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SPEECH REVISIONS IN MONOLINGUAL ENGLISH AND SPANISH-ENGLISH BILINGUAL CHILDREN

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SPEECH REVISIONS IN MONOLINGUAL ENGLISH AND SPANISH-ENGLISH BILINGUAL CHILDREN

by

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Dissertation

Presented to the Faculty of the Graduate School of

The University of Texas at Austin

in Partial Fulfillment

of the Requirements

for the Degree of

Doctor of Philosophy

The University of Texas at Austin

May 2015

Dedication

This work is dedicated to my loving husband, Matt, daughter, Pyper, and my parents for their un-ending support. This work is also dedicated to the dearly departed Roxanne Ruiz-Felter for being inspiration from above.

Acknowledgements

I would like to thank my committee supervisor, Dr. Lisa Bedore for her support and for accepting me into her lab over ten years ago inspiring the idea for this degree. Her guidance has helped me complete this program. I am thankful to Dr. Elizabeth Peña for always providing advice and encouragement. I would like to express gratitude to Dr. Courtney Byrd for her teaching, consistent encouragement, and advice. Thank you to Dr. Almeida Toribio and Dr. Catharine Echols for serving on my committee and for their positive and encouraging feedback.

I am eternally thankful to my HABLA lab colleagues and friends: Kai, Maria, Connie, Sol, Karin, Roxanna, and Mirza. Additionally, I would like to thank Dr. Kai Greene for his long distance support through the completion of this work and to Alison Thomas for her help with this project. Further, I would like to thank the US Department of Education for the financial support I received during completion of this degree.

Speech Revisions in Monolingual English and Spanish-English Bilingual Children

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The University of Texas at Austin, 2015

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This study explores the manifestation patterns of speech revisions in monolingual English and Spanish-English bilingual children. All speakers exhibit speech revisions to some degree and some researchers have indicated that they may manifest due to linguistic uncertainty (Bedore et al., 2006; Loban, 1976). In the current study, speech revisions were documented in the context of two narrative conditions manipulated to elicit revisions. In one context, a high uncertainty condition, the narrative picture sequence depicted a vague or unclear ending to a story, therefore increasing the speaker's linguistic uncertainty. In the second condition, the low uncertainty condition, the narrative picture sequence had a logical ending reducing linguistic uncertainty. These tasks were designed to elicit speech revisions in children ranging in age from 3;5 to 5;11. Participants included 33 Spanish-English bilingual Kindergarten-age children, 32 language-matched monolingual English-speaking pre-K children, and 37 age-matched monolingual English-speaking children. All children exhibited typical language abilities based on a language screening measure. The first research question was whether there was a difference in the rate of speech revisions in English between the narratives with high and low uncertainty across the 3 groups of children. The second question pertained to whether the rate of speech revisions in their narrative samples was influenced by task (high vs low

uncertainty condition) when language productivity as measured by lexical diversity (NDW), mean length of utterance (MLU) and grammaticality. Results indicated that all of the children across the three groups exhibited fewer speech revisions in the low uncertainty condition than in the high uncertainty condition. There were no differences observed by group for frequency of revisions across task condition. Further, NDW accounted for a significant amount of the variance in frequency of revisions across all three groups. Again, there were no group differences observed in frequency of speech revisions when measures of language productivity were controlled. These results indicate that in an experimental condition, bilinguals were no more susceptible to exhibit revisions than their monolingual peers. Implications for these results and further considerations regarding revisions and the speech production process for monolinguals and bilinguals are discussed.

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Chapter 1: Literature Review

Speech revisions such as word repetitions and revisions of phrases are observed in all speakers at varying rates (Bedore, Fiestas, Peña & Nagy, 2006; Lickely, 2001; Loban, 1976; Yairi, 1972). Research in the area of speech revisions informs us that children and adults exhibit a high rate of speech revisions when they have difficulties in the language formulation process (Levelt, 1989). Increased rates of speech revisions are often considered to be a red flag for communication impairments such as language impairment (LI) and stuttering (e.g., Ambrose & Yairi, 1999; Thordardottir & Wesimer, 2002). Across languages such as Dutch, Swedish, Spanish, Kannada and Portuguese, researchers have documented the presence of speech revisions at varying rates (Bedore et al. 2006; Boey, Wuyts, Heyning, DeBodt, & Heylen, 2007; De Andrade & Martins, 2007; Kaur et al., 2011; Navarro-Ruiz & Rallo-Fabra, 2001; Nettelbladt & Hansson, 1999). As bilinguals are not always consistent in their use of one language or the other, it is not unexpected that their rate and pattern of speech revisions vary within a person.

The limited available research investigating speech revisions informs that bilinguals exhibit a higher than expected rate of speech revisions and tip of the tongue (TOT) states than monolinguals (Bedore et al., 2006; Ecke, 2004; Kroll & Gollan, 2014). Kroll and Gollan (2014) describe the TOT phenomenon as when a person has difficulty retrieving a known word. This difficulty in retrieval could manifest with partial phonological information about the word e.g., the person knows what sound the word starts with but does not retrieve the correct word. TOTs could also result in the retrieval

of the wrong word. While it is not in the scope of this work to review all pertinent information regarding TOTs, this phenomenon is important to mention as TOTs could manifest as speech revisions, e.g., the incorrect retrieval of a word during speech production could be interpreted as a lexical revision. Understanding what variables may contribute to these higher than expected rates of revisions may shed light into the speech production process for bilinguals.

Past claims of increased revisions in monolingual and bilingual speakers are based on the following types of analyses: analyses of narrative samples (re-tell and tell), conversation samples, and narratives elicited from a task designed to elicit speech revisions (Bedore et al., 2006; Fagan, 1982; Guo et al., 2008; Loban, 1976). These studies compared revisions in TD and LI monolinguals as well as functionally monolingual and bilingual speakers. Based on these analyses, researchers have hypothesized that certain groups are more at risk for the presence of increased revisions. Without contrasting tasks in these studies, authors have attributed speech revisions to speaker uncertainty in sentence formulation during the task, to memory demands in processing and/or to the effort to produce more fluent speech (Bedore et al., 2006; Fagan, 1982, Loban, 1976, Navarro-Ruiz & Rallo-Fabra, 2001). To further test claims regarding increased presence of revisions in certain groups, a contrasting task would be informative because it would allow for researchers to manipulate certain aspects of the task to see if the patterns of speech revisions change. Further, a contrasting task would be informative about what conditions may contribute to the presence of speech revisions. The goal of the current study is to evaluate if TD monolingual and bilingual speakers exhibit similar

frequencies of speech revisions in English under two different narrative conditions. Picture scenes are used to elicit narratives in which uncertainty is manipulated based on having a logical ending to the story versus a vague ending. The manipulation of the picture scenes in order to differentiate between a picture scene with a logical ending and a picture scene with a vague ending may impact a speaker's level of uncertainty in each condition, potentially impacting the frequency of speech revisions.

Information gained in this study will then allow for later comparisons of speech revision patterns to other populations, such as those with differing levels of language proficiency. Understanding why and under what conditions speech revisions manifest in these groups is important to further understand the language formulation process and the role these speech revisions may play in spontaneous speech. We first review previously defined terminology that has been used when studying revisions and then examine how the described behaviors are linked together. From these definitions we come to the operational definition for a speech revision in this project and discuss the types of speech revisions commonly observed in the literature that will be the focus of the current data collection.

DEFINITIONS OF SPEECH REVISIONS

Research across disciplines such as psycholingusitics, fluency, and language disorders often refer to speech revisions using overlapping terminology. In the domain of typical language production speech revisions are often referred to as "mazes" (Loban, 1976) or "speech revisions and repairs" (Fagan, 1982; Navarro-Ruiz & Rallo-Fabra,2001) in the domain of language or communication impairment they are referred to as "speech disruptions/disturbances" (Finnernan, Leonard & Miller, 2009; Thordardottir & Weismer, 2002) and in the area of fluency they are called "speech disfluencies" (Ambrose & Yairi, 1999; Byrd, Bedore & Ramos, 2015). Across domains these terms are used to describe distinct speech behaviors with overlapping qualities.

Interruption in the flow of speech production is common across definitions of mazes, speech revisions/repairs, speech disruptions/disturbances and speech disfluencies (Ambrose & Yairi, 1999; Finnernan et al., 2009; Guo et al., 2008; Loban, 1976; Lutz & Mallard, 1986). The stuttering literature identifies specific types of disfluencies such as sound prolongations, sound and syllable repetitions and monosyllabic word repetitions which have been attributed to stuttering (in monolingual English speakers) and those disfluencies that are considered non-stuttering like such as whole word repetitions, interjections phrase repetitions and phrase revisions (Ambrose &Yairi, 1999; Pellowski & Conture, 2002; Yairi & Ambrose, 1992). The distinction between stuttering like and non-stuttering like disfluencies is not without controversy in the literature. There is disagreement whether monosyllabic word repetitions should be considered stuttering like versus non-stuttering like for monolingual English speakers (Brocklehurst, 2013;

Einsardottir & Ingham, 2005). Across the domains of language production, psycholinguistics and stuttering there is overlap in examining speech revisions considered to be non-stuttering like (Ambrose & Yairi, 1999; Bedore et al., 2006; Byrd et al., 2015; Dollaghan & Campbell, 1992). For example, the previously cited articles all examine interjection/fillers e.g., "um" in their analysis of speech revisions which are considered to be non-stuttering like.

In reviewing all of the terminology (mazes, speech revisions/repairs, speech disruptions/disturbances and speech disfluencies), the term speech revision accurately encompasses the definitions for these terms as it describes the presence of a speech behavior that is an online correction of one's intended message. For the purposes of this work, we included speech revisions that have been identified in previous works such as content type revisions (e.g., lexical revisions, grammatical revisions, phonological revisions) and those considered to be editing type speech revisions such as interjections/filled pauses, repetitions and connectors (Bedore et al., 2006; Dollaghan & Campbell, 1992; Fagan, 1982; Guo et al., 2008; Kaur et al., 2011; Thordardottir & Weismer, 2002). Specific types of speech revisions in this study are the same that were used in the Bedore et al. (2006) study. For further description and examples from the current study of these revisions, please see Table 1.

Table 1: *Speech Revision Types and Coding Scheme*

Speech Revision Type	Description	Example/Code
Repetition	The repetition of a sound, syllable, whole word or phrase. Repetitions can occur at any point in the utterance.	The (p)[REP] pig got down. (To)[REP] tomorrow is Friday. The boy was holding his dog (and)[REP] and his turtle.
Interjection/Filled Pause	A non-meaningful vocalization during speech that can occur at the beginning of utterances or between words.	(Uh)[INT] The boy was holding his frog and his turtle. The black horse is (uh)[INT] in the fence.
Connector	Repetitive words or phrases such as conjunctions or time markers used at the beginning of utterances.	(And then)[CON] the bee stung him. (And)[CON] she felt something on her hand.
Lexical Revision	Revision of overt word choice errors that can take place at any point in the utterance.	(All)[LREV] two of the children were trying to help. (And they call)[LREV] and they named the fish goldie.
Phonological Revision	Revision of a phonological error that can take place at any point in the utterance.	He (scraw)[PREV] scream at the frog. (Weave)[PREV] leave my friend alone.
Grammatical Revision	Revision of overt grammatical error that can take place at any point in the utterance.	He (stick)[GREV] stuck out his tongue, And then (they)[GREV] he made a sign.

Note. Coding scheme adapted from Bedore et al. (2006). Speech revisions are in parentheses. Codes entered in SALT are in brackets to the right of the parentheses.

SOURCES OF SPEECH REVISIONS

Speech revisions are attributed to a variety of causes such as difficulties in the language formulation process potentially due to an individual's linguistic uncertainty (Bedore et al., 2006; Loban, 1976). Linguistic uncertainty refers to the level of certainty someone experiences while formulating a message, which could be impacted by factors

such as familiarity with the topic being discussed or linguistic ability (Loban, 1976). In addition, researchers have suggested that speech revisions can be attributed to increased linguistic complexity and efforts to produce fluent speech (Fagan, 1982).

In his longitudinal study of language development, Loban (1976) examined the speech revisions in the speech of first grade children through the twelfth grade. He followed three groups with 35 children in each group. The groups included a high language ability group, low language ability group and a group selected at random from the entire dataset of 211 total children. Children were classified as high or low in language ability based on teacher interviews. The teachers rated student's abilities in the following areas: amount of language, quality of vocabulary, skill in communication, organization, purpose and control of language, wealth of ideas and quality of listening. Teacher ratings were averaged over the thirteen year period to assign children to either the high or low language ability groups for analysis. A random group was included as a comparison to the high and low language ability groups. As part of the yearly data collection, each subject completed an oral interview in the Spring of each year. These interviews were then analyzed for speech revisions. He calculated the average length of revisions per utterance and percent number of revision words as a measure of linguistic uncertainty (frequency of revisions associated with linguistic uncertainty) and found that speakers stayed stable (presenting with either high revisions or low revisions) in their speech over time. Revision rate tended to stay stable even as speakers gained linguistic experience and increased linguistic complexity. Loban suggested that "low" frequencies of speech revisions may indicate that children were more careful in their language

production and therefore exhibited fewer speech revisions, or it could indicate a lower level of ability such that a child with lower language skills may produce shorter simple utterances. He further noted that those with high amounts of speech revisions may have been eager communicators who produced speech without cohesion or who were disorganized in their thoughts.

