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A Comparison Of Maze Frequency And Type Across Language And Speaker: A Look At English And Spanish Narrative Retells

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A COMPARISON OF MAZE FREQUENCY AND TYPE ACROSS LANGUAGE AND SPEAKER: A LOOK AT ENGLISH AND SPANISH NARRATIVE RETELLS

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Dedication

Everything I am, I owe to you and the sacrifices you have made. This thesis is dedicated to:

Louise Robinson, Jim, Nancy and Josh Silver. Thank you.

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Abstract

Background: Mazes, as they are referred to in the language literature, are disfluencies that do not add meaning to an utterance including filled pauses, whole word revisions, part word revisions, part word repetitions and whole word repetitions. Extensive research has been conducted on mazes in monolingual and bilingual children, yet the research has not been extended to adults' narrative retell production.

Aims: The current study analyzes monolingual English, monolingual Spanish, and bilingual English and Spanish narrative retells to compare the percent of maze use and type of maze use amongst groups.

Methods & Procedures: The narrative retells of thirty-nine bilingual English and Spanish adults were compared to twenty functional monolingual English speakers and twenty-one functional monolingual Spanish speakers. The amount of mazes and types of mazes used during the narrative retells were analyzed for all participants using the Systematic Analysis of Language Transcripts database (Miller & Iglesias, 2010).

Outcomes & Results: The results concluded that bilingual adults had a higher percent of mazing when producing a narrative retell in their nondominant language. The functional monolingual Spanish group used less whole word revisions than the English dominant group during the Spanish retells.

Conclusion: Bilinguals maze more than monolinguals and most notably maze more in their nondominant language. Many possible explanations are discussed in the current study as to why this difference exists.

Key Words: mazes, bilingual, narrative retells, percent mazes, English, Spanish

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Chapter 1: Literature Review

1.1 Introduction

Speakers often revise and alter their communication message while in the midst of speaking. The process of choosing the correct word, using it in the appropriate syntactic category and articulating said word is incredibly fast and is performed with relatively few mistakes. However, when a mistake does occur, speakers use disfluent speech, known as *mazes* in order to fix the mistake or to buy time to plan the remainder of the utterance.

These disfluencies, which are referred to as mazes, are defined as words, initial parts of words, or unattached fragments that do not add meaning to an utterance (Fagan, 1982). Pauses, either silent or filled, are also considered mazes and allow the speaker more time to plan the rest of the utterance. Filled pauses consist of the use of filler words (such as: *um, uh*, etc.) that do not add additional meaning to an utterance. Extensive research has been conducted looking at children's use of mazes; however, a gap exists pertaining to maze type and frequency in adult speakers. The current study attempts to fill this gap by analyzing maze type and frequency of use in monolingual and bilingual English and Spanish adults.

1.2 Theories of Language Production

In order for a speaker to successfully transmit their thought into a spoken message, which is understood by their listeners, the speaker must have a plan for speech production. Goldman Eisler (1968) outlined three steps involved in speech planning. The first requires the speaker to imagine what the desired content of the speech will be. Once the speaker has a firm idea of the message's intended content, they progress to the second step, choosing a syntactic structure in which to convey the intended message. The last step requires the speaker to make the semantic choices that will appropriately fit in the previously decided upon syntactic structure. Therefore, it is only logical that when deciding upon the syntactic and semantic content of speech that the

speaker may need to pause during the planning phase. After the message has sufficiently been planned, the speaker then moves onto the speech production phase of communication.

1.2.1 Monolingual Language Production

Several theories of language production will be reviewed at which point the author will begin to discuss mazes. There are several theories behind successful language production including the *Logogen Theory* (Morton, 1969), the *Dell Interactive Activation Model* (Dell, 1986), and the *Theory of Lexical Access* (Levelt, 2001), which will further be explained in this section. Understanding typical language production is necessary before one can attempt to explain mazes and other disfluencies in speech.

The Logogen Theory (Morton, 1969) explains how we access words from our mental lexicon. The two steps are lexical selection followed by phonological encoding. Lexical selection begins with a lexical concept, which needs to be mapped onto a linguistic form. After the appropriate linguistic form for the concept has been identified, linguistic selection occurs. The concept is grammatically coded to ensure its proper use. Once the correct word has been chosen and the grammatical structure has been identified, phonological encoding occurs. Phonological encoding allows for the word to be given its phonetic characteristics, which are then sent to the articulators and the word is spoken (Kroll & DeGroot, 2005; Levelt, 1992).

Dell's (1986) Interactive Activation Model is yet another model that aims to explain and understand the process of normal speech production. According to the Dell's Two Step Interactive Model (Dell, Schwartz, Martin, Saffran, & Gagnon, 1997), speech production first requires the activation of the *lemma*. The lemma is a concept map of semantic features for each word; from there, the subsequent phonemic level is activated. The model is bi-directional, meaning that the phonemic level can be activated before the semantic level. This is the case

when a speaker uses a word in a different semantic class to represent the target. For example, saying *mat* instead of *cat*. The speaker wanted to produce *cat* but activated the word *mat*, which are similar phonetically but not part of the *animal* semantic class that was needed for the target production. Therefore, the phonemic level was activated before the semantic level which lead to the speaker choose a word that was phonetically similar to the target word, yet not of the desired semantic category.

Speakers often produce word errors by producing a semantically related word to the target word (Dell, 1986; Kapatsinski, 2010; Levelt, 1999). For instance, *cat* and *rat.* Both *cat* and *rat* activate a similar lemma as they share semantic properties: small, four legged animals with tails (Dell, 1986; Levelt, 1999). The distinguishing feature of the Dell Interactive Activation Model is its bi-directionality. By addressing bi-directionality, this idea that word production can occur by either activating the phonemic level or the semantic level first and the other will follow. Therefore, the Dell Interactive Activation Model explains how different phonetic and semantic word errors can occur.

