits than monolingual speakers? Although not all ambiguities can be resolved through prosody, there are still some which can be resolved. For instance, there are cases where a sentence may be interpreted in more than one way due to its ambiguous sentence structure, this type of ambiguity is referred to as syntactic ambiguity. When a listener is faced with this type of ambiguity, they are able to use Intonational Phrase Boundaries, or pauses in speech, to resolve the ambiguity of a relative clause (Jun, 2003). For instance, a stimuli sentence would appear as such with the apostrophe symbol acting as the symbol for the pause:

The doctor examined the son of the librarian 'who reads in the park

In this case, the relative clause "who reads in the park," (using an apostrophe to indicate a pause) could either be referring to the son or the librarian. Thus, how someone interprets a sentence depends on the way they resolve said ambiguity. A pause between the subject of the complex noun phrase, *son of the librarian*, and the relative clause serves as a cue to the syntax of the sentence, which can resolve issues of syntactic

ambiguity. This pause works as a signal from the speaker to the listener that these items do not belong together. The presence of a pause signals to the listener that the relative clause refers to the subject of the complex noun phrase, *the son*, and not an alternative potential subject such as *the librarian*. This is known as high attachment (Carreiras & Clifton, 1999). On the other hand, low attachment is implicated when there is a lack of a pause between the noun and the relative clause, which sends a cue that the relative clause attaches to the most recent noun (Dussias, 2001). However, since these occurrences are more like tendencies rather than requirements, it is not always the case. In other words, speakers will not always produce a pause, or boundary break during such instances.

How someone tends to interpret this type of sentence when the prosody is neutral or not present (such as the sentence is presented visually rather than orally and the individual must read it interprets it silently) has been shown to differ across languages. Carrerias and Clifton (1999) designed three eye-tracking experiments to test attachment preferences between Spanish and English speakers and whether preferences in Spanish are a result of IPBs or the Spanish language. A total of 116 participants were involved in this study, broken down into 44 for Experiment 1, 36 for Experiment 2, and 36 for Experiment 3. They found that when presented with sentences containing syntactic ambiguity (such as the structure explained above) and no pauses, Spanish speakers showed a preference for a high attachment interpretation, while English speakers showed a preference for low attachment. Furthermore, Dussias (2001) reported similar results that support previous findings that English monolinguals show a preference for low attachment. In this study, language proficiency served as a good predictor of attachment

preference. Those who rated their proficiency in Spanish as higher than English showed a preference towards high attachment. On the other hand, those who rated their proficiency in English higher than Spanish showed a preference towards low attachment.

Interestingly, some bilinguals showed mixed preferences between high and low attachment (Dussias, 2001). In other words, some bilinguals showed preference for low attachment while others showed preference for high attachment. Finally, late bilinguals, who acquired second language as adults, showed preference for low attachment whereas early bilinguals, who learned English and Spanish before age 6, showed a preference for high attachment when reading (Dussias, 2001).

A recent study by Fernández (2017) revealed differences in the use of IPBs between Spanish-English bilinguals, Spanish monolinguals, and English monolinguals when producing sentences with this type of ambiguity. The study measured the use of IPBs by manipulating the length and placement of the relative clause. The results for the monolingual groups fit the previous findings of the IPBs. The duration of an intonational pause from the Spanish monolingual group was longer than that of the English group monolingual group. However, the bilinguals that showed less proficiency in Spanish showed prosodic patterns that are consistent with Spanish speakers. This finding suggests that perhaps bilingual groups possess a similar prosodic system as the one used by Spanish monolinguals (Fernández, 2017). Nevertheless, there are several shortcomings to this study such as its small sample size.

According to recent studies, the rate of transmission of information across different languages differs in terms of the relative speed in which information is

verbalized as well as the allowed syllable structures of each language. However, all human languages show that the rate at which information is encoded is similar whenever speaking rate and syllable structures is taken into account. However, English and Spanish appear to vary in the amount of information per syllable that each language manages to convey, with English being able to convey more information (Pellegrino et al. 2011; Coupe et al. 2019). In other words, while some languages may perceptibly be spoken at a different speaking rate than others, the amount of information encoded is actually highly similar.

The results of all these studies show evidence of several different linguistic components interacting at various levels of processing including lexical, semantic, and phonological. In other words, even though there is interactivity in bilingual representation and processing of sounds, words, and syntax, there has been scant evidence for this in use of prosody. Based on other areas of research, there should be similar interactivity for bilinguals, which would suggest that bilinguals will not behave exactly like monolinguals (due to their knowledge of another language's prosody). However, past research has been conducted using a monolingual standard of methods. As bilingualism is a difficult construct to define, it is also a difficult one to define and understand beyond simply speaking a language well enough. The currently proposed study seeks to be a part of a new wave of language research by investigating prosodic differences across languages in monolingual English and bilingual Spanish-English speakers. However, Spanish monolinguals were not accounted for in this study. There is still a lack of research into how bilinguals mentally represent prosody and how they use it in their daily life. The

following study will look at the prosodic differences across monolingual and bilingual speakers to try and find further evidence to support the theory that bilinguals do not have two separate systems, one solely dedicated to their native language and one dedicated to their second language, but they instead have a unified language processing system where there is constant active interaction between both languages.