In another early study, Fagan (1982) studied the speech revisions of 20 TD English-speaking fifth graders. The language samples analyzed were recordings of the students telling an imaginary absent student about a social studies lesson they had missed. Specific revision types studied what he referred to as "edit mazes", a revision of a word or phrase, word repetitions and filled pauses, "uh" or "um". He hypothesized that with increased sentence complexity, children would exhibit more revisions. Results indicated that the frequencies of all three revision types were significantly correlated with sentence complexity. In his discussion, Fagan emphasized that speech revisions may serve different roles depending on the part of the utterance it appears. Revisions before nouns were to modify word choice or to correct a phonological error while revisions before verbs served to buy time while retrieving the verb stem or edit verb choice. Revisions may buy a speaker time when retrieving a word or be a necessary part of correcting word sequences that have already been produced. He also indicated that revisions may be attributed to memory demands during the language production process, allowing for only part of an utterance to manifest as a revision while initiating the following utterance. Fagan emphasized that revisions likely manifest to help a speaker achieve fluency during speech production, versus impeding the speech production process.

In a study by Guo et al. (2008) the authors studied speech revisions in children with LI (mean age = 9.95) as compared to age-matched (mean age =8.13) and language-matched peers (mean age = 9.97). The authors used a narrative picture description task with a "vague" story ending to try and elicit speech revisions from both groups. Speech revisions documented in both groups of speakers included: syllable repetitions, word repetitions, phrase revisions and pauses. The authors found that children in the LI group showed higher rates of revisions than their age-matched peers but not their language-matched peers. The authors suggested that the increased revisions indicated less mature levels of lexical and syntactic knowledge in the LI and language-matched groups and, further, reflected more lexical and syntactic deficits in the LI group. Across the above reviewed studies revisions have been identified in *both* the TD and LI groups warranting further investigation as to the potential relationships among variables contributing to higher frequencies of revisions in one group versus the other.

Research examining children's speech revisions offers competing interpretations with regard to an individual's linguistic knowledge and experience with a language. Revisions found in typical speakers have been described as a self-control and coordination mechanism that helps speakers disambiguate spoken messages (Bortfeld, Leon, Bloom, Schober & Brennan, 2001; Evans, 1985; Navarro-Ruiz & Rallo-Fabra, 2001). An example of this coordination includes when a speaker uses a filled pause or interjection term such as "uh" which may indicate to a conversation partner that they need more time to formulate their message so that their conversational turn is not ended by the other communication partner. Another example of this would be when a speaker

revises a word or phrase for the purposes of clarification of their message "The boy (ran I mean) rushed over to where the boat sank." In this example the speaker revised the message online to provide more specific information for the listener. In speakers with more language experience in a certain language (more time using and hearing a language such a monolingual speaker versus a bilingual speaker who may split their time between hearing and using two languages), one may expect that a speaker with more experience may exhibit more self- control and coordination mechanisms expressed through speech revisions (e.g., a lexical revision where the speaker revises their lexical choice) than a speaker with less experience with a certain language that may not have enough experience to revise their message (Kroll & Gollan, 2014; Navarro-Ruiz & Rallo-Fabra, 2001).

Speech revisions have also been attributed to increased processing load and the production of longer utterances (Bortfeld et al., 2001; Shriberg, 1996). Shriberg (1996) found that in three separate conversational tasks with monolingual adults longer utterances consistently had more speech revisions than shorter utterances. Similarly, Wagner, Nettelbladt, Sahlen, and Niholm (2000) found speech revisions to be significantly related to longer utterances in a narrative task compared to a conversational task, attributing potential differences to task demands imposed on the children. In the Bedore et al. (2006) study of speech revisions in Spanish-English bilingual children, the authors found that the rate of occurrence for speech revisions was positively correlated with MLU in both English and Spanish. This similarity in positive correlation between MLU and speech revisions across languages indicates that longer utterances are likely to

have an increased presence of speech revisions which were unrelated to any type of language impairment.

CROSS LANGUAGE DIFFERENCES IN REVISIONS

The little available work pertaining to speech revisions in bilinguals has provided important information regarding potential patterns in the presence of speech revisions. Bedore et al. (2006) studied the narratives for 22 typically developing (TD) Spanish-English bilinguals and narratives of age-matched functionally monolingual English peers. The authors documented filled pauses, repetitions, grammatical, lexical, and phonological revisions as well as connectors. (See Table 1 for further description and examples of these revision types used in the Bedore et al. 2006 study and those used in the current study). The authors found a significant correlation between MLU and number of total words and the presence of revisions in both languages. Children exhibited more revisions overall in their narratives in Spanish than in English. Specifically, children exhibited higher rates of multisyllabic word repetitions and grammatical revisions. The authors attributed the increased language-specific characteristics of Spanish such as greater grammatical complexity (more morphosyntactic elements such as articles that must agree with their nouns) creates more opportunities for children to revise their message in Spanish than English. Most of the revisions observed by the children in Spanish were to revise an article (grammatical revisions). In Spanish, there are eight possible article choices for the speaker (el, la, un, una, los, las, unos, and unas). This result serves as an example of the syntactic differences between languages that may affect speech revisions in bilingual speakers.

A similar language specific result was also noted in a study by Byrd et al. (2015) where the authors found that TD Spanish-English bilingual kindergarteners exhibited significantly more revisions that were considered stuttering-like based on monolingual English norms (sound and syllable repetitions and monosyllabic word repetitions) in Spanish than in English. These results speak to the need for careful documentation and investigation of speech revisions in TD bilingual speakers to inform about possible language-specific patterns. The results of Byrd et al.'s (2015) study highlights the potential for misdiagnosis of a fluency disorder due to the increased presence of revisions in TD speakers and converges with the pattern of higher frequency of speech revisions in Spanish observed in the Bedore et al. (2006) study.

A recent study by Hopper (2014) examined the narrative re-tells in English and Spanish of Spanish-English bilingual children ranging in age from 5-9 years old. Data was collected for the students at the beginning and end of the school year for each child in K, 1st grade and 2nd grade. Utterances were determined to be simple or complex and then analyzed for average percent revisions per utterance. The authors found higher average percentages of revisions in complex versus simple utterances. Over time, the authors found that revisions in English remained stable, while there was a decrease in revisions in Spanish over time. The patterns observed over time are partly in agreement with those of the study of Loban (1976), where there appeared to be a stable trend of revisions in English over time. The finding that revisions in Spanish decreased over time warrants further investigation into potential language specific patterns about how speech revisions may change over time in bilinguals. This study also provides insight about

potential patterns in speech revisions related to linguistic complexity such as simple versus complex utterances highlighting the important of taking into account measures of linguistic complexity in the study of speech revisions.

Studies pertaining to languages other than English and Spanish also inform about the presence of speech revisions in bilingual speakers. Kaur, Hegde, Shruti, Kumaraswamy, and Subba Rao (2011) studied speech revisions in English-Kannada bilinguals and functionally monolingual Kannada children ranging in age from 6 to 8 years old during a narrative task. Each group of 20 children told 3 stories (one in Kannada, English, and a free condition where they could mix languages). The monolingual Kannada speakers in this study had exposure to English in school but spoke Kannada at least 70% of the time. Authors found that bilingual Kannada-English speakers exhibited more speech revisions overall than their monolingual Kannada-speaking peers. Within group results indicated that the bilingual group exhibited more revisions in their non-dominant language, English. The functionally monolingual group of Kannada speakers exhibited more revisions in the Kannada condition. The authors suggest that the functional monolinguals in the study likely exhibited more revisions in Kannada due to their lack of experience with English which made them less likely to be able to correct or revise messages in English. These findings for English are in contrast to the work of Bedore et al. (2006) where the authors found more overall speech revisions in Spanish for both the bilingual and functionally monolingual English speakers. In the bilingual group the children were exposed to English from an earlier age, allowing them to be able to revise intended messages in English. The authors further discuss how

bilingual speakers with differing levels of language experience may process and manipulate language differently than their monolingual peers. Information gained from these studies in bilingual speakers is an important starting point in documenting speech revision patterns associated with using two languages from an early age.

SPEECH REVISIONS AND RISK GROUPS

The increased presence of speech revisions has been attributed to communication impairments. Leadholm and Miller (1995) proposed guidelines when considering the presence of speech revisions in monolingual English speakers to help distinguish between typical language and language impairment. They suggested that when children exhibit revisions of 20-25% or more of the total utterances produced, more than one revision per utterance and more than three words produced per revision, clinicians should be concerned for the possibility of impairment. Communication impairments such as language impairment and stuttering overlap in the types of speech revisions observed in the speech of differing groups of monolingual children. Understanding how some of these revisions manifest in different impairments is important when observing patterns of revisions in TD speakers. Dollaghan and Campbell (1992) compared the speech revisions of children with language impairment due to traumatic brain injury and those with typically developing language. Speech revisions present in the speech of both groups included revisions at the sound level such as phonological/sound revisions and syllable repetitions, word level (word repetitions), phrase level (grammatical and lexical revisions) and different pauses such as filled pauses (“uh” or “um”) and silent pauses. The groups differed in the occurrence of silent pauses, indicating that even years post

brain injury language processing was still being affected in comparison to the relative low occurrence of silent pauses in TD speakers. Further, Hall, Yamashita and Aram (1993) compared the speech revisions of children with specific language impairment (SLI) to those with SLI and a concomitant phonological disorder and found that the children with the concomitant phonological disorder had more speech revisions at the sound and syllable level (sound and syllable repetitions) which are most commonly associated with stuttering (Ambrose & Yairi, 1999; Carias & Ingram, 2006).

Thordardottir and Weismer (2002) compared the speech revisions and filled pauses in children with language impairment (LI) to those of their MLU matched TD peers. Specific speech revisions documented included word repetitions, content mazes (e.g. revisions at the phrase level such as a semantic revision where a lexical item is changed) and filled pauses (e.g., "uh" and "um"). Children with LI exhibited more speech revisions than the MLU matched TD peers, indicating that increased presence of revisions could be indicative of a language learning difficulty. Finnernan et al. (2009) studied the speech revisions in school age children with LI as compared to their TD peers on two different priming conditions (a different syntax condition where the children described pictures with different grammatical structures and a matching syntax condition where they described pictures with the same grammatical structure). The children with LI exhibited more speech revisions such as repetitions, fillers and longer silent pauses than their TD peers in both conditions. The authors suggest that the children with LI exhibited more speech revisions than their TD peers due to lower levels of automaticity in language formulation. Results of this study are also in agreement with a study by

Nettelbladt and Hansson (1999) that compared speech revisions in Swedish speaking children with LI and their TD peers. The authors found that both groups exhibited pauses, word repetitions and revisions though the LI group exhibited significantly more than the TD group.

Research in the area of stuttering has indicated that high rates of speech revisions observed at the sound and syllable level such as sound repetitions (the repetition of a single sound e.g., "S s stop it"), syllable repetitions or part word repetitions (e.g. "bo boring") and audible (e.g. "b…….bear") and inaudible sound prolongations (e.g. ".. …..bear") are most often associated with stuttering (Ambrose & Yairi, 1999; Byrd, Logan & Gillam, 2012; Carias & Ingram, 2006). The frequency of these speech revisions are often part of the differential diagnosis for stuttering should these revisions reach a certain percentage out of total words produced by a speaker. The current standard for monolingual English speakers is more than 3% of stuttering like speech disfluencies out of a 100 word sample is considered to be an indication of stuttering (Ambrose & Yairi, 1999). Currently there is no standard for bilingual speakers in the differential diagnosis of stuttering though speech revisions such as sound repetitions, syllable repetitions and sound prolongations have been observed in Spanish-English bilinguals with suspected or confirmed stuttering (Bernstein Ratner & Benitez, 1985; Byrd et al., 2015; Carias & Ingram, 2006; Howell et al., 2004; Taliancich-Klinger, Byrd, & Bedore, 2013).

While it is out of the current scope of this study to focus on variables contributing to stuttering in bilinguals, it is important to note that TD Spanish-English bilinguals who do not stutter have been shown to exhibit both stuttering and non-stuttering like speech

behaviors per monolingual English norms (Ambrose & Yairi, 1999; Byrd et al., 2015). Further, some research has suggested that bilinguals may be at risk for developing stuttering due to exposure to two languages before starting school (Howell et al., 2009). As this research has not been replicated, it is not surprising that controversy exists regarding the results and suggested implications regarding this study (Byrd et al. 2015). While controversy exists regarding whether or not bilinguals may be at risk for developing stuttering due to their exposure to two languages, it is important to consider that this point of view exists in the literature (Howell, et al. 2009). As there is overlap in the literature regarding speech revisions and disfluencies, results from the current study may provide insight to a bilingual child's speech behaviors in English in a controlled condition.

It is important to consider the data available from the above referenced studies as they are informative regarding the comparisons of speech revisions and the types of revisions seen to date in children with stuttering, LI and TD speakers. While these comparisons show that higher rates of certain revisions are observed in the LI groups (e.g., more pauses) or in children who stutter (sound and syllable repetitions), these studies consistently report that the TD speakers also exhibit the presence of the same kinds of revisions in their speech. Therefore, examining patterns of revisions in TD bilingual speakers as compared to their monolingual peers will provide more information regarding what factors and variables (e.g. MLU, sentence complexity, and linguistic uncertainty) may play a role in their presence.