The Theory of Lexical Access (Levelt, 2001) is similar to Dell's (1986) Interactive Activation Model although it lacks its hallmark bi-directionality. The Theory of Lexical Access assumes that speech production consists of two main steps, which are broken up differently than in Dell's Interactive Activation Model. The two steps in the Theory of Lexical Access are: lexical selection and form encoding. During lexical selection the speaker identifies the target concept, known as perspective taking. The speaker will then pick out the concept in their mental lexicon; this concept is referred to as the lemma. As mentioned with the Interactive Two-Step Model (Dell et al., 1997), the lemma in the Theory of Lexical Access also contains the semantic and syntactic properties that code a word. The lemma is often identified through competition of

similar lemmas. For instance, if the target word is *horse*, the lemma for *donkey* may also be activated because they have shared semantic features. Once the speaker chooses the lemma that best fits the desired concept, the second step of the Theory of Lexical Access begins.

There are several phases involved in form encoding, which can only occur after the correct lemma has been selected. First, the morphological and phonological codes are retrieved. This allows the speaker to alter the form in a way to better express their desired meaning. For example, the speaker can make the lemma plural if necessary. The phonemes are then separated into syllables. The syllabification is not kept on file in the speaker's mental lexicon; instead it is done on the spot. The final step is the phonetic encoding of the lemma, which allows the word to be produced in its spoken form (Levelt, 2001).

The Logogen Theory, Dell's Interactive Activation Model, and the Theory of Lexical Access postulate that speech production must first involve the selection of a target concept; once this concept has been identified the theories diverge to different steps. According to the Theory of Lexical Access since syllabification is not stored in the mental lexicon and must be done during the act of speaking, there is an opportunity for the speaker to make a mistake. It is possible that part word mazes may be explained during this phase of the lexical access language production model. To understand how and why mazes occur, one must understand the language theories discussed above in order to recognize where communication breakdowns can potentially occur.

1.2.2 Theories of Bilingual Language Production

Language production models for bilingual speakers contain an additional aspect since two words are activated for the same concept and the speaker must decide which representation to use. Kroll and DeGroot (2005) disagreed with the idea that a fundamental difference between

lexical access models in bilinguals and monolinguals exists, and instead argued that a satisfactory lexical access model for monolinguals can be applied to bilinguals. A bilingual individual must determine which word to use to express their intended meaning. In the case of a bilingual individual, two words that refer to the same concept are activated during the initial step of language production. The speaker chooses which word to use based on the language that is being spoken at that time (Poulisse, 1997 as cited in Kroll & DeGroot).

A model of lexical access that pertains to bilinguals is the *Language Nonspecific Model* (Costa & Carmazza, 1999) in which the word is accessed in both languages. In the Language Nonspecific Model, lexical selection considers lexical items in both languages and chooses the item with the highest activation level. Each lexical representation is linked with the appropriate grammatical properties of the word and the phonological representation. There is only one level of lexical activation; therefore, it differs from monolingual models such as Dell's Interactive Activation Model and the Theory of Lexical Access because there are not several steps involved in the lexical activation.

According to the Language Nonspecific Model, the lexical item with the strongest activation is selected and produced (Costa & Carmazza, 1999). The speaker chooses the word in the target language at the lexical level because once the word is chosen the grammatical properties are activated. This model lacks bi-directionality; word selection does not occur at the phonological level because a communication breakdown would occur since the word would not contain the proper syntax or morphology (Kroll & DeGroot, 2005).

The language production theories previously discussed attempt to explain how a word is chosen from competing words and subsequently produced. As discussed, bilingual language production has an added level of complexity, as the word in the language being utilized must be

chosen as to not interrupt communication.

1.3 Mazes and Language Production

Despite how straight forward language production models initially appear, communication rarely occurs without errors. Breakdowns occur throughout word production, as is evident when a speaker says an unintended word or part of a word and attempts to fix the error by producing a maze. Mazes include pauses, part or whole word repetitions, as well as part or whole word revisions, which occur naturally in spontaneous speech. Table 1 provides examples and definitions of maze types as seen in narrative retells.

Table 1.1: Maze types and examples from English (E) and Spanish (S) narratives

Maze Type	Description	Example
Filled Pause	Non-word vocalization at the beginning of a phrase or between words. (E: um, uh, oh, etc.; S: este, eh, etc.)	E: Then (uh) the boy found the frog. S: Entonces (eh) el niño encontró la rana.
Part Word Repetition	Part of the word unit is repeated.	E: The (f*) frog jumped. S: La (r*) rana saltó.
Whole Word Repetition	The entire word unit is repeated.	E: (The) the boy was sad. S: (El) el chico estaba triste.
Part Word Revision	Part of the word is revised or altered, either for lexical or grammatical reasons.	E: They were (looked) looking. S: La rana (salta) saltó.
Whole Word Revision	The entire word is altered either for lexical or grammatical reasons.	E: The (dog) boy was sad. S: El (perro) niño estaba triste.