II. HYPOTHESES

Current Study

The goal of this thesis study was to determine whether the prosody used by someone speaking English varies depending on whether that person also fluently speaks Spanish. However, this study will not only focus on the use of intonational phrase boundaries (IPBs), but also on speaking rate. These are two aspects of prosody that are known to differ across English and Spanish. This study was designed to assess Intonational Phrase Boundaries (IPBs), an aspect of prosody that has been shown to change when individuals are presented with prompts that support the syntax for either high or low attachment sentences, and speaking rate, another aspect of prosody known to differ across languages. Therefore, the experiment was designed to test whether speakers would produce a pause when prompted to produce syntactically structured high/low attachment sentences as well as evaluating whether bilinguals spoke at a faster rate than monolinguals. Accordingly, we decided on the following hypotheses:

1. Bilinguals will be more likely to produce a pause in high attachment syntactic sentences because there is a high-attachment preference in Spanish, and a pause at this location would be consistent with a high-attachment syntactic interpretation.
2. Monolinguals will produce fewer pauses in the low attachment trials since English speakers show a preference for a low attachment interpretation (Fernández, 2017)
3. Bilinguals will speak at a faster rate than monolinguals because Spanish is spoken at a faster speaking rate than English.

III. METHODOLOGY

Design

The current study will use a 2 X 2 mixed factorial design with Language Status (English Monolinguals vs. Spanish-English Bilinguals) and Syntactic Structure (High attachment vs Low attachment) as factors. Language Status served as a between-subjects factor while Syntactic Structure served as a within-subjects factor. The experiment used 40 target sentences mixed, counterbalanced between high and low attachment, along with 40 filler sentences so that the experimental manipulation would appear less obvious to participants.

Participants

There was a total of 51 participants divided into 29 monolingual and 22 Bilingual Speakers. The participants were recruited using the human participants pool, SONA system, of Texas State University. Monolingual speakers were defined as individuals who only speak English, thus are only proficient in one language. Bilingual speakers were titled as “Balanced” Bilingual Speakers, who are defined as individuals who are more proficient in English but can name at least 30 objects in Spanish. The term “Balanced” was used to describe these individuals because it would allow for a more flexible definition to what it means to be a bilingual rather than just stick to the common, mainstream definition of being capable of speaking the language fluently. Additionally, To have a more accurate information on each participant’s language histories, a language history questionnaire was used to assess individual’s proficiency and language acquisition.

Materials

The experiment was designed using the MATLAB computer software and was administered using a Mac Desktop in Dr. Kristen Tooley's research lab. The study used two versions of a list of stimulus sentences. The stimuli lists included five practice trials, 40 target sentences, and 40 filler sentences. The target sentences were further divided into 20 high attachment sentences and 20 low attachment sentences. All sentences that were structured as high attachment in List 1 were changed to low attachment in List 2. Thus, each stimuli list included appropriate stems and prompts such as:

Table 1. *Sample of stimulus sentences, along with stems and the prompts. Also, this table highlights the location of the pause (using an apostrophe) that were measured.*

Target Sentence	The magician surprised the girlfriend of the man who plays guitar in a band.
Stem	The magician surprised the girlfriend of the man
<u>Prompts</u>	
High Attachment:	<u>Researcher prompt:</u> Which man? The one who plays guitar in a band.
Participant:	The magician surprised the girlfriend of the man ‘ who plays guitar in a band.
Low Attachment:	<u>Researcher prompt:</u> Which girlfriend? The one who plays guitar in a band.
Participant:	The magician surprised the girlfriend of the man who plays guitar in a band.

The language proficiency assessments that were administered include the Multi-Lingual Naming Test (MINT; Gollan et al., 2011), the Michigan English Language Institute College English Test (MELICET), and the Diplomas de Español como Lengua Extranjera

(Diplomas of Spanish as a Foreign Language – DELE).

Multi-Lingual Naming Test (MINT)

The MINT is a picture naming task that examines the speaker's vocabulary and semantic concepts in several languages including English, Spanish, Mandarin, and Hebrew. For this study, the assessment was administered in both English and Spanish. The test consists of 68 items featuring a wide variety of objects (e.g. apple, parachute, bed) to balance out the differences between monolingual and bilingual speakers. All participants completed this assessment in both English and Spanish.


Michigan English Language Institute College English Test (MELICET)

The MELICET test is a multiple choice language proficiency assessment designed to examine the participant's knowledge and use of vocabulary, reading, and grammar of the English language. It is divided into two sections. The first section is a fill-in-the-blank section where participants finished the rest of the sentences presented. This section consists of 30 items. The next consists section consist of a paragraph with various blanks for the participant to fill in. This section consists of 20 items.