MODELS OF SPEECH PRODUCTION AND SOURCES OF SPEECH REVISIONS

In order to understand how revisions may manifest in speech, we examine Levelt's classic (1989) model to gain insight as to how the revisions in the current study may be linked and to what may happen during the language formulation process when a speaker exhibits a speech revision. In Levelt's (1989) speech production model, speech production is an incremental process where the speaker proceeds through levels to formulate a message. The speaker conceptualizes a message, retrieves "lemmas" (words) and morphological information, and then retrieves the phonological/articulatory information needed to express the message. Uncertainty may be present at any of these levels and, as result of a speaker's linguistic uncertainty, speech revisions could manifest at the grammatical, word, or phonological level.

More recent models of speech production have expanded on the incremental processes described above in Levelt's (1989) model. Hartsuiker and Kolk (2001) expand on Levelt's monitoring theory by adding up temporal durations of processing stages to help predict when interrupting and repairing during the speech production process takes place. The model includes the same stages of speech production as Levelt (1989) including: conceptualization, formulation and articulation. Expanding on Levelt (1989), the model proposed by Hartsuiker & Kolk (2001) includes two stages of articulation, a selection stage and a command stage. Motor programs are chosen and activated in the selection stage and then executed in the command stage. Additionally, this model extends the process of monitoring described in Levelt's (1989) model by distinguishing three components within the monitor: comparing, interrupting and restarting. In this

model, when a speech error is detected (comparing component) a parallel process of interrupting the flow of speech and restarting speech occurs (exhibited by speech revisions). This contrasts with Levelt's (1989) theory that the repair process for speech production could not begin until interruption in the flow of speech was completed.

Another recent expansion/adaptation of Levelt's (1989) work specific to lexical access is Oppenheim, Dell, and Schwartz's (2010) Dark Side Model of lexical access. The authors take learning and experience into account (versus considering speech production as a stable process) by incorporating an incremental learning process to continually shape its semantic to lexical relationships. In this model there is a light side and a dark side to shaping the semantic/lexical relationships. The light side learns a target mapping by strengthening connections from activated semantic features to a target word. The dark side unlearns competing mappings by weakening connections from the same semantic features to other activated words. Together, these processes continually strengthen and weaken the semantic/lexical connections. This process accounts for correct word retrieval latencies noted in TD speakers. A TD speaker may exhibit latency in correct word retrieval due to strengthened and weakened connections depending on number of times they have retrieved a certain word with competing relationships to that word being strengthened and weakened.

Levelt's classic (1989) model and the more recent models that follow a similar incremental framework for production provide important information regarding how speech revisions may manifest (Hartsuiker & Kolk, 2001; Oppenheim et al., 2010). Recent work in bilingual speech production further informs on these relationships for

bilingual speakers. The frequency lag or weaker links hypothesis (Gollan, Montoya, Cera & Sandoval, 2008; Gollan, Sandoval, & Salmon, 2011) was proposed to explain why bilinguals at times seem to navigate two languages without difficulties and at other times are considered to be at a disadvantage to their monolingual peers. This bilingual disadvantage is due to bilinguals spending less time speaking both of their languages than the time a monolingual spends speaking only one language. This difference in frequency of time spent speaking their respective languages between bilinguals and monolinguals potentially puts bilinguals at a disadvantage in lexical processing tasks such as vocabulary measures and in the retrieval of low frequency words (Bialystock, Luk, Peets & Yang, 2010; Murray & Foster, 2004; Peña, Bedore & Zlatic-Giunta, 2002). A potential effect of this disadvantage could be the presence of increased speech revisions, e.g., interjections which have been attributed to the speaker "buying time" during message formulation while they attempt to retrieve the right word (Fagan, 1982) or the opposite effect where a bilingual due to their limited experience with one of their languages may exhibit more simple utterances in their less dominant language due to inability to navigate and self-correct in that language (Navarro Ruiz & Rallo-Fabra, 2001).

Another theory, the competition for selection hypothesis (Green, 1998; Kroll, Bobb, & Wodniecka, 2006) posits that in the sentence planning process, a bilingual's two languages are competing for selection even when the speaker is planning in one language. Selections are activated in both languages with one language being inhibited. Some researchers have found that the inhibited language is the dominant language (Guo, Liu,

Mistra & Kroll, 2011; Kroll, 2008). These theories are informative regarding the processing demands during speech planning for bilinguals.

In order to study the theory of competition in speech planning for bilinguals, researchers have focused on the competition between a bilingual speaker's two languages and less so on comparing bilinguals to monolinguals (Kroll & Gollan, 2014). Difficulties with inhibitory control in the speech production process may also manifest as speech revisions. For example, lexical and grammatical revisions may reflect the speaker's repair of an initial unsuccessful attempt to inhibit a competing lexical/grammatical unit for selection. Understanding how speech revisions manifest and under what conditions they may occur in both bilinguals and monolinguals will be informative about potential similarities and differences in processing demands in the speech production process for these two groups.

While speech revisions have been documented across languages and ability groups, we still do not know how the factors that lead to speech revisions interact. Further, there is less information about how these factors may affect a bilingual speaker. Children require some degree of skill and metalinguistic awareness to make revisions. Thus, in some cases speech revisions may also be indicative of linguistic knowledge that allows individuals to correct what they have to say in order to disambiguate their message (Evans, 1985; Navarro-Ruiz & Rallo-Fabra, 2001). Given their divided language input, bilingual children may know less about each of their languages than their monolingual peers, allowing bilinguals to exhibit more revisions than their monolingual peers (frequency lag hypothesis) (Kroll & Gollan, 2014). On the other hand, speakers are

thought to revise their message because they have linguistic uncertainty which does not distinguish between a monolingual's language experience and a bilingual's divided language experience (Loban, 1976). Linguistic uncertainty may be attributed to unfamiliar context/ideas or the production of complex utterances (e.g., Bedore et al., 2006; Fagan, 1982; Loban, 1976). In Spanish-English bilingual children, linguistic uncertainty could be associated with unfamiliarity with vocabulary or difficult language structures (low frequency forms such as subjunctive forms in Spanish) (Bedore et al., 2006). Further exploration of linguistic uncertainty in TD speakers and how it may impact the speech revisions in monolingual and bilingual speakers would offer additional insight into the language formulation process for both groups.

Incremental speech production models (Hartsuiker & Kolk, 2001; Levelt, 1989; Oppenheim et al., 2010) and more recent work relating to bilinguals in the frequency lag hypothesis and competition for selection hypothesis (Gollan et al., 2011; Green, 1998; Guo et al., 2011; Kroll, et al., 2006; Kroll & Gollan, 2014) inform about language formulation and how revisions may manifest due to uncertainty or inhibitory control. What we do not know is if attempts to manipulate a contributing factor of revisions, i.e., linguistic uncertainty (e.g., through manipulating key vocabulary presented during a narrative task), would affect the way that revisions manifest in typical speakers during the language formulation process. Manipulating linguistic uncertainty through a task where there would be familiar versus unfamiliar vocabulary and concepts would allow for the elicitation of revisions in a controlled way so that patterns of revisions in conditions with different levels of uncertainty can be documented in the speech of TD monolingual and

bilingual children. In this study the operational definition of linguistic uncertainty is one's level of uncertainty during message formulation which could be impacted by several factors including familiarity with vocabulary or ideas. One could experience high or low certainty depending on the context or situation. In a high uncertainty situation a person may exhibit more speech revisions, whereas in a low uncertainty context an individual may experience few or no speech revisions (Loban, 1976).

The purpose of this study is to explore patterns of speech revisions exhibited in English in younger TD monolingual English-speaking and Spanish-English (SE) bilingual children by manipulating a narrative task previously seen to elicit revisions in older school age children (Fey, Catts, Proctor-Williams, Tomblin & Zhang, 2004; Guo et al., 2008). Eliciting revisions in younger children developing their linguistic foundations in English allows for a unique opportunity to capture speech revisions during a critical time in their language development. Looking at bilingual children of Kindergarten age in comparison to a younger group of language-matched controls will help control for possible group differences being attributed to differences in MLU as bilingual children have been shown to have lower MLU's than their age matched peers (Paradis & Genesee, 1996). This study will also address questions pertaining to whether revisions in Spanish-English bilinguals manifest due to increased levels of uncertainty (as manipulated by narrative context) or measures of linguistic complexity as measured by mean length of utterance, number of different words (NDW) and grammaticality.

The measures of linguistic complexity chosen for this study have been explored in other work pertaining to speech revisions, specifically, MLU (in Bedore et al. 2006;

Zackheim & Conture, 2003) where TD speakers have exhibited a higher frequency of speech revisions in relation to an increased MLU. Normative language data provided for monolingual English speaking children through the age of 13 shows increases in the development of MLU and NDW (Leadholm & Miller, 1995) highlighting the importance of exploring of NDW in bilingual populations to see if there is a relationship between MLU and NDW in the presence of speech revisions in bilinguals. NDW has been shown to differentiate children with TD and LI in monolingual English speakers (Miller, 1991; Watkins, Kelly, Harbers, & Hollis, 2005). As the frequency of speech revisions has been associated with the presence of LI, it is important to control for measures of linguistic complexity which have been previously been shown to differentiate ability groups. Grammaticality was explored in the current study as a measure of complexity as it has previously been shown to distinguish TD from LI Spanish speakers and Spanish – English bilinguals (Fiestas & Peña, 2004; Restrepo, 1998) relevant to the Spanish-English bilinguals in the current study. The specific research questions to be addressed are:

1. Is there a difference in the frequency of speech revisions in English between the high uncertainty and low uncertainty narrative conditions for the monolingual and bilingual groups?
2. Is the rate of speech revisions in narrative samples influenced by narrative condition (high vs low uncertainty) when you control for language productivity as measured by NDW, MLU and grammaticality?

I predict that speech revisions for both the monolingual and bilingual groups will be correlated with syntactic complexity measures such as NDW, MLU in morphemes (MLUm) and grammaticality across the low and high uncertainty conditions. As children use more complex language they will be more likely to exhibit revisions as a product of their more complex output. I expect that the bilingual group will show more speech revisions overall than the monolingual control group as the bilingual group is in the process of learning English and still being exposed to and using Spanish versus the monolingual group that has a stronger foundation in English and only uses English. In addition, children in both groups will likely exhibit more revisions during the high uncertainty narrative task than the low uncertainty narrative task as the vague and unclear narrative endings will be more likely to elicit revisions in their output.

Chapter 2: Method

PARTICIPANTS

Approval for this study was obtained from the University of Texas Institutional Review Board. A total of 106 children were recruited for the study from bilingual and monolingual preschool classrooms and daycares in the north Texas area. The participants in the study included 33 TD Spanish-English bilingual children of Kindergarten age ranging in age from 4;7 to 5;11 (mean = 70.93 months SD = 3.9 months), 37 TD age-matched monolingual English speaking children ranging in age from 4;7 to 5;11 (mean = 70.05 months SD = 3.9 months) and 32 TD younger monolingual English speaking children ranging in age from 3;5 to 4;6 (mean = 49.7 months SD = 6.4 months) to serve as younger group language-matched controls based on MLUm in the baseline narrative retell task in English (Rice, 1990). The younger group served as language-matched controls to the bilingual group while the age-matched monolingual English speaking group served as a comparison group to the bilingual group based on age. A power analysis determined that 30 children per group would be sufficient to show differences between groups for the frequency of speech revisions. The number of children per group is comparable to the number of subjects per group in a recent study of speech revisions in bilingual speakers by Kaur et al. (2011).

One child in the age-matched group was excluded from the analysis as the audio recording for the baseline task was corrupted. Another child in the age-matched group was excluded from the final analysis due to hearing impairment confirmed by the parent during the parent interview. Two children in the language-matched group were excluded

from the final analysis as they were not able to complete the experimental task, yielding limited output. The final analysis included 102 children (33 bilingual, 37 AM and 32 LM). In the baseline narrative retell, *Frog on His Own* (Mayer, 1973) (FOHO), the average MLUm for the monolingual age-matched group was 7.52 (1.11), the average MLUm for the bilingual group was 6.57 (1.05), and the average MLUm for the language-matched monolingual group was 6.61 (1.58).

All children that returned a signed consent form participated in the language screening with the Bilingual English Spanish Oral Screener (BESOS) screener (Peña, et al., 2008) including a parent or caregiver interview and a baseline narrative re-tell in English of the story *Frog on His Own* (Mayer, 1973). All participants in the study met the following criteria:

- Typical hearing and cognition as confirmed by parent report.
- Typical language development as determined by passing scores on the BESOS screener.
- A minimum MLUm of 4.0 for the baseline narrative task.

Specific criteria for the language-matched group included:

- The completion of the baseline narrative task with an MLUm of 4.0.
- English only input and output as determined by parent interview.
- BESOS scores above the 25th percentile for the Semantics and Syntax subtests (corresponding to -.67 Z score).