A speaker mazes at both grammatical and/or ungrammatical junctures throughout speech. Grammatical intervals are those that occur at a punctuation point or before relative and interrogative pronouns. The mazes, or hesitation pauses, as referred to by Goldman Eisler (1968), occur naturally at these points and do not affect the listener's ability to comprehend the

intended message. Ungrammatical mazes typically occur in the middle of a juncture, which could be in the middle of a phrase, and result in a repeated phrase. They may also occur when the sentence begins with a false start, when the speaker changes the mid phrase to the desired production. Typically, 55% of mazes occur at grammatical intervals, compared to 45% that occur at ungrammatical intervals, during spontaneous speech (Goldman Eisler). Most mazes occur at pre-syntactic points, which require the greatest amount of planning (Fagan, 1982). Filled pauses typically occur at the beginning, typically after the first word, of utterances (Boomer, 1965).

Speakers tend to maze less when spontaneous speech production includes rehearsed or commonly used phrases, highlighting a link between maze frequency and speech spontaneity (Goldman Eisler, 1968). Thus, researching maze use allows for insight into language planning (Goldman Eisler). By understanding and recognizing breakdowns that occur in normal speech, researchers are better able to understand the processes that are involved in normal speech production.

Speakers maze for many reasons; however, the two that are most agreed upon are to increase the planning time in order to finish the remainder of an utterance (Fehringer & Fry, 2007) or to fix an undesired production (Fagan, 1982). Disfluencies typically occur at the beginning of sentences, where there is an increased amount of planning necessary in order to successfully carry out the utterance (Bortfeld, Leon, Bloom, Schober, & Brennan, 2001). Regardless of maze type, a maze that precedes a noun is used to hold for time while finding the correct word, to modify a noun, or to correct a mispronunciation (Fagan, 1982; Fehringer & Fry, 2007). For example in "*The (dog*) frog swam in the water*", the "(*dog**)*"* is a maze which signifies the speaker unintentionally said "*dog"* but revised it to "*frog*" which was the intended noun, thus modifying the noun. Mazes that occur in the verb position are either to fill time while

finding the desired main verb or to modify verb choice (Fagan, 1982). For example in "*The dog (j*) ran fast*", the *"(j*)"* is a maze which signifies the speaker was about to say "*jump"* but was able to revise the production so the desired verb "*ran"* was said instead.

Bortfeld et al. (2001) suggested an additional reason that a speaker may maze, identifying a relationship between longer pauses, more mazes, and the speakers lack in confidence over an utterance. That is to say that when a speaker is unsure of the correct response, they tend to use more mazes. Mazes may also be used during conversation to ensure proper management of pragmatics, such as turn taking. Mazes serve as a tool to manage conversational pragmatics and a tool to fix an undesired production; it also allots the speaker more time to plan the remainder of the utterance. Mazes, which are disfluencies that occur in normal speech production, are a complex conversational tool used by speakers. This study will only look at mazes during the production of narrative retells, although it is important to note that mazes occur during conversational speech as well.

1.4 Word Level Mazes

It is necessary to first understand maze production and its relation to language production before one can begin to discuss mazes at the word level and the speaker's inherent desire to produce cohesive utterances. There are two theories that seek to explain the point at which a speaker recognizes that an unintended word has been produced and attempts to revise it.

The *Gradient Continuity Hypothesis* (Kapatsinski, 2010) indicates that speakers want to produce cohesive and continuous utterances. When a word error is recognized the speaker will finish saying the word before a word revision occurs. The *Main Interruption Rule* (Levelt, 1983) states that the speaker seeks to revise a production error the instant it is detected. Once the

speaker recognizes a word error, they seek to correct it immediately resulting in more part word revisions (Kapatsinski, 2010).

Kapatsinkski (2010) found that words that occur with higher frequency within speech are less likely to be revised during production, indicating that speakers prefer to wait until after the high frequency word is produced, albeit incorrect, before the revision takes place. Words that are used more during conversation are more automatic and require less revision than words that are produced with lower frequency. On the other hand low frequency words tend to be revised the instant an error is detected, following the main interruption rule (Kapatsinski). Understanding why speakers maze and the strategies they use to fix mazes can be also be applied to bilinguals who function under these same models, but have two languages to consider.

1.5 Mazes in Bilinguals

Just as there were slight differences amongst language production models for monolingual and bilingual individuals, which were previously discussed, mazes also differ between the populations. Bilinguals use each of their language systems less, which is referred to as the *Weaker Links Hypothesis* (Gollan & Goldrick, 2012). The Weaker Links Hypothesis assumes that bilingual disadvantages are most noticeable at the point in language production in which frequency effects are the strongest. Gollan and Goldrick (2012) refer to the small, yet significant bilingual disadvantages such as reduced fluency and reduced speed during naming tasks, among others. For instance, bilingual individuals named pictures slower than monolinguals (Gollan, Montoya, Cera, & Sandoval, 2008; Gollan et al., 2011; Ivanova & Costa, 2008). This was especially evident when bilinguals were asked to produce the names of low-frequency items.

Further support for the Weaker Links Hypothesis is seen by the fact that research has reported that during naming tasks bilinguals also experience a more frequent tip-of-tongue state

(Gollan & Goldrick, 2012). A tip- of-tongue state, as explained by Gollan and Acenas (2004), is a failure of word retrieval. During such a state the speaker may have the idea of the concept they wish to express, known as the lemma, but fail to find the appropriate word (Gollan & Acenas, 2004). For the purpose of this study, tip-of-tongue states are referred to as mazing. Studies showed that bilinguals are at a disadvantage during tongue twister production, which provided evidence that bilingualism effects sub-lexical processing (Gollan & Goldrick, 2012).

An additional hypothesis as to why bilinguals tend to maze more often than monolinguals is the *Interference Hypothesis* (Gollan & Goldrick, 2012). The Interference Hypothesis presumes that since bilinguals have two functional language systems, words are activated in both languages. Therefore, the competition between the two language systems may explain why bilinguals may tend to maze more than their monolingual peers (Gollan & Goldrick, 2012).