Diplomas de Español como Lengua Extranjera (DELE)

The DELE is a recognized title of Spanish proficiency granted by Spain's Ministry of Education, Culture and Sport. This title is earned by passing an examination that evaluates the individuals reading, grammar, and vocabulary skills in the Spanish Language. Similar to the MELICET, this assessment is a multiple-choice test consists of three sections, a Text, Vocabulary, and Grammar section. The participants only completed the Text and Grammar section for a total of 40 items.

Table 2. *Language Proficiency Assessments Sample Items*

<p><u>MELICET</u></p>	<p>“What time will we arrive in San Francisco?”</p> <p>“Im not sure, because I don’t know _____ from here.”</p>
<p><u>MINT</u></p>	
<p><u>DELE</u></p>	<p>En la compañía se esta decidiando estos dias si _____</p> <p>nuevos horarios pra los trabajadores.</p>

Procedure

The experimenter greeted each participant and presented them with a consent form to read over and sign. This form explained all the details of the experiments along with any potential risks that may befall the participant. Before completing the sentence task part of the experiment, each participant engaged in a 7-10-minute conversation with the experimenter to establish the participant’s natural speaking rate.

Next, each participant completed a sentence task. The experimenter was present in the room for the entirety of the experiment to ensure that participants understood the experiment’s instructions and proper procedure. At the start of the experiment, each participant was instructed that every trial will begin by presenting them with a single sentence (stem) that they will have to read aloud. The sentence remained on the

screen until the participant pressed the space bar to continue. Following, the researcher presented the participant with the appropriate prompt for the given trial. After this, participants pressed the space bar as soon as they are ready to begin recording the newly combined sentences using the stem and prompt presented to them. For the target sentences, the questions focused solely on the resolution of ambiguity while the filler sentences served to distract the participant from the set structure of the target sentences. Afterward, they completed the MELICET, MINT, and DELE language proficiency assessments in said order. However, the MINT assessment was administered twice; once in English and once in Spanish; the English version was administered first. Lastly, they completed a language history questionnaire online designed by Dr. Iva Ivanova to establish language exposure and dominance, in this case English and Spanish. Specifically, the questionnaire included 21 items in total consisting of questions regarding demographics information including, but not limited to age, sex, and birthplace, as well as a self-report of their language proficiency for all of their languages at the speaking, writing, and reading level. The experiment lasted between 90-100 minutes to complete.

Data Scoring and Analysis

For the initial conversation, the recording was analyzed by calculating the participant's syllables per second during their dialogue with the experimenter. For the main experiment, each participant was recorded using a standard microphone headset through a microphone amplifier connected to the main laboratory computer, which recorded the participant's response for each trial. Moreover, the experimenter listened and coded for any perceptible pause produced during each trial. Specifically, the

researcher listened for a boundary produced at the N2 location, between the second noun of the complex noun phrase and the relative clause. In other words, the experimenter judged whether a pause was actually produced during the run of each trial. A measure of speaking duration for this region was also taken. Using the Audacity audio editing software. The experimenter accessed the sound file of each participant and observed the audio recording showing the drops and rises in pitch and intonation for each sentence recording. With this, the experimenter methodically observed and listened for each potential pause produced in the recording. Overall, all trials were recorded, transcribed, and analyzed for pauses. However, during transcription and analyses, trials were considered valid if participants successfully combined the stems and prompts in the intended grammatical structure. For instance, if participants were presented with a stem such as *the magician surprised the girlfriend of the man*, the experimenter would present them with a prompt such as *the one who loves magic tricks*. The experimenter instructed the participants to combine each stem and prompt in a way that would sound natural and be used in regular conversation with the resulting sentence being *The magician surprised the girlfriend of the man who loves magic tricks*. Yet, if participants failed to combined the stem and prompts successfully, such as neglecting to omit “the one” from the prompt, forgetting the prompt, or ignoring the noun phrase, then these trials were considered invalid; thus excluded from the analyses for being considered invalid trials. Overall, there was a total of 556 invalid trials and 1484 valid trials.

As for the language proficiency assessment, the scores of the MELICET and DELE were collected and graded based on the number of correct responses out of the 50 and 40 items of each test respectively. For the MINT vocabulary proficiency assessment,

the experimenter tracked the score of the participant's responses using a designated blank excel file designed for the test while administering the test by presenting every slide individually. Thus, the experimenter administered the test and scored the participant's responses simultaneously.

Analyses were carried out in R (R Development Core Team, 2008) using logit mixed models for the measure of perceived intonational boundaries, and linear mixed-effects models for the analyses of min and max pitch (Baayen, Davidson, & Bates, 2008; Jaeger, 2008). Language Group (Bilingual vs. Monolingual), and Attachment Condition (High vs. Low) were included as mean-centered fixed effects (along with all interactions), and all models estimated random intercepts for participants and items. The use of these models predicted the probability of pausing as well as the minimum and maximum pitch at the N2 location. This was used to analyze and test hypothesis #1 and #2. Additionally, the measure for average speaking rate (in syllables per second) was computed for each participant using the initial researcher-participant conversation at the beginning of the experiment to test hypothesis #3. Lastly, independent-samples t-tests were used to determine differences between groups on the Language proficiency assessments and if average speaking rate differs across Language Group. All effects were considered significant at $\alpha < .05$.