The two children that were excluded from the final analysis affected the observed range of MLUm in the narrative task for the language-matched group (4.0 MLUm – 12.0 MLUm). Specific criteria for the monolingual age-matched group included:

- English only input and output as determined by parent interview.
- Age range of 4;7 – 5;11.
- BESOS scores above the 25th percentile for the Semantics and Syntax subtest (corresponding to -.67 Z score).

Group specific criteria for the bilingual group included:

- Use of English and Spanish as confirmed by the parent questionnaire.
- BESOS scores above the 25th percentile on 3 out of the 4 subtests (corresponding to -.67 Z score).

Observed rates of ENG input and output ranged from 28% - 76% for the bilingual group.

PROCEDURES

Materials

Qualifying Screening. All children whose parents signed a consent form approved by the University of Texas IRB were screened for typical language development via the Bilingual English Spanish Oral Screener (BESOS, Peña et al., 2008). Children were screened using the BESOS presented via computer screen. The experimental version of the BESOS (Peña et al., 2008) served as the primary indicator of typical language development as this screening measure tests semantic and syntactic knowledge. The screener consists of 4 subtests: English Semantics, English Morphosyntax, Spanish Semantics and Spanish Morphosyntax. Test items selected from the items set for the comprehensive Bilingual English Spanish Assessment (BESA) (Peña et al., 2014). The BESOS morphosyntax subtests contain cloze and sentence repetition items (17 English items and 16 Spanish items). Research using the BESA morphosyntax subtest indicates good sensitivity and specificity for children to be studied (Gutiérrez-Clellen & Simon-Cereijido, 2007). Correlation between the BESA and BESOS morphosyntax indicate a significant relationship in each language of .826 (Spanish) and .893 (English). The semantics tests in both languages include receptive and expressive items. In English there are 11 total items (4 receptive, 7 expressive) while the Spanish version contains 12 items (5 receptive, 8 expressive). A strong positive correlations of .855 (Spanish) and .887 (English) have been found between the BESOS semantics screener and the BESA test where the items for the BESOS were drawn from (Lugo-Neris, Peña, Bedore & Gillam, in press).

Children also completed a narrative retell in English based on the wordless picture book *Frog On His Own* by Mercer Mayer (1973). The purpose of the baseline narrative was to ensure that the children could generate a narrative and, therefore, likely be able to complete the experimental task. Additionally, the MLUm for group selection was calculated from this narrative. All audio files from the screening sessions were uploaded onto a Dell Latitude E6500 laptop for scoring, transcription and analysis by the author who is an ASHA certified bilingual speech language pathologist and a research assistant trained by the first author. All digital and paper data were de-identified by assigning the child a number for the purposes of the study. Digital data was secured via the University's password and firewall protected data server. Only authorized research personnel for the study had access to the digital and paper data.

Parent Interview. A detailed parent interview was used to collect information regarding language input and output for each child participating in the experimental portion of the study (Peña et al., 2008). This interview served to ensure each child's monolingual or bilingual status. In this questionnaire parents were asked questions pertaining to their child's language exposure and use of each language. Parents provided information regarding socio- economic status (SES) as well as detailed information about the languages their child has been exposed to since birth. In the last part of the questionnaire parents provided information regarding an hour by hour account of their child's language input and output for one week day and one weekend day. This information determined the child's percentage of input and output in each language. This parent questionnaire correlates significantly with language dominance and performance on semantics and syntax measures (Bedore et al., 2012; Gutierrez-Clellen & Kreiter, 2003). Means and standard deviations for mother education as an index of SES, age of acquisition of English and percent English input and output are provided in Table 2 for each group. A univariate analysis of variance (ANOVA) was run to test for differences between the mean SES based on mother education of the three groups. Results of the ANOVA indicated a statistically significant difference between the bilingual group and two monolingual groups (AM and LM): $F(2,99) = 48.18$, $p>.001$, η^2 *partial* = *.49* (large effect) based on the conventions of Murphy & Myors (2004) indicating a lower mean SES for the bilingual group compared to the monolingual ENG groups. The two monolingual ENG groups did not differ statistically from each other in terms of SES. SES was not considered as a potential variable contributing to the presence of speech

revisions in this study, though the groups differences based on this result will be taken into account in the discussion section.

Table 2: *Demographic Means and Standard Deviations*

Group	N	Mean SES	AOA	% ENG
Bilingual	33	2.73 (1.70)	2.03 (2.08)	.51 (.15)
Language Match	32	5.00 (1.19)	.0 (.00)	.10 (.00)
Age Match	37	5.54 (.73)	.0 (.00)	.10 (.00)

Note. Mean SES based on mean Hollingshead values for mother education. Age of acquisition (AOA) is the mean age in years that the children were first exposed to English.

Experimental Narratives. For the experimental narratives, a story telling task developed by Fey et al. (2004) and replicated by Guo et al. (2008) designed to elicit speech revisions in school age children with and without language impairment was used as the high uncertainty condition. In the original work by Fey and colleagues (2004) and Guo et al. (2008) the sequence of pictures was determined to be "vague" or unclear (high uncertainty) and not provide the children with adequate information (based on the pictures scenes) about the story ending, therefore allowing for more speech revisions. There were 4 high uncertainty narratives, each with 3 pictures. Please refer to Appendix A for further description and picture scenes of the high uncertainty narratives presented during the experimental task. Pilot testing on this task was completed with 4 monolingual English speaking children (2 pre - K age children and 2 Kindergarten age children). All 4 of the children completed the narrative task and exhibited the revision types described in Bedore et al. (2006) adapted for the current study. Data for one of the Kindergarten children showed a higher percentage of overall speech revisions than three of the other children in both tasks indicating that this task may be sensitive at capturing within group differences in the presence of speech revisions. Additionally, all of the pilot participants exhibited more overall speech revisions in the high uncertainty condition than in the low uncertainty condition.

A low uncertainty condition was created to contrast with the high uncertainty condition. Children were asked to tell 3 narratives from 3 picture sequences. These narrative scenes were adapted from picture sequence sets from *The Entire World of Celebrations and Seasons* sequence cards by Say It Right (2007). These sequences

depicted 3 pictures with comparable detail and imagery to those of the high uncertainty narratives as determined by ratings from 5 ASHA certified speech language pathologists and ten MA level students in speech language pathology. The third picture in the low uncertainty narrative scene depicted a logical ending to the sequence.

For the purpose of this study all of the pictures in the low and high uncertainty condition were re-drawn for consistency of style. The picture scenes were rated as either logical (low uncertainty) or vague (high uncertainty). Ten Masters level graduate students in speech language pathology and 5 certified speech language pathologists rated all the picture scenes on a scale from 1 -5 with 1 being vague and 5 being logical. All raters assigned the high uncertainty pictures a 5 and the average rating for the low uncertainty pictures was 1.13. Please refer to Appendix A for further description and the sample pictures used in the low uncertainty and high uncertainty condition. A SONY DS-30 digital voice recorder was used to audio record all experimental narrative sessions for later analysis. All narrative scenes were presented via a computer screen.

TESTING PROCEDURES.

Qualifying Screening. All data collection took place in a quiet room in the child's daycare center or school. The examiner explained that the children would be looking at pictures and answering some questions. Positive feedback for participation such as "you are working so hard" and "I like the way you are answering my questions" was provided as needed to keep the children on task and participating. Data collection started with the BESOS screener presented via computer screen and a baseline narrative retell, "Frog on His Own", by Mercer Mayer. The examiner read the retell script to the child and then verbally instructed the child to tell the narrative back to the examiner. The qualifying screening took place in a single 20-25 minute session per child for the monolingual groups (AM, LM). Bilingual children completed the BESOS in English and Spanish as well as a narrative retell. Qualifying screening for the bilingual group took approximately 30-35 minutes per child. Parent interviews were conducted over the phone or in person to determine language input and output for each child that participated in the qualifying screening. Qualifying screening score means and standard deviations for the BESA subtests for each group are provided in Table 3.

Table 3: *MLU and BESA Scores by Group*

Group	MLUm	ENG SEM	ENG SYN	SPN SEM	SPN SYN
BIL	6.57	9.24	14.06	11.64	14.21
	(1.05)	(1.56)	(2.14)	(0.82)	(1.56)
LM	6.61	9.44	14.81	-	-
	(1.58)	(0.91)	(1.86)		
AM	7.52	9.73	15.97	-	-
	(1.11)	(1.15)	(1.17)		

Note. MLUm was calculated based on the narrative retell task.

A multivariate analysis of variance was run to test for differences between the groups for the baseline narrative variables and the BESOS scores. The bilingual group and the language-matched group did not differ statistically on baseline measures of NDW and MLUm as measured in the baseline narrative. The age-match groups' MLUm was higher than that of the bilingual group $F(2,99) = .007$, $p>.005$. η^2 partial= .115. (medium effect). There were no statistically significant differences between groups for the BESOS ENG semantics subtest. Differences on the BESOS ENG syntax subtest between the bilingual group and the language-matched group did not reach statistical significance. The difference between the scores for the ENG syntax subtest between the age match group and the bilingual group was significant: $F(2,99) = .000$, $p>.001$ η^2 partial= .178 (large effect). Conventions for determining measures of effect size for partial eta squared

are taken from Murphy and Myors (2004) where a small effect is η^2 partial of .01 - .05, a medium effect is η^2 partial .06 - .13 and a large effect is η^2 partial .14 or greater.

Experimental Narratives. Children meeting the inclusionary criteria participated in the experimental narratives task. Time between the qualifying screening and the experimental narratives was 3 to 4 days. The experimental narratives task took place in a quiet room in the child's daycare center or school. The experimental tasks for both groups (monolingual and bilingual) were completed in 20 to 25 minutes per child. Children were provided with a predetermined model narrative to ensure that they were familiar with the task before the experimental narratives scenes were randomly presented. Three pictures from the model narrative were shown to the child via computer screen. Pictures from the model narrative and the model script read to all of the children are available in Appendix A. The examiner pointed out important vocabulary such as "toy", "money", "purse" etc. from the pictures on the screen and had the child repeat each word. If the child did not repeat the words the examiner said, the examiner scaffolded with verbal cues and hand over hand pointing to the pictures of the target words. This procedure was repeated for the model narrative and for each of the experimental narratives.

Pointing out vocabulary and having the children repeat the words if they did not say them spontaneously ensured that the children were exposed to important vocabulary before being expected to narrate a story. Additionally, this procedure was in place so that if narratives incomplete or children used especially short utterances, it would not be

attributed to unfamiliarity with key vocabulary in the story (Guo et al., 2008). The same individual set of words specific to each narrative was utilized for each child to ensure exposure to vocabulary in the narrative scenes. Please refer to Appendix A Figures A1 – A8 for key vocabulary words presented with each story scene.

After the initial model story, children were prompted to look at the next story sequence and repeat its target words. Narrative sequences from both the low uncertainty and the high uncertainty condition were presented in random order with all three pictures from each story on the screen at the same time. Procedures for stories from both conditions are the same. After the experimenter reviewed the important vocabulary for that specific picture scene and had the child repeat the words, the child was prompted with "tell me the best story you can". No further prompting was provided unless the child stayed silent in which the case the examiner said "Is that all you wanted to tell me about your story?" Children told a total of 7 stories (4 stories deemed to be "high uncertainty" and 3 that are labeled "low uncertainty"). A fourth story scene, deemed low uncertainty, was used as the model narrative scene for all of the children resulting in there being one more high uncertainty scene than low uncertainty scene in the experimental task.

After the children told the last story in the experimental task, they were shown pictures of objects that they had seen in the story sequences and asked to name the pictures. The purpose of this vocabulary task was to ensure the children were familiar with key vocabulary in the pictures that they were asked to tell a story about. The children were asked to name each picture. These pictures were presented in the same

order for every child. Average raw scores for the vocabulary task for each group of children are presented in Table 4. The average raw score is out of a total of 35 words. Please refer to Appendix B for the images used in the vocabulary task.

Table 4: *Number of Correct Responses on the Vocabulary Task*

Group	Vocabulary task mean (SD)
BIL	32.21 (1.91)
LM	33.12 (1.36)
AM	34.00 (1.29)

Note. The numbers above depict means and standard deviations for the groups on the vocabulary task. The raw score was calculated out of a total of 35.

Transcription. The Systematic Analysis of Language Transcription for Research Software (SALT, 2012) was used for narrative transcription and coding on a Dell Latitude E6500 laptop computer. Audio files of all narratives collected were transcribed verbatim by the examiner per the utterance segmentation and transcription guidelines for speech revisions or mazes provided by Miller and Chapman (2004). This software was used to determine the frequency of speech revisions as well as provide information such as frequency and type of speech revisions present in the narratives.

Coding Scheme. Codes that were entered into the completed transcripts to capture speech revisions were adapted from Bedore et al. (2006). Examples of speech revisions include: 1.) repetitions of sounds, syllables, words or phrases, 2.) interjections or filled pauses that serve as non-linguistic units of speech which can take place at the beginning of utterances or between words, 3.) phonological revisions to correct overt errors in phonology, 4.) grammatical revisions that correct errors of grammar, 5.) lexical revisions that correct overt word choice errors, and 6.) connectors which are the repetitive use of conjunctions or time markers at the beginning of utterances. Please refer to Table 1 for examples of speech revisions and the corresponding codes entered into SALT.