Mazes are used more during narrative stories and retells compared to conversation (Navarro-Ruiz & Rallo-Fabra, 2001). It is common for typically developing (TD) children to use more pauses during their narrative retells (Navarro-Ruiz & Rallo-Fabra, 2001). Children with a Specific Language Impairment (SLI) as well as TD children mazed throughout the narrative sample with pauses and repetitions predominating as the most commonly used maze (Navarro-Ruiz & Rallo-Fabra, 2001).

Results from a study conducted by Bedore, Fiestas, Peña, and Nagy (2006) indicated that there was not a significant difference between the percentage of utterances with mazes used by monolingual and bilingual children. There was a slightly higher use of mazes in bilingual children but the results were not significant. Both monolingual and bilingual children presented with significantly more grammatical revisions during their narrative retells in Spanish compared to the English retells of both monolinguals and bilinguals. Bedore et al. also examined language

productivity and the effects on mazes. Language productivity was analyzed by looking at mean length utterance (MLU) and number of different words (NDW). The results indicated that there was a significant relationship between maze use, grammaticality, and MLU for Spanish speakers. In comparison, there was great presence of filled pauses and connectors as MLU and NDW increased for English speakers. As the complexity of language use increased for the monolingual English speakers, maze use also increased. Bedore et al. concluded that bilingual children speaking in their nonnative language produce two to three times more mazes compared to monolinguals or when the same bilingual child is speaking in their native language.

Much research has been performed looking at children's use of mazes. There is little agreement on whether a correlation exists between maze use and language maturity of the speaker (Fagan, 1982). With age, the speaker gets better at the syllabification stage of the Theory of Lexical Access (Levelt, 2001). If the speaker's ability improves, mazing should decrease. Therefore, one might assume that as the speaker matures the percentage of mazes would decrease; however, the contrary has been found to be true. As speakers mature and become more comfortable with language and as their lexicon grows, the amount of mazes typically remain constant across most of adulthood but may increase in older adults (Leadholm & Miller, 1995).

Similar, yet conflicting results have been reported of a linear relationship between age and rate of mazes. The rate of within utterance mazes is not constant and increases with age (Bortfeld et al., 2001). These findings are not intuitive as one may assume that as a speaker ages, more words are produced automatically since a speaker has more familiarity with words. One may think that fewer mazes should occur as the adult matures since they are using words that are more familiar and thus require less revision. This assumption would fall under results obtained by Kapatinski et al. (2010), which state that words which are more frequently used through out

conversation require less revision compared to words which are less prevalent in conversation. These inconsistencies are present throughout the literature as some researchers have found that speakers maze less with age as words become more automatic (Leadholm & Miller, 1995), while others have found that speakers use more mazes as they age (Bortfeld et al., 2001).

If the Weaker Links Hypothesis (Gollan et al., 2011) is true, one could infer that the reason mazes occur in bilinguals is that they are attempting to find the phonological representation needed to produce a word. Since each language is used with less frequency, access to the sounds needed to produce a word may take more time and result in more revisions compared to monolingual speakers.

Previous research on the percent of mazes and their implications on the clinical realm have focused on children's language output. For instance, it is thought that a higher percentage of mazes in school aged children often signify a potential language disorder (Miller, 1996). A study conducted by Nettelbladt and Hansson (1999), found that children with specific language impairments had significantly more mazes compared to the mean length utterance matched control group. Mazes have a diagnostic relevancy pertaining to language impairments in children, however it is unclear how that translates to adult speakers.

Many studies have been conducted on mazes in monolingual and bilingual children, yet the research has only begun to examine adults' narrative retells. The current study analyzes monolingual English, monolingual Spanish, and bilingual English and Spanish narrative retells to compare the percent of maze use and type of maze use amongst groups. The study aims to answer the following research questions:

1. Does the percentage of mazes produced differ between the bilinguals in their English and Spanish narrative retells?

2. Does the percentage of mazes produced in narrative retells differ between bilingual and monolingual adults?

3. Do the types of mazes used during the narrative retells differ between bilingual and monolingual adults?

Chapter 2: Methods

2.1 Participants

A standard group design study was conducted with a total of 80 participants. There were five groups, which consisted of 20 functional monolingual English (FME) speakers, 19 English dominant bilinguals (ED), 14 balanced bilinguals (BB), six Spanish dominant bilinguals (SD), and 21 functional monolingual Spanish (FMS) speakers. The ED, BB, and SD groups had 39 participants in total. Participants were divided into the 5 groups based on results from an adapted language questionnaire by Peña, Gutiérrez-Clellen, Iglesias, Goldstein, and Bedore (2014); it required them to report language input and output throughout a typical week. Participants filled out information regarding the language use of their conversational partner and their own language output during a specific activity. This allowed participants to think about their day and how their language patterns change based on day, activity, and conversational partners. Based on the results from the questionnaires, participants were placed into the five groups: FME, ED, BB, SD, and FMS.

The FME, ED, BB, SD, and FMS group placements were determined by looking at the average input/output in each language during an average day as indicted by the participants in the language questionnaires. A participant was considered to be SD if 40% or less of their input/output was in English and 60% or more of their input/output was in Spanish. Similarly, categorization of ED was made if 60% or more of the participant's input/output was in English and 40% or less of their input/output was in Spanish. A person was considered to be BB if 40-60% of their average output was in English and Spanish. Participants were assigned into groups after testing had been conducted. Thus, groups had no bearing on testing procedures and were merely used in order to examine whether language dominance resulted in language behaviors similar to those of the monolingual groups. Due to the close proximity to the US-Mexico border,

a true monolingual speaker was difficult to find, therefore for the purpose of this study a functional monolingual speaker is defined as a person who speaks and hears only one language at least 80% of the time during a typical day.