IV. RESULTS

Perceptual measure of boundary production

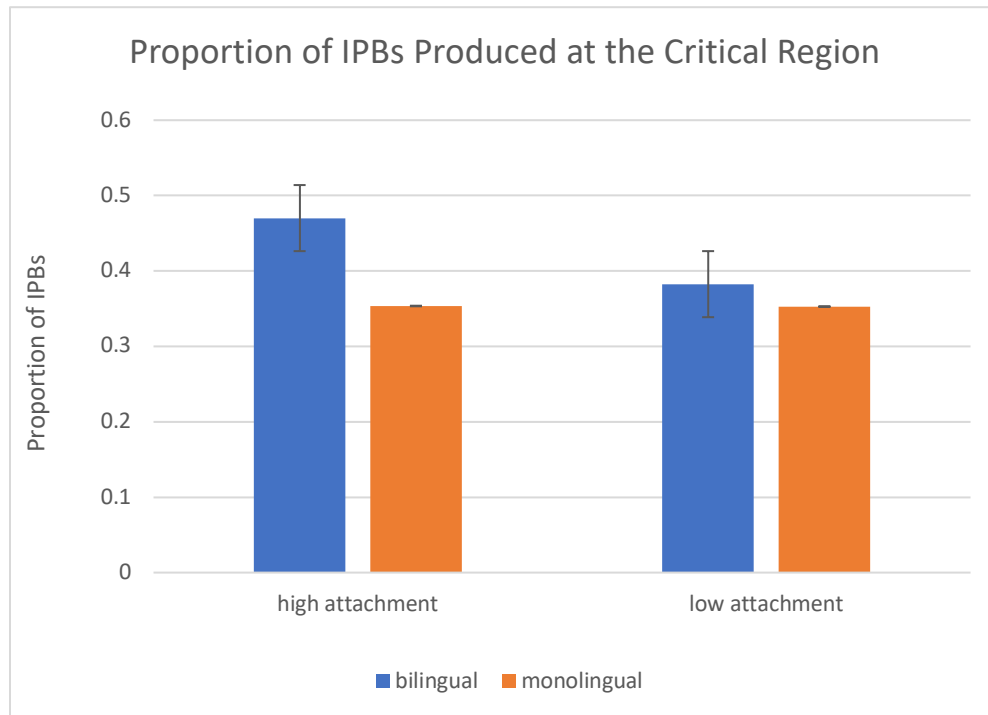


Figure 1. Proportion of IPB production at the critical region broken down by language group and (Monolingual ($n = 29$) vs. Bilingual ($n=22$)) and Target sentence condition (high vs. low attachment). Error Bars signify Standard Deviation.

Analyses of monolingual and bilingual participants revealed non-significant main effects of Language Group and Attachment type (all p -values greater than 0.05). There was also a non-significant ($p = 0.14$) trend towards a possible interaction in which bilinguals showed a greater a tendency to produce a pause when compared to monolingual participants when presented with high attachment sentences (47% vs. 35%). Multi-level analyses on R for the minimum and maximum pitch produced at the N2 word also revealed no significant differences with all p -values greater than 0.05.

Measure of Languages Proficiency Assessments

The results from the independent samples t-test used for the MINT (English), MINT (Spanish), and MELICET between monolingual and bilingual participants

revealed no significant differences between groups; both p-values were greater than 0.05. (see Figure 2 and Figure 3). Nevertheless, the MINT (Spanish), while not statistically significant, showed a trend towards a difference between groups, $t(49) = 1.23, p = 0.225$. Additionally, the results from the DELE assessment showed a statistical significant difference between monolingual ($M = 12.86, SD = 2.67$) and bilingual participants ($M = 24, SD = 6.41$); $t(49) = 3.87, p = 0.0003$ (See Figure 4).