Reliability. Reliability was obtained for data scoring (BESOS screener), narrative transcription, and coding of speech revisions. Reliability for the data scoring of the screener was obtained by having a trained graduate research assistant re-score a random sample of 20% of the screening protocols (total protocols = 270, re-scored 54 protocols). Inter-rater reliability for the BESOS screener was 96% with discrepancies solved between the rater and the examiner to reach 100% reliability. Reliability for the narrative transcriptions was obtained through a three-step process. In step 1 of the process, the examiner and a trained graduate student trained by the examiner transcribed all samples verbatim. In step 2 all of the samples were listened to again by either the examiner or research assistant and changes were made to the transcripts if there were differences noted. In step 3 a second trained research assistant then listened to a random 20% the samples (142 individual stories from 20 participants) and made note of any differences they may have heard in the transcript. Reliability was determined by counting the number of disagreements divided by the number of agreements and disagreements in the stories (based on words transcribed) reliability was 95.3% with disagreements being solved to reach 100% agreement. All narratives were initially coded for speech revisions and grammaticality by the examiner and a trained research assistant. Reliability for coding was obtained by having a different trained research assistant re-code a random sample of 20% of the narratives (143 individual stories). Reliability was calculated by counting the number of disagreements divided by the number of agreements and disagreements (based on number of codes in the samples). Reliability for coding was

94.2% with disagreements being resolved to 100% agreement for the stories that were listened to a third time.

ANALYSIS

Data Analysis. All screener scores were entered into Microsoft excel and checked against the norms for the BESOS (Peña et al., 2008) to ensure that the children selected for the experimental portion scored within the average range for their age. All parent interviews were entered into Microsoft excel to calculate the children's current language input and output in each language. Narratives were analyzed in SALT Research for frequency of speech revisions, type of speech revisions, and measures of linguistic complexity as measured by grammaticality, number of different words (NDW), mean length of utterance in morphemes (MLUm) in each sample.

Statistical Analysis. In order to address the first question regarding differences in task for both groups, a repeated measures ANOVA was used to determine if there were differences in the rate of speech revisions between the high and low certainty narrative conditions for the three groups. To address the second question, a multivariate analysis of covariance was used to explore the variability of frequency of revisions in the narrative conditions co-varying for language complexity measures such as NDW, grammaticality and MLUm.

Chapter 3: Results

In the experimental task, 3 low uncertainty and 4 high uncertainty stories were originally administered to each child. To maintain balance in analysis, observation of means and standard deviations of production measures were compared across the 4 high uncertainty stories. As the 4 stories were comparable in measures of language production (MLUm and NDW) and mean number of revisions, one story was taken out of the final analysis. The "apples" story was removed by random selection. The final analysis included 3 low uncertainty and 3 high uncertainty stories.

Variables for analysis were initially generated in SALT Research and then transferred to a Microsoft excel spreadsheet for further calculations. The two dependent variables (frequency of revisions) were calculated as summed totals of revisions for both the high and low uncertainty narrative conditions. Revisions included in the final analysis included: connectors, repetitions, interjections, lexical revisions and grammatical revisions. Phonological revisions were removed from the final analysis as most children demonstrated none. NDW and MLUm data was generated in SALT for each narrative and then averaged in Microsoft Excel for each condition. MLU in morphemes was used in this study as it takes into account smaller units of language (e.g., plural –s) which inform further about English linguistic abilities for the groups (Dollaghan, Campbell, & Tomlin, 1990). Percent grammaticality was computed for each narrative by dividing the number of grammatical utterances by the number of grammatical and ungrammatical utterances and then multiplying that number by 100 to yield a percent grammaticality

value. Refer to Appendix A for revision totals and language productivity means and standard deviations for each individual story.

The first question in this study was whether there was a difference in the frequency of speech revisions in English between the high uncertainty and low uncertainty narrative conditions across groups. A repeated measures analysis of variance was run to test differences between the frequency of speech revisions between groups across the different narrative conditions (high uncertainty and low uncertainty) and to test for interactions between the groups and the task. In this analysis the between subjects variable was the child's group (bilingual, language match or age match) and the within subjects variable was the total frequency of speech revisions in each of the narrative conditions (high and low uncertainty). Results showed a main effect for condition $F(1,99) = 33.72$, $p < .001$, η^2 partial= .254 (large effect). On average, all three groups demonstrated significantly more speech revisions in the high uncertainty condition than in the low uncertainty condition with a similar proportion of increase in speech revisions in the high uncertainty condition versus the low uncertainty condition. On average there was a mean increase of 6.33 revisions (SD=3.97) for all three groups between the low uncertainty condition and the high uncertainty condition. Descriptive statistics (means and standard deviations) were calculated for each variable used in statistical analysis (Table 6). Figure 1 depicts the total speech revisions for each narrative condition by group

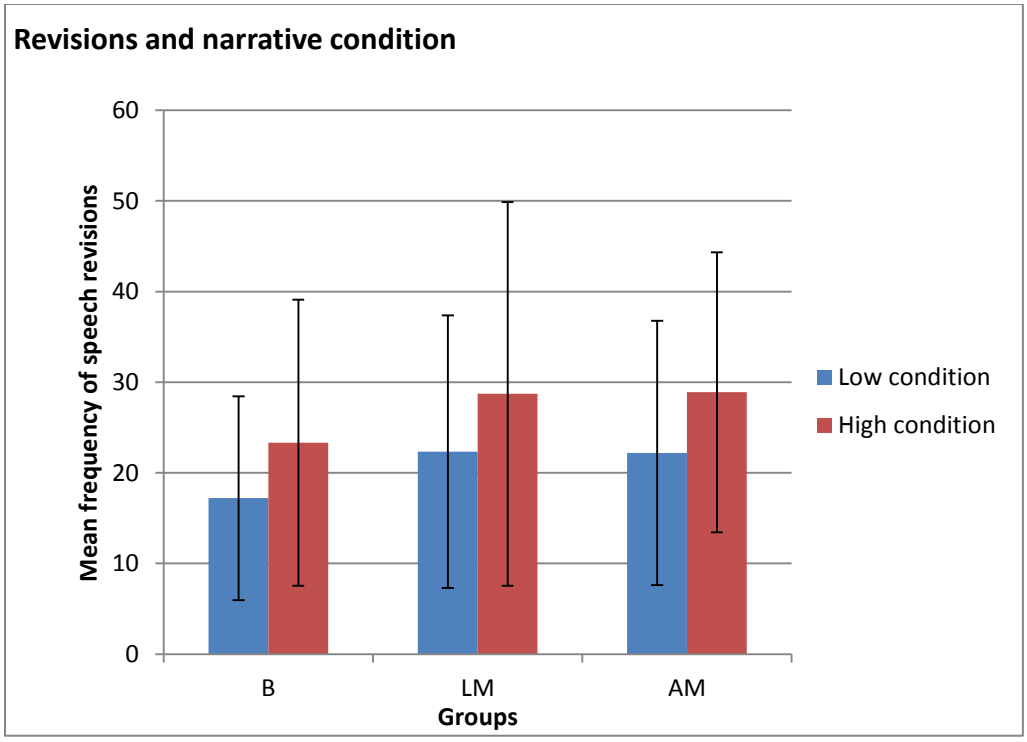


Figure 1: This bar graph represents the mean frequency of speech revisions in each narrative condition. Condition was significant with the groups exhibiting significantly more revisions in the high uncertainty condition than in the low uncertainty narrative condition. Group acronyms: B (bilingual), LM (language-matched) and AM (age-matched).

The repeated measures ANOVA also examined the potential interaction between condition (low vs high uncertainty) and group. While each group exhibited fewer total speech revisions in the low uncertainty condition than in the high uncertainty condition, the repeated measures ANOVA showed no interaction between the frequency of revisions by group; $F(2,99) = .024$, $p>.05$, η^2 partial=.000. This means that statistically the bilingual group demonstrated no more revisions than their language and age-matched peers. In fact, although not statistically significant, the bilingual group exhibited fewer revisions than the LM or the AM groups in each of the narrative conditions. The bilingual

group showed the same pattern of overall fewer speech revisions in the low uncertainty condition than the high uncertainty condition as the LM and the AM groups. These results were unexpected and will be addressed in the discussion.

To explore whether differences in the frequency of revisions was mediated by differences in story length between the two conditions, a Multivariate Analysis of Variance (MANOVA) was run to test for differences in story length (total number of utterances) between the high and low conditions and for potential differences across groups. No statistically significant differences were found for story length as measured by total number of utterances between the high uncertainty and low uncertainty conditions across groups. The high uncertainty condition yielded: $F(2,99) = 2.94$, $p>.05$, η^2 partial=.057 and the low uncertainty condition yielded: $F(2,99) = 2.41$, $p>.05$, η^2 partial=.046 indicating that the 3 groups exhibited similar story length across the high and low uncertainty conditions. This result indicates that in the current study, story length did not account for the variance observed in frequency of revisions across the low and high uncertainty conditions. This warrants further investigation into other variables such as measure of language complexity which may play a role in the frequency of revisions across groups in the high and low uncertainty conditions.

Table 5: *Statistical Variables Means and Standard Deviations*

Group	Condition	Total revisions (SD)	Mean NDW (SD)	Mean MLUm (SD)	Mean % Grammatical (SD)
Bil	Low	17.21 (11.25)	55.30 (15.71)	6.71 (1.96)	56.63% (20.38%)
	High	23.33 (15.78)	65.03 (20.51)	7.57 (1.26)	59.62% (20.53%)
LM	Low	22.34 (15.05)	60.37 (21.97)	5.91 (1.84)	57.50% (21.84%)
	High	28.72 (21.17)	70.84 (28.34)	6.23 (1.67)	61.56% (20.43)
AM	Low	22.19 (14.59)	66.40 (18.71)	7.33 (1.00)	90.06% (9.63%)
	High	28.89 (15.44)	80.67 (20.57)	7.99 (1.36)	89.96% (9.41%)

The second question in the analysis was whether or not there were group differences in the frequency of revisions for the low and high uncertainty conditions when controlling for measures of language productivity such as NDW, MLUm and percent grammaticality. A mixed model analysis was used to examine the variability of frequency of overall speech revisions when controlling for variables of language complexity (NDW, MLUm and grammaticality). The dependent variables in this model

were the total number of revisions in both the high and low condition. Fixed effects in this model included: condition as a within subjects variable (high or low uncertainty), group as a between subjects variable (bilingual, language match, age match), and NDW, MLUm and percent grammaticality as covariates. Model selection included checking for significant interactions among the fixed effects (checking for significant interactions by group and all of the covariates and condition and all of the covariates). Subject was considered a random effect in this model.

Pseudo R squared was calculated as a measure of effect size based on the fixed effects of the model. Pseudo $R^2 = .40$ corresponding to a large effect based on conventions defined by Peugh (2010). Conventions for interpreting Cohen's f^2 are taken from Murphy and Myors (2004). The model shows a main effect for NDW $F(1,99) = 96.91$, $p<.001$, Cohen's $f^2 = .91$ (large effect) which has a significant effect on total number of revisions. There were no main effects for condition $F(1,99) = 3.67$, $p>.05$, Cohen's $f^{2=}.0375$ or group $F(1,99) = .91$ $p>.05$, Cohen's $f^{2=}-.0095$ indicating that there were no statistically significant differences in frequency of revisions across groups or condition when measures of language productivity such as NDW, MLUm and percent grammaticality were controlled. In this model the frequency of speech revisions is most closely related to NDW, e.g. for every one unit increase in NDW (1 word per unit), total revisions increased by .44 revisions across groups in both the high and low uncertainty conditions.

Main effects for MLUm $F(1,99) = 2.55$, $p>.05$ and percent grammaticality $F(1,99) = .939$, $p>.05$ did not reach statistical significance. This means that MLUm and percent

grammaticality did not account for a significant amount of variance in the frequency of revisions in the low and high uncertainty conditions across the bilingual and monolingual groups. The relationship between amount of revisions and NDW for each group in both the low and high uncertainty narrative conditions is exhibited in Figure 2. To best capture this relationship, the data points were removed and trend lines were added to the scatter plot.

Figure 3 is also a scatter plot that depicts the relationship between MLUm and frequency of speech revisions across groups for each condition. Figure 4 displays the relationship between percent grammaticality and frequency of speech revisions across groups for each condition. Data points were suppressed and trend lines were added to Figure 3 and Figure 4. While the relationships between frequency of revisions and MLUm and percent grammaticality were not statistically significant, the figures provide a visual representation of the relationship between frequency of revisions and these covariates in the data. The main effect for condition $F(1,99) = 3.67$, $p > .05$ approaches significance ($p = .058$). In examining the directionality of the dependent variable (frequency of revisions) in relation to condition, the groups consistently showed less total revisions in the low condition versus the high condition when controlling for the language complexity measures.