Sequential and simultaneous bilinguals were not differentiated for the purpose of this study. Participant profiles are reported in Table 2. The average ED participant was 28 years old (SD = 11), had 77.12% (SD = 8.21%) English input/output, 22.85% (SD = 8.21%) Spanish input/output, and completed 16 years of education (SD = 2). The average BB participant was 30 years old (SD = 13), had 50.44% (SD = 6.17%) English input/output, 49.56% (SD = 6.17%) Spanish input/output, and completed 18 years of education (SD = 2). The average SD participant was 26 years old (SD = 5), had 27.81% (SD 4.89%) English input/output, 72.19% (SD = 4.89%) Spanish input/output, and completed 17 years of education (SD = 2). The 20 FME speakers were an average of 25 years old (SD = 6), had an average English input/output of 98.22% (SD = 2.63%), an average Spanish input/output of 1.78% (SD = 2.63%), and completed 17 years of education (SD = 3). The 21 FMS speakers had an average age of 44 (SD = 7), an average English input/output of 0.22% (SD = 1.00%), an average Spanish input/output of 99.78% (SD = 1.00%), and completed 9 years of education (SD = 4).

Table 2.1: *Participants Characteristics*

	FME [*n*=20]	**ED** [*n*=19]	**BB** [*n*=14]	**SD** [*n*=6]	**FMS** [*n*=21]
Age	25 (6)	28 (11)	30 (13)	26 (5)	44 (7)
Years of Education	17 (3)	16 (2)	18 (2.16)	17 (2)	9 (4)
Percent of English Input/Output	98.22% (2.63%)	77.12% (8.21%)	50.44% (6.17%)	27.81% (4.89%)	0.22% (1.00%)
Percent of Spanish Input/Output	1.7% (2.63%)	22.85% (8.21%)	49.56% (6.17%)	72.19% (4.89%)	99.78% (1.00%)

Note. Standard Deviations are in parentheses. FME=functional monolingual English; ED=dominant; BB=balanced bilingual; SD=Spanish dominant, FMS=functional monolingual Spanish

2.2 Procedure

2.2.1 Recruitment

The ED, BB, and SD participants were recruited from *The University of Texas at El Paso* (UTEP)*, El Paso Community College* (EPCC)*,* and the general public. All bilingual participants had to attend two testing sessions and received a $30 Wal-Mart gift card, which was funded by a grant through the University Research Institution.

Participants that comprised the FME group were recruited from UTEP, EPCC, and the general public; they were made aware of the study through flyers sent to professors. Individuals from a low SES municipality, outside of El Paso city limits but within El Paso County, served as the FMS group; they were made aware of our study by a non-profit organization located within El Paso County. Upon completion of the study, all monolingual (FME and FMS) participants received a $25 Wal-Mart gift card, which was funded through the College of Health Science Research Award. All participants, monolingual and bilingual, were apart of a larger language study conducted at UTEP.

2.2.2 Data Collection & Measures

In the beginning of the session, participants filled out a language questionnaire (Peña et al., 2014), which addressed language history and patterns of current language use. Test administrators introduced the narrative script to each participant by instructing him or her to read it aloud, remember it to the best of their ability, and retell it at the end of the testing session. Participants first read the script of a short narrative and then completed language tests associated with the larger study. These additional tests took approximately 30 minutes to complete, and after the tests were conducted the participants retold the story that they read at the beginning of the session without the script. Two different stories were used to initiate the narrative retell production: *Frog On His Own* (Mayer, 1973), and *Frog Goes To Dinner* (Mayer, 1974).

Bilingual participants (ED, BB, and SD) provided narrative retells for different stories in English and Spanish across two sessions. This controlled for carryover treatment affects as it ensured that the first language (L1) was not aiding in the second language (L2) story production since different stories where used for each language. Counter balanced sessions were administered which resulted in half of the subjects producing a narrative retell in English during their first session while the other half produced a retell in Spanish. Monolingual (FME and FMS) participants read the randomly chosen frog story, completed additional language tests, and then retold the frog story all within one testing session.

2.2.3 Transcription

Trained bilingual lab assistants from UTEP transcribed the narrative retells using the Systematic Analysis of Language Transcripts (SALT; Miller & Iglesias, 2010). Mazes were coded using the conventions outlined in the SALT manual. Transcripts were analyzed by running the maze summary analysis, which is a standard feature in all of the SALT programs. For this study, six measures from the maze summary were analyzed: 1) number of single word filled

pauses, 2) part word repetitions, 3) whole word repetitions, 4) part word revisions, 5) whole word revisions, and 6) percent of mazed words. (Refer to Table 1 for maze types and examples.)

2.2.4 Transcription Reliability

Twenty-four (20%) of the 120 transcripts (39 bilingual speakers in English and Spanish, 20 FME, and 21 FMS) were transcribed by a second trained bilingual research assistant. Inter-rater reliability was calculated by dividing the number of agreements over the sum of agreements and disagreements in the sample. There was 97% reliability for the 12 out of 60 English retells, and 97% reliability for the 12 out of 60 Spanish retells. The transcripts were then coded specifically for the mazes of interest in this study following the conventions from the SALT program (Miller & Iglesias, 2010). (Refer to Table 1.) Coding reliability was conducted on 12 (20%) of the 60 English retells, which resulted in an average reliability of 94.5% (range = 86-100). Maze coding on 12 of the 60 Spanish retells were checked in their entirety by the two trained bilingual research assistants, resulting in 91.9% reliability (range = 85-100).