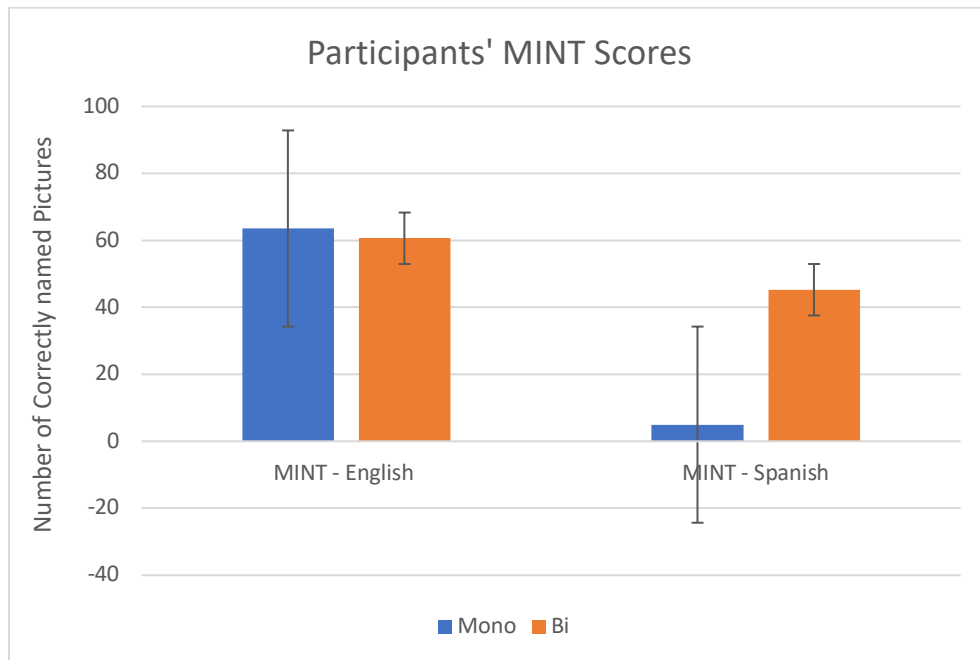


Figure 2. Participants' mean proficiency scores on the Multilingual Naming Test (MINT), for Monolingual (n=29) and Spanish-English bilingual (n=22) participants. The maximum score is 68. Error Bars signify Standard Deviation.

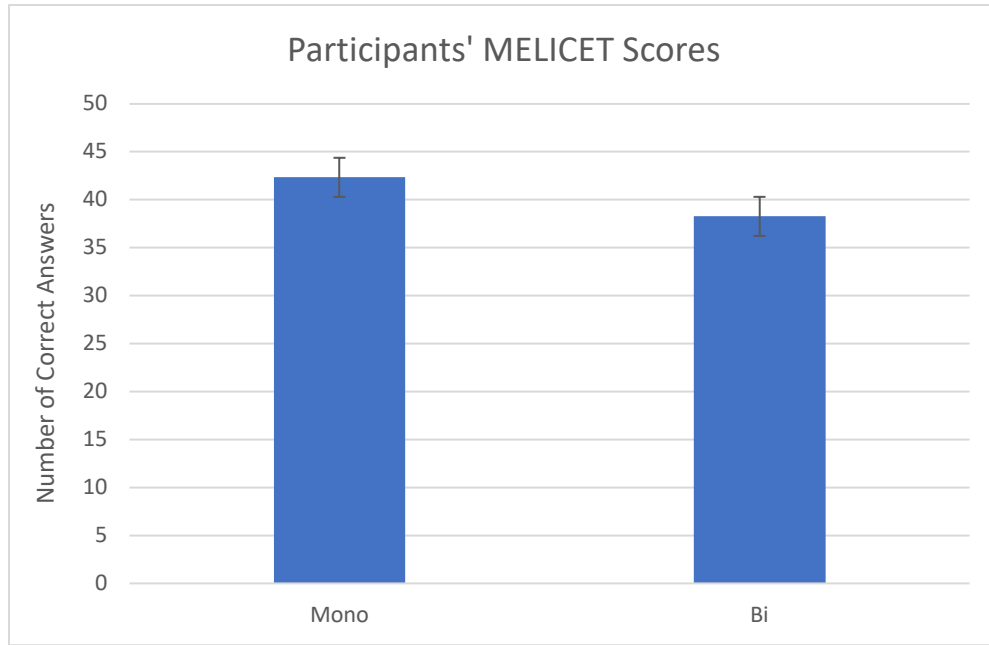


Figure 3. Participants' mean proficiency scores on the Michigan English Language Institute College English Test (MELICET), for Monolingual (n=29) and Spanish-English bilingual (n=22) participants. The maximum score is 49. Error Bars signify Standard Deviation.