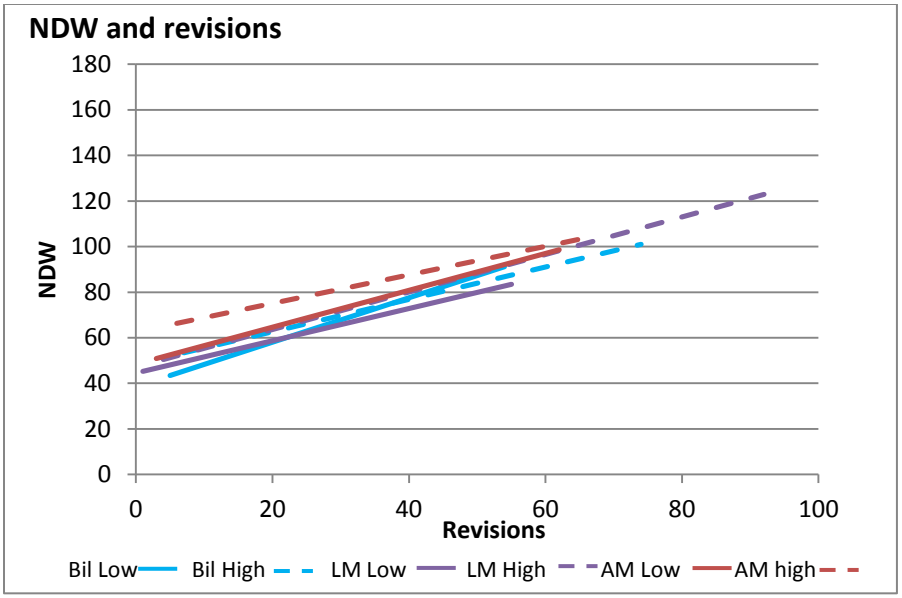


Figure 2: This line plot exhibits the relationship between NDW and frequency of speech revisions reached statistical significance. There were no group differences for NDW and frequency of speech revisions across the low and high condition. Group acronyms: B (bilingual), LM (language-matched) and AM (age-matched).

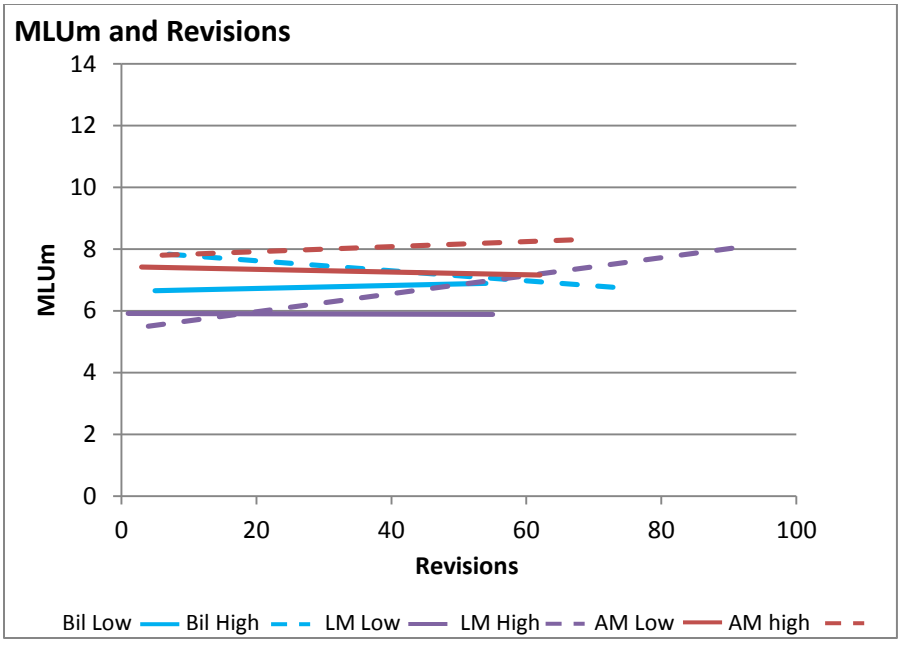


Figure 3: This line plot exhibits no significant relationships found for MLUm and speech revisions across groups or condition (low and high uncertainty). Group acronyms: B (bilingual), LM (language-matched) and AM (age-matched).

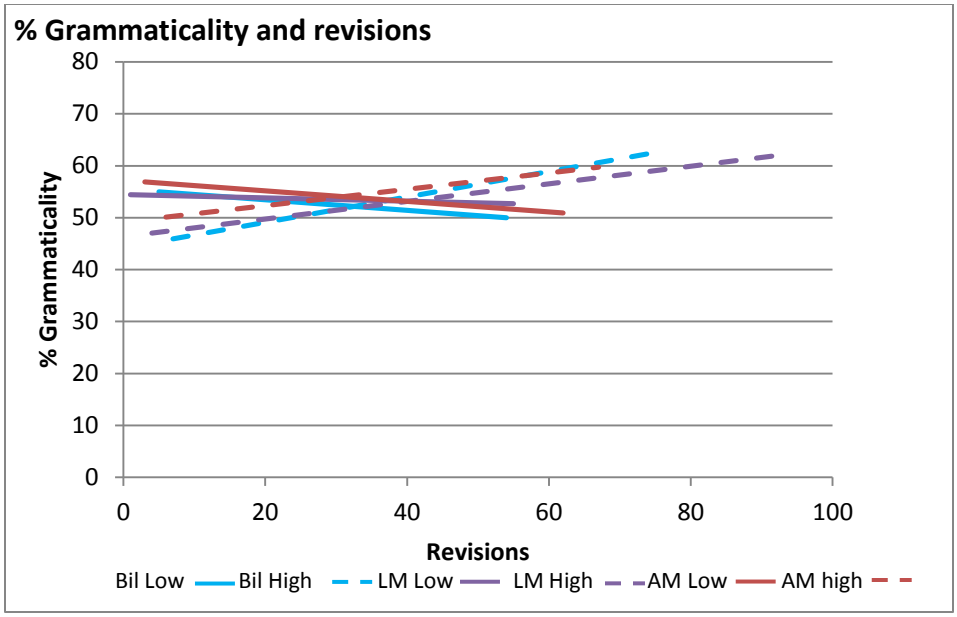


Figure 4: This line plot exhibits the relationships between percent grammaticality and frequency of speech revisions. No statistical significance was found for percent grammaticality and frequency of revisions across groups in the high and low uncertainty conditions. Group acronyms: B (bilingual), LM (language-matched) and AM (age-matched).

Chapter 4: Discussion

The purpose of this study was to explore potential patterns of speech revisions in English in TD Spanish-English bilingual children and their monolingual English speaking children. In the few studies that exist regarding speech revisions in bilingual speakers, data suggest that there may be inherent characteristics of a bilingual's language that potentially influence revisions such as additional grammar markers in Spanish as opposed to English which may contribute to increased opportunities for speech revisions (Bedore et al., 2006). Other researchers attribute the presence of revisions to language proficiency and the speaker's ability to self- correct in that language (Kaur et al., 2011; Navarro-Ruiz & Rallo-Fabra, 2001). Research pertaining to speech revisions and monolingual children suggests that frequent speech revisions could be a red flag for speech or language impairment (Dollaghan & Campbell, 1992; Finnernan et al., 2009; Nettelbladt & Hansson, 1999; Thordardottir & Weismer, 2002). Additionally, other researchers have found that TD Spanish English bilingual could be at risk for misdiagnosis of stuttering based on monolingual English norms for stuttering (Byrd et al., 2015). This study served as a starting point to explore the manifestation and potential patterns of speech revisions in English in Spanish English bilingual children in a controlled condition.

This study was achieved through the use of an experimental task previously seen to elicit speech revisions in older monolingual English speaking school age children (Fey et al., 2004; Guo et al., 2008). Eliciting speech revisions in this younger group of children (Pre-Kindergarten and Kindergarten) allowed for exploration of speech revisions in English during a foundational period in linguistic skill development. Younger

monolingual English speaking age matched controls were included in the study to help control for differences attributed to measures of language productivity such as MLUm, NDW and grammaticality. The groups were deemed comparable based on descriptive statistics describing similar linguistic skills such as MLUm, NDW and percent grammaticality on a baseline narrative retell task.

LINGUISTIC UNCERTAINTY AND SPEECH REVISIONS

The first question of interest was related to frequency of speech revisions in both the low uncertainty and high uncertainty narrative conditions for each group. It was hypothesized that all of the children would show more speech revisions in the high uncertainty condition than in the low uncertainty condition as previous studies with a similar high uncertainty narrative task have elicited more speech revisions in older TD and LI monolingual English speaking children (Fey et al., 2004; Guo et al. 2008). It was also hypothesized that the bilingual group would exhibit more speech revisions than the monolingual English speaking children in the AM and LM groups. In considering the first question regarding frequency of speech revisions in the low and high uncertainty conditions, the children demonstrated less speech revisions in the low uncertainty condition than in the high uncertainty condition. This result is similar to the work of Fey et al. (2004) and Guo et al. (2008) where monolingual English-speaking children exhibited an increased number of speech revisions in a similar high uncertainty narrative task. More overall revisions in the high uncertainty condition could indicate that the speakers experienced more uncertainty about what they wanted to say and exhibited more revisions to help them achieve non-interrupted speech in the high uncertainty condition.

Results from the current study are in agreement with the work of Fagan (1982) where he attributed the presence of speech revisions to the speaker's attempt at achieving uninterrupted speech.

A potential confound to the results of the current study where more speech revisions were found in the high uncertainty narrative condition than in the low uncertainty condition across groups pertains to the actual narrative picture scenes. While the narratives deemed high uncertainty were the same ones used in the Guo et al. (2008) study and certified speech language pathologists and MA speech language pathology students all rated the high uncertainty picture scenes as being vague, what one cannot be sure of is if the unclear story ending accounted for most of the linguistic uncertainty in the narratives. This will be important to consider in future studies with this task and may require more refinement to the task to ensure that the entire picture scene is considered to be vague or unclear and not just the ending of the story. While it was beyond the scope of this study to examine all of the variables that may contribute to a speaker's linguistic uncertainty, the specific manipulation of the vocabulary and pictures in each condition appears to have been sufficient for all of the children in this study to show comparable levels of uncertainty as evidenced by their frequency of revisions.

An unexpected result in this study was that there was no statistically significant difference in the frequency of revisions between groups in either the low uncertainty or high uncertainty conditions. Lack of group difference is in disagreement with available literature examining other narrative tasks (re-tells and tells) where bilinguals exhibited more revisions than their monolingual peers (Bedore et al., 2006; Kaur et al., 2011). No

group differences in frequency of revisions or differences in the proportion of increase in revisions from the low to the high uncertainty condition indicate that in this experimental condition, bilinguals were not *more* susceptible to exhibiting revisions than their monolingual peers. In the current study the consistency in the performance across groups showed that bilinguals, specifically Spanish-English bilinguals, are not just inherently more likely to exhibit revisions than their peers.

When conditions were controlled (in this case presenting narratives that had a clear versus a vague ending) differences between the groups were reduced. When considering that theoretical models of speech production are not always specific to bilingual speakers, (e.g., Hartsuiker & Kolk, 2001) these results suggest that the speech production processes for these groups in this particular task were similar enough to be accounted for by these models originally intended for monolingual speakers. This is not to say that a monolingual and bilingual in all accounts of their speech production are directly comparable but that under these specific experimental conditions bilinguals were not at a disadvantage (exhibiting significantly more or less speech revisions) in their speech production when compared to their monolingual peers. For the purposes of this study, the revisions variable was a summed total across revision types. Closer examination of the specific types of revisions (e.g., content vs edit type revisions) and their loci in comparison to monolingual speakers in this task may yield group-specific patterns in the manifestation of revisions not available in the current work. This could further disambiguate the specific role of these revisions and whether or not a TD

bilingual and a TD monolingual speaker exhibit similar patterns when these variables are taken into account.

The lack of significant group differences between monolingual English speakers and Spanish English bilingual in the current study is also of interest when considering other risk groups such as children with language impairment or stuttering. In studies comparing TD English speakers and English speaking LI peers, authors have found consistent patterns where the LI group exhibited more revisions than their TD peers (Dollaghan & Campbell, 1992; Finnernan et al., 2009; Nettelbladt & Hansson, 1999; Thordardottir & Weismer, 2002). As bilinguals have been identified potentially at risk for diagnosis of stuttering (Byrd et al., 2015; Howell et al., 2009), this result is evidence to suggest that in an experimental condition designed to elicit revisions, bilinguals and monolinguals were not significantly different from in each other in frequency of these revisions.

Task Demands. It is important to consider the task demands in this study in comparison to other works that utilized narrative re-tell or tell from a book, or conversation samples as opposed to an experimental condition like in the current study (Bedore et al., 2006; Byrd et al., 2015; Fagan, 1982; Loban, 1976; Kaur et al., 2011). In the study by Kaur et al. (2011) children were asked to tell 3 different stories, one in English, one in Kannada and then one where they were free to mix languages. In the Byrd et al. (2015), Bedore et al. (2006) and Hopper (2014) the tasks consisted of narrative analyses from stories generated from wordless picture books. These studies are informative in determining language-specific patterns for revisions, though they differ from the current study in that the studies did not manipulate their condition to try and elicit revisions.

It is important to consider task demands on the bilingual speaker with respect to theoretical interpretations of a bilingual's linguistic processes and skills (i.e., frequency lag hypothesis and competition for selection/inhibitory control in bilinguals). Differences in the types of tasks may yield different results across tasks due to demands placed on the speaker. Comparing the results of the current study to those without manipulation of the task is informative about how the potential demands during conversation or narration without manipulation or control of variables such as vocabulary may contribute to differences in frequency of speech revisions. This would be consistent in supporting the frequency lag hypothesis where bilinguals have been found to be at a disadvantage to their monolingual peers in the retrieval of low frequency words and in vocabulary knowledge tasks which could in part contribute to the presence of speech revisions (Kroll & Gollan, 2014). When variables such as familiarity with vocabulary are not controlled,

bilinguals could potentially exhibit more challenges in maintaining their fluency due to the inability to inhibit one language over the other or they could potentially revert to production of less complex and more familiar words/utterances in their L2, therefore exhibiting less speech revisions.