2.3 Analysis

The first research question, which sought to analyze the difference between the percent of mazed words used during the bilingual (ED, BB, and SD) participants' English and Spanish narrative retells was answered using a repeated measures ANOVA. The dependent variable was the percent of mazes within the narrative retell and the independent variables were language of the narrative (English and/or Spanish) and the groups of the bilingual participants (ED, BB, and SD). A one-way ANOVA in both English and Spanish was performed to answer the second research question. The second research question analyzed the percent of mazes in the monolinguals' (FME and FMS) narratives compared to bilinguals' (ED, BB, and SD) narratives. The dependent variable was the percent of mazes that occurred within the narrative retell and the

independent variable were the groups of the participants: FME, FMS, ED, BB, and SD. In order to answer the third research question, which analyzed the types of mazes in each language used by the bilingual and monolingual adults in their narrative retells, a one-way ANOVA in English and Spanish was performed. The dependent variables were the types of mazes: filled pauses, part word and whole word repetition, and part word and whole word revision. The independent variable was the groups of the bilingual participants: ED, BB, and SD. For the one-way ANOVAs, significant results were further examined using Tukey's post-hoc tests.

Chapter 3: Results

The FME, FMS, ED, BB and SD groups' narrative retells were analyzed for patterns in maze use and frequency of mazing.

3.1 Percentage of Mazes in English and Spanish for Bilingual Participants

The first research question which looked at the difference between the rate of mazes in the bilinguals' English and Spanish narrative retells was answered by performing a repeated measures ANOVA. There were no main effects for Language [F (1, 33) = 1.042, p = .315] or Group [F (2, 33) = 2.628, p = .087]. There was a significant interaction for Language by Group [F (2, 33) = 3.783, p = .033]. Figure 1 shows the mean percent mazes present in the bilingual groups narrative retells. Results indicated that the FME and FMS groups mazed more in their nondominant language. For instance the FME group used mazes in 17.19% of the Spanish narratives compared to 9.75% of the English narratives. The BB group used a similar amount of mazes in English and Spanish.

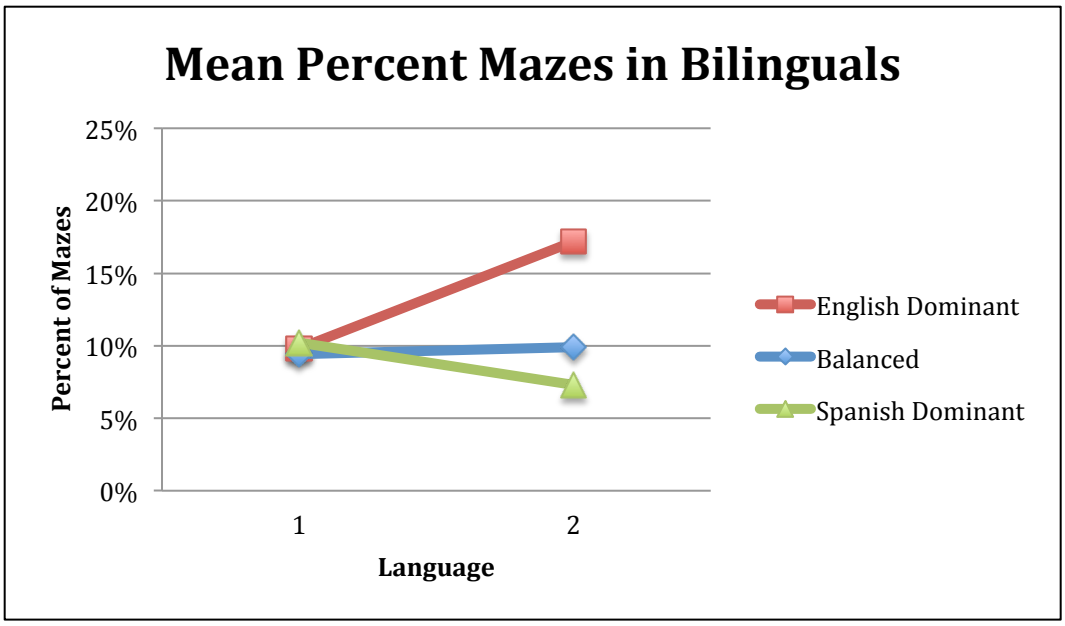

Figure 3.1: Mean percent mazes in bilingual participants.
Language 1 refers to English, and Language 2 refers to Spanish.

3.2 Percentage of Mazes in Bilingual compared to Monolingual Participants

To answer the second research question, two one-way ANOVAs were performed for both English and Spanish retells. For the English ANOVA, percent of mazes was compared between the four groups who retold the story in English: FME, ED, BB, and SD. The difference in the percent of mazes used in the English retells [F (3, 58) = 2.076, p = .114] was not significant.

For the Spanish language ANOVA, percent of mazes was compared between the four groups who retold the story in Spanish: ED, BB, SD, and FMS. The difference between the groups for the percent of mazes used during the Spanish retells [F (3, 55) = 3.504, p = .022] was statistically significant. Post-hoc tests revealed that the ED group used significantly more mazes than the SD group during their Spanish retells (p = .046). The ED group used slightly more mazes than the BB group during the Spanish narrative retells; however, the difference between the ED and BB was not significant (p = .055).