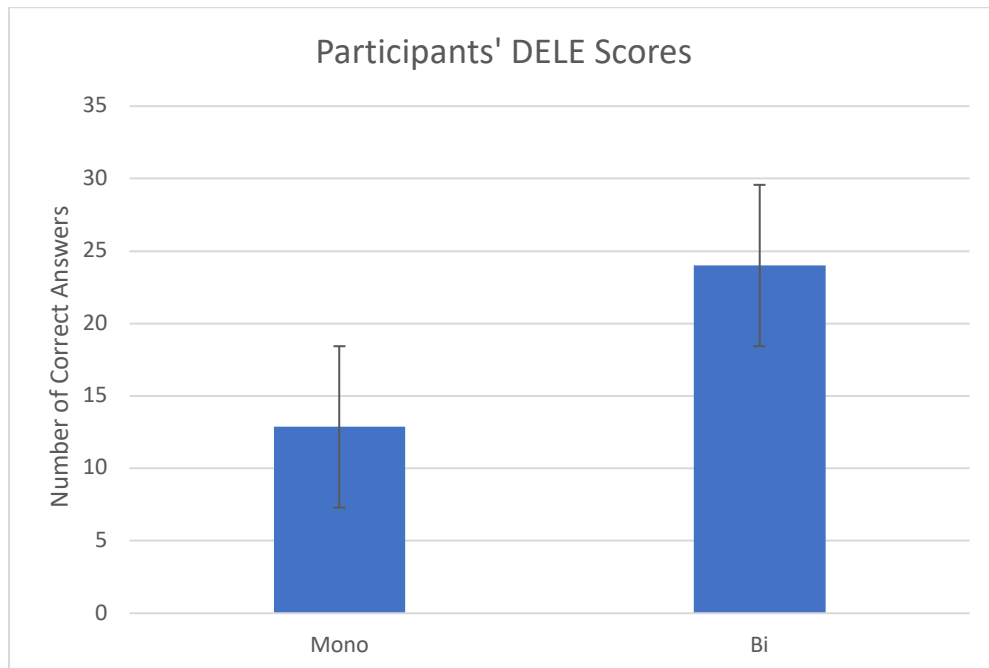


Figure 4. Participant's mean proficiency score on the Diplomas de Español como Lengua Extranjera (DELE) for Monolingual (n=29) and Spanish-English bilingual (n=22) participants. The maximum score is 36. Error Bars signify Standard Deviation.

Measure of Speaking Rate

Analyses on the speaking rate variable between monolingual and bilingual speakers were done by calculating each participant's total number of syllables from the initial conversational with the experimenter divided by the total time in seconds. An independent samples t-test used to find the differences between monolingual ($M = 2.59$, $SD = 0.51$) and bilingual participants ($M = 2.65$, $SD = 0.57$) revealed no significant differences between language groups $t(49) = 0.69$, $p = 0.493$ (see Figure 5).

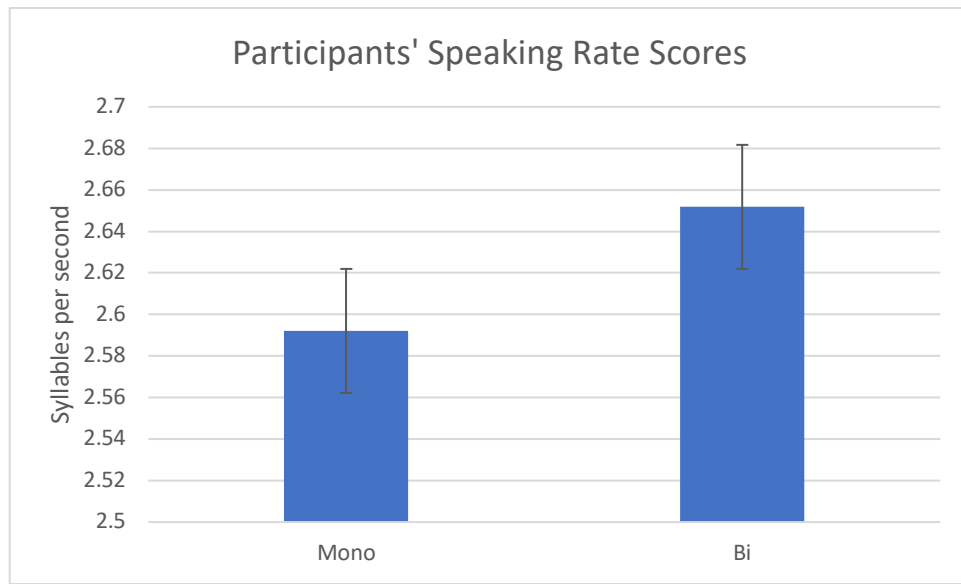


Figure 5. Participant's mean scores of measured speaking rate during conversation for Monolingual (n=29) and Spanish-English bilingual (n=22) participants. Error Bars signify Standard Deviation.

V. DISCUSSION

Defining bilingualism, where an individual is able to speak both languages with equal proficiency, is no longer sufficient. Various recent studies have concluded that there are other factors to consider when defining such an important concept and thus the present study took a different approach to the study of bilingualism. In this case, prosody production in a bilingual's dominant language can be indicative of how languages are represented within the language processing system. Specifically, the present study sought to continue the new trend of research studies and focus on whether a bilingual possesses two separate language processing systems, one for each language spoken, or a unified language processing system where both languages are represented and used. A speaker's prosody, specifically the use of IPBs and speech rate, can be examined to test whether this theory was possible.

Outcomes from the perceptible measure of pause production as well as the examination of a speaker's minimum and maximum pitch did not show statistical differences between groups. In other words, there were no real differences between monolingual and bilingual speakers in terms of the way they produce pauses when presented with sentences of high and low attachment interpretation. Nevertheless, the trend points to the predicted results in which bilinguals were more likely to produce a pause when presented with a syntactically structured high attachment interpretation. In other words, this evidence suggests an overlap between languages during processing and thus indicating that both languages are being represented.