LANGUAGE COMPLEXITY AND SPEECH REVISIONS

The second question pertained to examining the frequency of speech revisions in both the low and high uncertainty narrative conditions when controlling for measures of language productivity. It was hypothesized that measures of language complexity such as NDW, MLUm and grammaticality would all be correlated with frequency of revisions in both narrative conditions across groups. Results indicated that the only significant covariate when examining frequency of revisions across groups in both the low and high uncertainty conditions was NDW. There was no statistical significance for group or any of the other measures of language productivity that have been previously shown to be correlated with frequency of revisions such as MLU or grammaticality (Bedore et al., 2006; Fagan, 1982; Hopper, 2014).

The significant result for NDW is informative about the relationship between vocabulary knowledge in English and the presence of revisions for these groups. This result is consistent with the lexical access model by Oppenheim et al. (2010) which describes strengthening of semantic and lexical connections and a counter process weakening competitor semantic lexical connections when retrieving a word. In successful word retrieval the semantic lexical relationships between the lemma and target word have been strengthened and connections between that lemma and other lexical

items that may have shared features are weakened. Kroll and Gollan (2014) (pg. 100) provide a clear example of this scenario and describe the retrieval of the word DOG. In the retrieval of the word DOG, the semantic lexical relation may be MAMMAL – DOG strengthening this connection and weakening a competitor such as MAMMAL – BAT. As the connections for the competitor were weakened, attempts to retrieve BAT may yield an error (speech revision e.g., lexical revision) or delay in retrieval. Arguably, if a speaker exhibits a higher number of different words in their output they would have more competing selections which could be attributed to the higher number of revisions.

As this model was originally intended to explain lexical access in monolingual speakers, the lack of group differences in frequency of revisions allow for this model to be applied to bilinguals during this experimental task. Potentially, a bilingual could have more competing semantic lexical relationships that are strengthened and weakened depending on what language they are speaking. Their language specific vocabulary as well as shared vocabulary from both languages could be activated during lexical selection competing for selection. Depending on what language they are speaking and which lexical item they select (in the language they are speaking or possibly in the other language), these relationships could continuously strengthen and weaken over time. This is important to consider as a bilingual speaker's language use is not always consistent and changes with experience.

Further, NDW accounted for most of the variance in the presence of revisions across groups with no statistically significant group differences indicating that bilinguals were no more or less susceptible to exhibiting speech revisions with increased

spontaneous word knowledge. In this task, the children were not required to produce certain words or a minimum number of different words in their narratives. In considering differences in a bilingual's lexical access that have been found in prior work (Kroll & Gollan, 2014) it is possible that this task did not strain the lexical access system enough for a bilingual to exhibit a disadvantage in their word retrieval.

The lack of group differences in frequency of revisions is important to consider as in the current data set there was a statistically significant difference in SES based on maternal education between the groups. The bilingual group exhibited a lower overall mean SES than the AM or LM groups. Research has shown that SES is significantly related to vocabulary development in monolingual English speaking children (Dollaghan et al. 1999; Hart & Risley, 1995). Additionally, studies in bilingualism have demonstrated a significant relationship between SES and higher vocabulary skills in English and better story re-tell skills in both English and Spanish (Hammer et al., 2012; Oller & Eilers, 2002). Considering the significance of SES shown in prior studies in relation to vocabulary knowledge, the lack of statistically significant group differences in NDW on the baseline narrative task and in the experimental task is surprising. On one hand one might expect that due to this significant difference in SES that the bilingual group would be at a disadvantage to their monolingual peers yet their frequency of speech revisions in relation to NDW was not significantly different from the monolingual ENG peers with a significantly higher mean SES. Further investigation into the role of SES and the manifestation of speech revisions in bilingual speakers is warranted to better understand this potential relationship.

In studies that have explored the frequency of revisions in bilinguals the relationships between these variables is not always known. In the Kaur et al. (2011) study the authors did not report these relationships. In the Bedore et al. (2006) study certain revision types were significantly correlated with MLU and grammaticality in English and Spanish. In considering studies where these measures of language complexity were taken into account (Bedore et al., 2006; Hopper, 2014), the differences in the types of tasks (narratives) versus experimental tasks in the present study may not have been sensitive enough in order for variables to show a difference between groups. For example, in the experimental task, the familiarity with specific vocabulary was controlled for but the children did not have to produce a certain type of utterance (they could have produced a simple or complex sentence which were examined together). This is in contrast to the Hopper (2014) study that specifically examined certain types of utterances (simple and complex) where he found more revisions in complex versus simple sentences. Results of the current study are also in contrast to the work of Bortfeld et al. (2001), Fagan (1982), and Shriberg (1996) that showed more speech revisions with increased language complexity.

It is also important to consider that in the current task, the children had three pictures in which to formulate their narratives in comparison to studies that had the children generate narratives after hearing a scripted story (narrative re-tell) or telling a story from picture book (narrative tell) such as in the work by Byrd et al. (2015) and Bedore et al. (2006) where authors found significant correlations between language complexity measures such as MLU, number of total words and grammaticality. The lack

of significance of MLUm and grammaticality indicates the need for further work in this area comparing frequency of speech revisions in bilingual speakers across different tasks such as conversation, narrative and experimental conditions.

Another unexpected result was that condition only approached significance, meaning that the language productivity measures and frequency of revisions had similar relationships across the low and high uncertainty conditions. As previous works have shown that these measures of complexity are significantly related to frequency of revisions, it is possible that when variables of language complexity were controlled, this experimental task was not sensitive enough in differentiating conditions of low and high uncertainty to capture group differences in the frequency of revisions. If revisions are thought to be a potential effect of the efforts to produce more complex language, more stringent requirements for this task such as a sentence structure priming component or adding additional picture stimuli to increase narrative length may be beneficial in identifying patterns of revisions in bilinguals and monolinguals (Fagan, 1982; Finnernan et al., 2009; Levelt, 1989; Shriberg, 1996,).

LIMITATIONS

This study served as a starting point for understanding how speech revisions manifest in English during an experimental task in younger Spanish-English bilingual speakers. Data for this study was only collected in English. Identifying potential patterns in speech revisions in only one of a bilingual's two languages is not a complete representation of a bilingual's speech patterns. Previously reviewed studies (Bedore et al., 2006; Byrd et al., 2015; Hopper, 2014) have determined a language-specific effect for

frequency of speech revisions which is important to consider when drawing conclusions about a bilingual's linguistic patterns. If the bilingual group were given a similar experimental task in Spanish, such as the one in the current study, they may exhibit more revisions in Spanish due to the need to navigate more linguistic rules such as noun gender agreement and articles than in English. Additionally, what we do not know from this study is if the frequency of revisions would remain stable over time for these groups. Another limitation of this study is that revisions were analyzed together and potential patterns for specific types of revisions (lexical, grammatical, etc.) were not identified. Further, children in this study were tested throughout the school year at different points in their language learning, which could have influenced their performance on the experimental task.

FUTURE DIRECTIONS

Aspirations for continuing this work include collecting data in both languages and further adapting the task to see if complexity variables such as grammaticality and MLU can be manipulated in an effort to further manipulate linguistic uncertainty. Initial thoughts for achieving this include adding a priming task as part of the experimental narrative condition in which the children would be primed to use certain grammatical structures (simple and complex) and then comparing the results to recent studies that have analyzed speech revisions in simple and complex utterances (Hopper, 2014). Additionally, this task will be modified to include more picture stimuli to facilitate longer narratives and a narrative task to compare frequency of speech revisions between tasks. Another important consideration is collecting data in both languages during specific time

points in the school year (Fall and Spring) to capture potential differences in language development for bilinguals in comparison to monolinguals. The participant groups will be expanded to include children with differing levels of language abilities, such as those with language impairment and stuttering (both monolingual and bilingual). Participants with differing levels of bilingualism (e.g., functional monolingual, balanced bilingual and children dominant in one of their two languages) will also be included. Participants will also be matched for SES in an attempt to control for potential differences related to SES based on maternal education. Analyses will also include consideration of each revision type (connector, lexical revision, etc.), location of revision in the utterance (beginning of utterance, within utterance), and utterance complexity (simple vs complex), to explore potential relationships between certain types of revisions and variables such as language proficiency and language complexity.

Appendix A

Model story script read to each child before the experimental task.

A gift for Mary

E: This is a story about a nice old grandma. Her name is Grandma Gracie.

E: Grandma Gracie loved to buy presents for her grandkids.

E: Grandma Gracie always went to Wal-Mart to buy fun toys.

E: One day, Grandma Gracie went into Wal-Mart and found something special.

E: She thought this would be the perfect gift for her granddaughter Mary.

E: She bought a great gift at Wal-Mart and decided to wrap it up for Mary.

E: When she got home, she needed to find her things to wrap the present.

E: Grandma Mary found her wrapping supplies in her house.

E: She found the scissors and tape and pretty green ribbon to wrap the present.

E: Grandma Mary wasn't sure she had enough ribbon.

E: She cut a piece and measured it to make sure she had enough.

E: The first piece of ribbon she cut was not enough, so she cut another piece.

E: She cut a second piece of ribbon and was so happy because it was the perfect size.

E: She decorated the present for Mary with pretty striped paper.

E: And then she put the green ribbon around the present.

E: Grandma Gracie had never seen such a beautiful present.

E: She knew that Mary would love this present.

E: Grandma Gracie heard a knock at the door.

E: Mary had come over to visit her.

E: Grandma Gracie gave Mary the present she had wrapped.

E: And you know what?

E: Mary loved her present and gave grandma Gracie a big hug.

Illustration A1: Model narrative scene presented while the clinician read the model narrative script (see Appendix A, page 1). Key vocabulary: purse, drum, ribbon, tape, present. Illustration adapted from Say It Right (2007).

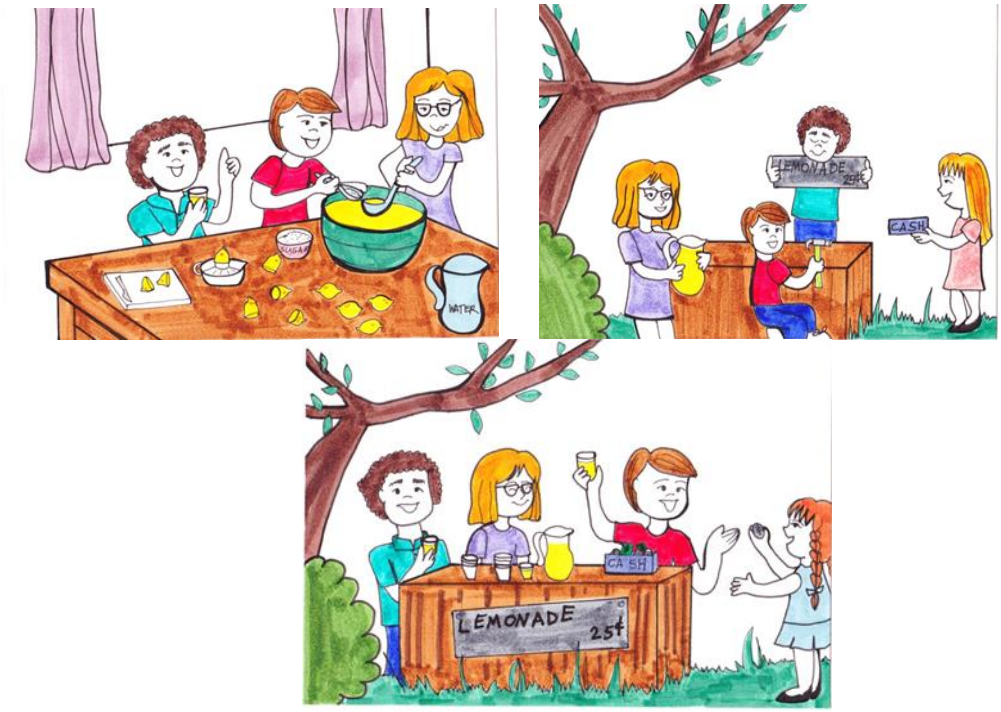
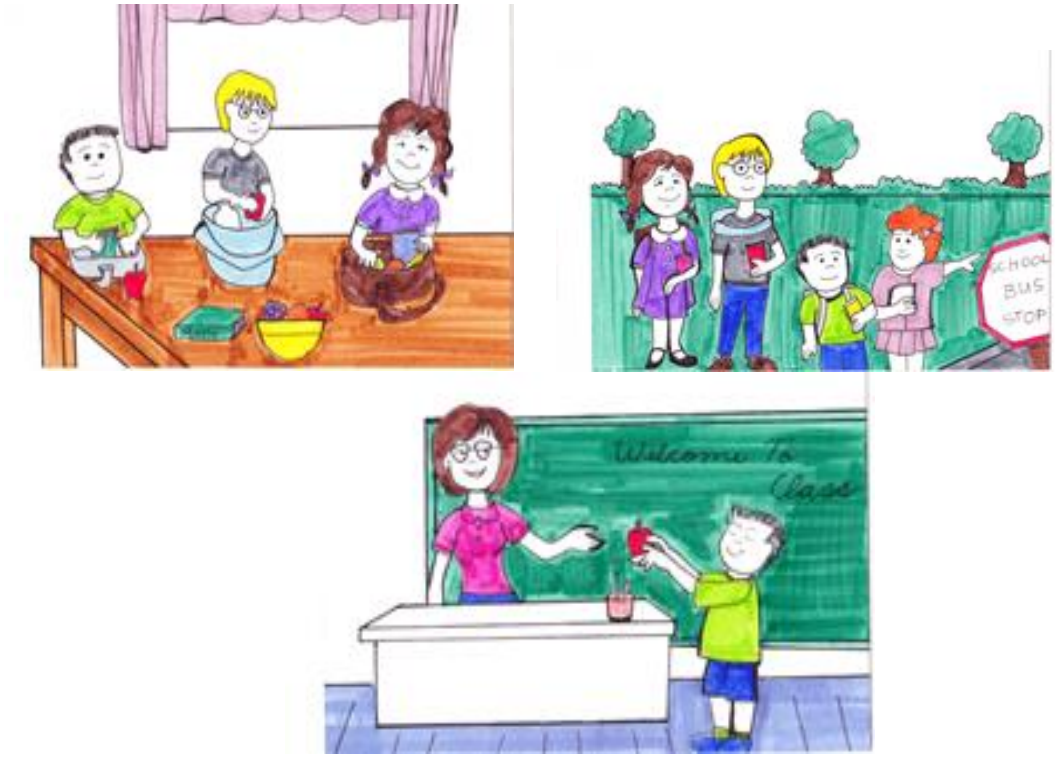


Illustration A2: Lemonade story scene (low uncertainty). Key vocabulary: children, money, hammer, pitcher, lemons. Illustration adapted from Say It Right (2007).