3.3 Types of Mazes in Bilinguals' Retells

The third research question which sought to analyze the types of mazes used by monolingual (FME and FMS) and bilingual (ED, BB, and SD) adults in their English and Spanish narrative retells was answered by performing a one-way ANOVA for both English and Spanish. First, the types of mazes were compared for the English retells (Refer to Table 1 for Maze types and examples). The mean data for narrative retells produced in English is given in Table 3. There was not a significant difference between the ED, BB, and SD groups, and the FME adults in relation to their English narrative retell on the basis of percent maze words [F (3, 58) = 2.076, p = .114]. There was not a significant difference in the number of filled pauses [F (3, 58) = 0.906, p = .444] nor part word repetitions [F (3, 58) = .947, p = .424], whole word repetitions [F (3, 58) = 2.016, p = .122], part word revisions [F (3, 58) = .472, p = .703], or whole word revisions [F (3, 58) = 1.432, p = .243]. The differences between groups for words per minute were not significant [F (3, 58) = 2.679, p = .056)]. Post-hoc testing revealed the use of slightly more words per minute during the English retells for the ED group when compared to the SD (p = 0.54).

Table 3.1: Descriptive Results for English Retells

	Functional Monolingual English	English Dominant Bilinguals	Balanced Bilinguals	Spanish Dominant Bilinguals
Percent Maze Words	0.66 (0.03)	0.92 (.044)	0.09 (0.038)	0.10 (0.059)
Words per Minute	151.22 (32.07)	158.83 (53.87)	136.26 (30.75)	110.18 (23.94)
Filled Pauses	6.85 (7.71)	9.47 (8.70)	6.14 (5.14)	5.00 (4.00)
Part Word Repetition	0.25 (0.44)	0.37 (0.59)	0.43 (0.76)	0.00 (0.00)
Whole Word Repetition	0.60 (0.82)	2.00 (2.73)	1.57 (1.45)	1.33 (1.21)
Part Word Revision	0.55 (0.51)	0.74 (0.99)	0.71 (0.83)	0.69 (0.84)
Whole Word Revision	1.15 (1.31)	1.68 (1.70)	1.50 (1.87)	2.67 (1.51)

Note. Standard Deviations are in parentheses. FME=functional monolingual English; ED=English dominant; BB=balanced bilingual; SD=Spanish dominant, FMS=functional monolingual Spanish

Another one-way AVOVA was run on the Spanish narrative retells to analyze maze type between groups. The mean data for narrative retells produced in Spanish is given in Table 4. Significant differences were not found between the ED, BB, SD, and FMS groups in regards to the number of words per minute [F (3, 55) = 1.001, p = .400], filled pauses [F (3, 55) = 2.408, p = .078], part word repetitions [F (3, 55) = 1.410, p = .250], word repetitions [F (3, 55) = 1.007, p = .397], and part word revisions [F (3, 55) = 1.577, p = .206]. There was a significant difference between the ED and SD groups regarding the percent mazes in the Spanish retells [F (3, 55) = 3.504, p = .022]. Post-hoc testing revealed, the ED group had a significantly higher percentage of mazes in the Spanish retell then the SD (p = .046). The ED group had a slightly higher percent of mazes than the BB group; however, the difference was not significant (p = .055).

There was also a significant difference between the ED and FMS groups regarding the number of whole word revisions present in the Spanish narrative retells [F (3, 55) = 6.449**,** p =

.001]. Post-hoc tests revealed that the FMS group had significantly less whole word revisions compared to the ED ($p < .0001$).

Table 3.2: *Descriptive Results for Spanish Retells*

	English Dominant Bilinguals	Balanced Bilinguals	Spanish Dominant Bilinguals	Functional Monolingual Spanish
Percent Maze Words*	0.17 (0.12)	0.09 (0.51)	0.07 (0.04)	0.12 (0.49)
Words per Minute	120.04 (37.39)	136.81 (21.22)	140.72 (25.46)	125.84 (35.89)
Filled Pauses	7.88 (8.17)	3.79 (3.83)	3.83 (1.60)	3.85 (2.76)
Part Word Repetition	0.94 (1.12)	0.50 (0.76)	0.33 (0.52)	1.15 (1.39)
Whole Word Repetition	5.25 (6.54)	3.71 (3.67)	3.17 (2.56)	2.80 (2.48)
Part Word revision	1.13 (1.09)	0.64 (0.84)	0.50 (0.84)	1.40 (1.50)
Whole Word Revision*	5.75 (4.09)	3.93 (2.73)	2.33 (1.97)	1.55 (2.09)

Note. Standard Deviations are in parentheses. FME=functional monolingual English; ED=dominant; BB=balanced bilingual; SD=Spanish dominant, FMS=functional monolingual Spanish

Chapter 4: Discussion

Through researching mazes and their varied uses, an entirely different platform from which to study language production is erected. In the current study, we analyzed the narrative retells produced by monolingual English and Spanish speakers as well as retells produced by bilingual English and Spanish speakers in their two languages to compare the percent of maze use and type of maze use amongst the groups. We also sought to analyze their narrative retells to compare types and percentage of mazes used between the narratives produced in their dominant and nondominant languages. General findings indicated that bilingual speakers tended to maze more in their nondominant language.

4.1 Maze Frequencies and Language Dominance

When analyzing the data, which examined the difference between the percent of mazes used in the bilinguals' English and Spanish narrative retells, a clear trend was evident. Bilinguals tended to maze more in their nondominant language. Bortfeld et al. (2001) identified a relationship between an increased number of mazes and a speaker's lack of confidence. The less one speaks and is exposed to a language, the less confidence they have using it. One could argue that bilinguals maze more in their nondominant language since the nondominant language is used less frequently (Gollan & Goldrick, 2012). The speaker may not be as confident while using it, thus relying on mazes in order to have more planning time. This theory was supported by the current study as results indicated that participants mazed more in their less dominant language. This also supported the results from Kapatsinski (2010), which stated that words used more during conversation are more automatic and require less revision than words that are produced with lower frequency. Therefore this link between language frequency of use and confidence

may explain the increased percent of mazes present during the retells in the participants' nondominant language.