Additionally, there were also no real differences between language groups for three out of the four language proficiency assessments (MINT – English, MINT – Spanish, and

MELICET) that were administered. While the results for the MINT -English and MELICET may be so surprising, it is a bit unexpected that there was not a more significant difference between monolinguals and bilinguals when completing the MINT – Spanish. A reason for this may have to do with the geographical region in which this study was conducted. Since the state of Texas possesses a long history of Hispanic heritage along with a large Hispanic population, there is a prevalent presence of the Spanish language. Its citizens are regularly exposed to it and thus possess a higher knowledge of Spanish when compared to other regions across the country. However, monolingual speakers were not enquired if they had previously taken or were currently enrolled in Spanish courses. Also, the results for the DELE assessment did show a significance between language groups with bilingual speakers showing a higher level of proficiency in Spanish than monolingual speakers, which was expected.

Lastly, measures of speaking rate did not reveal differences language groups. An explanation for these results may be due to the participants' daily speaking environment. Since all participants were recruited from Texas State University, the participants were students who are predominantly exposed to the English language instead of Spanish. In other words, most students are comfortable holding a conversation in English with faculty, professors, and fellow classmates during their daily interactions within the university. Additionally, the initial conversation with the experimenter was only conducted in English and the rate at which information is conveyed seems to vary across languages varies, which may account for the lack of statistical difference between groups.

There was a trend where bilinguals tended to produce more pauses when compared to monolingual speakers. However, this trend is not enough to support the hypotheses,

addressing some of the limitations of this study may aid in finding a more robust effect of the current results. In other words, more evidence of this current trend would fall in with the original hypotheses that prosodic representations influence bilingual's during processing and suggest that bilingual speakers' language processing system is a unified system where both languages are represented at the same time.

This current study faced several limitations. First, there was a smaller than ideal sample for each language group and thus an insufficient overall sample size resulting in a study with low statistical power. With both groups possessing less than 40 or 50 participants each, there was a very limited representation of both populations of speakers with bilinguals only being represented by 22 individuals since initial sample size was at least a 100 participants with 50 in each group. Past research on relative clause ambiguity and attachment preferences conducted a study involving three experiments in which a total of 116 individuals participated (Carreiras & Clifton). Even though there were no true statistical significance between groups, a trend of the predicted results still appeared, thus a sample size that rivals this number may aid in providing a more robust effect.

Secondly, the durational measures of pre- through post-boundary word production were not assessed during analyses, but would be a fruitful avenue for future work. This type of analysis would ensure that the coding of pause is able to reflect the real differences between monolinguals and bilingual speakers. Third, during the initial stages of data collection, there was a technical issue with microphone amplifier that led to microphone malfunctions and loss of audio. The initial conversation recordings and experiment trials of nine participants, not included in the analyses reported, were rendered unusable and thus not valid for analysis. Suggestions for future studies include a

greater focus on a larger sample size as well as the analyses of the durational measures of pre- through post-boundary word production. Although there was no statistical significant effects, there was still a trend leaning towards the predicted results. With the inclusion of the aforementioned suggestions, there is still a possibility to find meaningful effects during a replication of the current study.

In conclusion, the results of the current study was not able to find any clear, significant differences between languages groups in terms of the way in which they produce pauses. Therefore, the current study was not able to confidently support the established hypotheses. While there was a trend that pointed to the predicted results, ultimately, the study was not able to support the view that prosodic representations of multiple languages are active and represented at the same time during language processing. Thus, there was no evidence to support the theory of a single, unified language processing system where both languages are represented and active.

Additionally, although there were several language proficiency assessments used in order to analyze and properly assess an individual's level of proficiency in each language, which included measures of grammar comprehension and vocabulary, future studies may need to include other measures of language proficiency to accurately assess a more precise measure of language competence. While the measures used in this study certainly provided useful insight, there were many instances in which bilingual participants were not able to name several items during the MINT – Spanish assessment, but were nevertheless able to engage in a conversation in Spanish with the experimenter. This may have contributed to the lack of significant differences between languages groups. Nonetheless, the DELE assessment, which focused on grammar and written

comprehension, was still able to detect significant differences in proficiency between both groups.

APPENDIX SECTION

Speaking Rate Conversation Questions

What were the best vacations that you enjoyed as a child?

What was the worst concert you've ever been to?

What is your opinion about social media?

What is the most effective relaxation technique?

What do you think are basic rules of coexistence?

What was the best gift you've ever received?

What does happiness mean to you?

What is one book that you would read again and why?

Which historical figure would you like to interview?

If you had to renounce one of your five senses, which one would you pick?

Practice Trials

The child knocked over the chair ‘

The caterer prepared ravioli ‘

The man gathered sticks in the woods ‘

The woman took a cab ‘

The girl flew the kite across the beach ‘

Target Sentences

The client criticized the pupil of the head chef who usually cooks poultry and fish.

The writer married the cousin of the barista who works the night shift.

The reporter interviewed the wife of the detective who reads mystery novels.

The cat scratched the father of the pharmacist who fosters animals waiting to be adopted.

The critic praised the teacher of the carpenter who carves wooden toys for needy children.

The firefighter rescued the patient of the therapist who meditates every day.

The businessman hired the publicist of the mayor who is popular among small business owners.

The tutor met the boyfriend of the librarian who collects comic books from Japan.

The executive befriended the aunt of the attorney who rides the subway to work.

The clown fooled the nephew of the architect who paints landscapes in the evenings.

The composer recruited the assistant of the choreographer who specializes in fundraising events.

The tourist irritated the uncle of the surfer who enjoys camping at the beach.

The woman congratulated the partner of the dancer who works for the National Ballet.

The cook disrespected the mother of the host who designs party invitations and decor.

The coach instructed the contender of the wrestler who trains during the off-season.

The receptionist ignored the son of the athlete who plays racquetball with friends on Sundays.

The maid welcomed the helper of the gardener who works during all holidays.

The car owner called the apprentice of the mechanic who takes engineering classes.

The barber groomed the manager of the singer who has a podcast about pop culture.

The bride confronted the manager of the waiter who was in the garden during the reception.

The magician surprised the girlfriend of the man who loves magic tricks.

The teenager pranked the husband of the baker who dislikes the smell of chocolate.

The producer disappointed the assistant of the director who enjoys romantic comedies.

The student interrupted the friend of the teacher who runs the chess club.

The babysitter fed the daughter of the accountant who eats all organic foods.

The doctor visited the passenger of the pilot who suffers from insomnia and anxiety.

The hiker scared the prey of the owl who was hiding in the tree.

The warrior defeated the brother of the king who wears a golden ring.

The night guard helped the daughter of the janitor who was waiting in the basement.

The dog licked the son of the lawyer who kept a bunch of different pets.

The salesman conned the brother of the athlete who rides skateboards around the neighborhood.

The man complimented the successor of the ambassador who attended the conference on climate change.

The photographer kissed the sister of the designer who used to always wear pink.

The contender challenged the son of the aristocrat who goes hunting for fun.

The robbers ambushed the ally of the archer who protects the villagers from the tyrant.

The criminal mugged the friend of the actor who was partying late at night.

The musician distracted the child of the woman who has a phobia of spiders.

The shopper greeted the daughter of the florist who hates snakes in her back garden.

The guard protected the assistant of the cardiologist who works 12-hour days.

The partner promoted the paralegal of the lawyer who attends yoga classes regularly.

Filler Sentences

The ship was ripped apart on the sharp reef by giant rocks and strong tide during the storm.

The student ignored the professor's instructions about the science project due tomorrow.

My parents bought a new china set to use during holidays.

The narrow road was closed during the winter for renovations that will help improve traffic flow.

Nomads traveled across the desert with enough water supplies to survive the trip.

The hiker traveled cross country during the summers to visit different National Parks.

The employee from the hardware store quit his job to go back to school full time.

The bus driver took a detour to avoid the traffic to avoid the traffic that was backing up on the interstate.

The wealthy family hired a maid and butler to help with the household chores.

The tabby cat glared at the stranger because he took his toys away.

The team's biggest fan was at the pier when the sun rose in a blaze of glory.

The small dog gnawed a hole in the sock of his owner while she was at work during the day.

The girl with the red hat sold 100 shirts at the merchandise booth for the baseball team.

My mom's best friend went to the store to buy flour, milk, and eggs.

The handyman replaced his old tools before he began his daily chores.

The navy attacked the enemy forces on the other side of the shore.

The boxer trained for his match his match against the current champion.

The operator of the excavator honked his horn to prevent an accident with distracted pedestrians.

The fitness trainer recruited new members to join a weekend kickboxing class.

The newlywed couple bought paintings to decorate the living rooms of their new home.

The band went to the football game to play during the big halftime show.

The farmer sells his crops at the local market to earn extra money.

The professional golfer volunteers at a summer camp near the city.

The lawyer gave the pizza delivery guy a generous tip for his friendly attitude.

The guitar player replaced the strings of his old guitar before the concert started

The pirates ambushed the merchants in order to take their cargo and supplies.

The fashion designer won an award for her work on women's shoes.

The man began taking piano lessons to play at his girlfriend's party

The director of operations hired a new accountant to help the financial department.

The mother of the baby went to the pharmacy to buy diapers and baby wipes.

The fisherman taught several pupils how to fish after noticing their lack of practice.

The adventurer explored several parts of the island in search of the treasure.

The soccer player began practicing every day in preparation for the tournament.

The prince is constantly studying for his upcoming role as a king.

The teenagers went to a concert to relax after a long week of school.

The cyclist goes on the long trail around the lakes after leaving work

The family went on a road trip to the Rocky Mountains at the start of the summer

My father likes to have parties around a bonfire during the winter months.

The musician replaced the strings of his old guitar before the concert started.

The horse trotted around the field during his morning training session.

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