Results from the current study also supported work by Gollan and Goldrick (2012) in regards to the Interference Hypothesis. The Interference Hypothesis states that words are activated in both language systems during bilingual language production thus explaining a possible reason as to why bilinguals maze more. Results from the current study contradict findings from Bedore et al. (2006) which found no significant difference between the percent of utterances with mazes used by the monolingual and bilingual children. Children and adult speakers are different in the sense that they may have varying levels of confidence with the languages, which may cause one group to maze more than the other. Perhaps children are less aware of their mistakes or just less inclined to fix them, which could explain the results from Bedore et al. The current study found a significant difference when comparing monolingual and bilingual adults when their retells were analyzed by group and language.

4.2 Maze Frequencies and Language

It was interesting to note the differences between the bilingual and monolingual groups' narrative retells in English and Spanish. There was not a difference in the percent mazes present in the English narratives, yet there was for the Spanish narratives. The ED group was found to maze more than the BB group in their Spanish narratives. One possible explanation may lie in the location in which the study was conducted. Although there are a high number of Spanish speakers in the El Paso area, English is the primary language. There is a wide individual variation in the amount of Spanish language use, however English is most likely spoken at school as well as work. Therefore, with a wider variability in Spanish, it may not be as frequently used as English. Therefore, with less use, speakers often need more mazes to compensate for

planning and production errors. These results echoed those found in the study conducted by Bedore et al. (2006) in which participants mazed more in Spanish than in English. This idea of frequency and its effects on the amount of mazes is echoed in the Weaker Links Hypothesis (Gollan et al., 2008). According to this hypothesis, individuals maze more in the language that is used with less frequency, which for many in the El Paso area would be Spanish. Another possible explanation for the increased number of mazes in Spanish narratives is that Spanish is a grammatically complex language in which verb conjugations that indicate person and tense are added to the ends of verbs (Bedore, Cooperson, & Boerger, 2012). Therefore, a slight mispronunciation of the verb ending can change the entire meaning of the word and thus result in the need for revisions, especially for those speakers who are not Spanish dominant.

Results from the current study determined that there was no difference between types of mazes in the English narratives between the monolingual English group and the three bilingual groups (ED, BB, and SD). There were, however, significant differences found between the Spanish monolingual and the bilingual (ED, BB, and SD) groups when analyzing their Spanish narrative retells. With respect to the Weaker Links Hypothesis (Gollan et al., 2008), increased mazing in bilinguals could be because they use each language less frequently than their monolingual peers, which would explain why the bilingual group used more whole word revisions than the monolingual group.

4.3 Clinical Implications

When diagnosing language disorders in children a large percent of mazes points to a possible language disorder yet results from the current study indicate that increased mazing occurs in adult bilinguals (Miller, 1996; Nettelbladt & Hansson, 1999). Therefore, a high percent of mazes alone may not be a reliable indicator of language disorder. Present research

indicates that bilinguals inherently maze more in their nondominant language; clinicians should not base the presence of a language disorder solely on the percent of mazes present in a narrative retell. Clinicians should continue to be culturally and linguistically aware so as not to over or under diagnose their patients.

4.4 Limitations

The current study had several strengths such as a larger sample size and a high reliability. However, it is not without its limitations. For instance, the FME, ED, BB, and SD groups had higher words per minute when compared to the FMS group, which may speak to their educational backgrounds. As discovered upon reviewing the questionnaires, the FME, ED, BB, and SD groups all had an average of 17 years of education compared to a mere 9 years for the FMS group. The FMS group was also older than the other groups. On average the FMS group was 44 years old compared to the FME, ED, BB, and SD groups, which were on average 27 years old. The FMS speakers were from an area in El Paso County where, according to U.S. Census data from 2013, 98.7% of the population was "Hispanic/Latino" and the median household income was $25,551, with 48.3% of the persons living below the poverty level (U.S. Census Bureau, 2013). This was in contrast to the FME, ED, BB, and SD speakers who were recruited from a public university and resided in the city of El Paso, a medium sized city where the median household income was $39,699, and only 24% of the population was considered to be living in poverty.

The current study did not take education level or age into account, which may affect frequency or types of mazes used by the participants. The FMS group was at a disadvantage because they had a lower education level (9 years) compared to the FME group (17 years). A potential relationship between education and frequency of mazes was not taken into account and

may have influenced the results. However, there were no differences in maze use during the Spanish retells. Results from Bortfeld et al. (2001) identified a relationship between an increased number of mazes and a speaker's lack of confidence. Therefore, it is possible that individuals with lower education may maze more for a variety of reasons, including lower self-esteem or because they have more grammatical/lexical mistakes in their speech.

4.5 Future Directions

Future researchers need to consider SES and education, as the adult bilingual and monolingual groups can differ quite drastically. Ideally, groups would be evenly matched on SES and education. This study acts as a starting point; however, future research must be done to confirm the validity of the results. The uneven number of participants in the bilingual subgroups is an additional limitation. There were only 6 individuals who qualified as SD bilinguals. Thus, the data may not grasp the linguistic and ability variation often present amongst speakers. In order to further validate these results, research should take great care to ensure that participant groups are equal in both numbers and years of education. Due to sanctions placed on researchers at The University of Texas at El Paso, we were unable to conduct research at universities in Mexico, which would have provided us with a monolingual Spanish group similar to those in the monolingual English group.

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