Illustration A3: Carnival story scene (low uncertainty). Key vocabulary: cups, cotton candy, fish, game, man. Drawing by Garrabieta (2014) for this project.



Illusration A4: School story scene (low uncertainty). Key vocabulary: backpacks, book, sign, fruit, teacher. Illustration adapted from Say It Right (2007).

Illustration A5: Barn story scene (high uncertainty).Key Vocabulary: barn, bats, barrel, pig, owl. Illustrations adapted for this project from Fey et al. (2004).

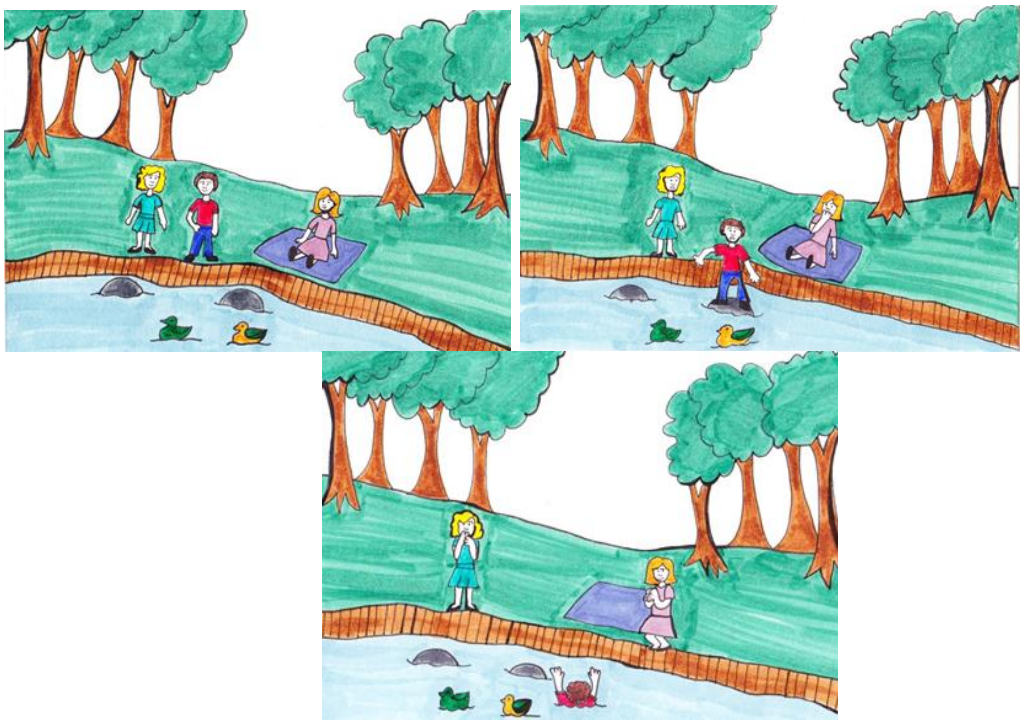


Illustration A6: Pond story scene (high uncertainty). Key vocabulary: blanket, duck, rock, tree, people. Illustrations adapted for this project from Fey et al. (2004).

Illustration A7: Tornado story scene (high uncertainty). Key vocabulary: basket, bird, kite, nest, tornado. Drawing by Garrabieta (2014) for this project.

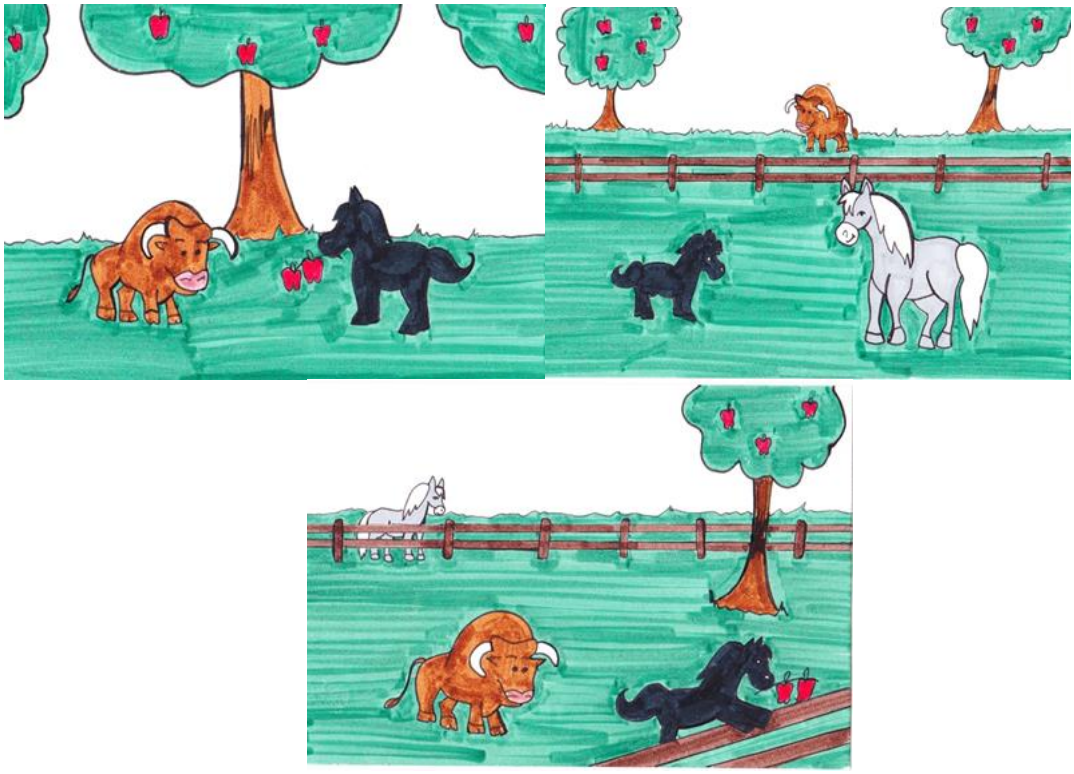


Illustration A8: Apples story scene (high uncertainty). Key vocabulary: apple, bull, fence, horse, grass. Illustrations adapted for this project from Fey et al. (2004).

Below are sample narratives from the high and low uncertainty condition. There is one sample narrative from one child from each group (BIL, LM, and AM). For definitions of codes used in the transcripts please see Table 1 in the text.

Sample low uncertainty narrative BIL
+[beginschool]

C one day there was|auxbe help/ing|help and someone (ha)[REP] had|have to get the fruit [u].

C ((and))[CON] there was|be fruit like orange grape/s apple/s [g].

C then they go in (uh)[REP] the school and the bus stop [u].

C ((and))[con] they go with the teacher [g].

C there/'s a kid a teacher a boar apple a drink [u].

C the bus stop because the kid/s had|have to go home [u].

C their mom he got|get the apple and the drink [u].

+[endschool]

Sample high uncertainty narrative BIL
+[beginbarn]

C (um)[INT] first (like)[INT] they get the farm [u].

C ((and))[CON] then they paint the farm [g].

C ((and then))[CON] they go the animal/s right there [u].

C ((and then))[CON] the animal/s live right there in the farm [g].

C (is um)[INT][REP] is|be some and was|aux be fly/ing|fly [u].

C ((and then))[CON] the bat/s and the bird/s and the owl and the pig [u].

C the owl pick/ed|pick the pig [g].

C ((and then))[CON] two pigeon/s right there with the farm [u].

+[endbarn]

Sample low uncertainty narrative LM
C (um um)[INT] (first)[REP] first they were|be at school [g].

C ((and))[CON] then they were|be take/ing|take out their lunch [g].

C ((and then and then))[CON][REP] there were|be about to eat it [u].

C (when when)[REP] when it/'s|it is|be dinner time [u].

C ((and and then and))[CON][REP] they were|be listen/ing|listen to the teacher [g].

C ((and then and then))[CON][REP] they were|be take/ing|take a bath [g].

C (and and)[CON][REP] tell/ing|tell the teacher [g].

C (i mean)[REP] i mean (um um um um)[INT] someone was|be give/ing|give the

apple to her [g].

C yep.

+[endschool]

Sample high uncertainty narrative LM
C (uh um)[INT] that pig (is)[REP] (is|be is)[REP] is|be jump/ing|jump [g].

C ((and and))[CON][REP] him is|be stand/ing|stand on a barrel [u].

C ((and))[CON] they bird are|be on the roof [u].

C ((and and))[CON][REP] these bat/s (are)[REP] are fly/ing|fly [g].

C ((and these and there pig))[CON][REP][GREV] this pig (is)[rep] is|be

stand/ing|stand (on)[REP] on the barn [g].

C ((and and))[CON][REP] (this pig is|be)[REP][LREV] this pal (is is|be is|be)[REP] is|be stand/ing|stand right there [g].

C ((and the con))[CON][LREV] and the owl (was|be)[GREV] is|be on there [g].

C (uh)[INT] they all fall down [g].

C (uh uh)[INT] all of them were|be fall/ing|fall down (in)[GREV] into the ground [g].

C uhuh.

+[endbarn]

Sample low uncertainty narrative AM
+[beginschool]

C First the children were|auxbe (um)[INT] pack/ing their lunch [g].

C and put/ing|put it on the table so they could eat it [g].

C ((and))[CON] whenever the children were|auxbe come/ing|come (they)[REP] they stop/ed|stop (because it say/3s|say)[LREV] because the sign say/3s|say stop [g].

C ((and))[CON] then the bus pick/3s|pick them up [g].

C ((and))[CON] (they)[REP] they start/ed|start get/ing|get unpack/ed|unpack [g].

C ((and))[CON] put/ing|put it on the table or in their cubbie/s [g].

C ((and then))[CON] (mm)[INT] he was|be give/ing|give the apple to his teacher [g].

C (and the teacher)[REP] and the teacher was (w)[REP] say/ing|say thank you [g].

C ((and then))[CON] after he gave|give the apple to the teacher he went|go to go get unpacked [g].

+[endschool]

Sample high uncertainty narrative AM
+[beginbarn]

C Well it start/3s|start when first the pig got|get on the barrel [g].

C (Then)[REP] then that little sheep got|get (wa)[REP] want/ed|want to look at the pig when he was on the barrel [g].

C ((and then))[CON] the bird saw|see [u].

C ((and then))[CON] the owl [u].

C ((and then))[CON] the owl he was|be look the bat/s [u].

C They flew|fly out of the barn [g].

C ((and then))[CON] the owl want/ed|want to but it could/n't [u].

C ((and then))[CON] the pig got|get on top of the barn [g].

C ((and then))[CON] they were|be all try/ing|try to get the pig down [g].

C ((and))[CON] the bird and the bat/s were|be try/ing|try to fly to get him down [g].

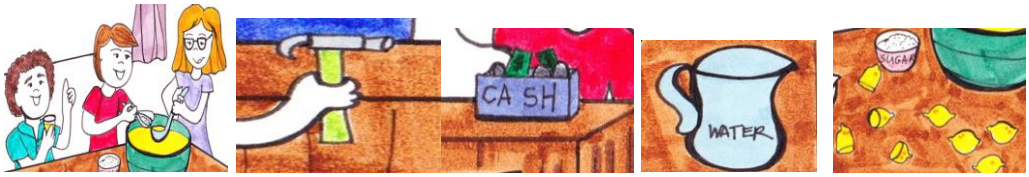
C ((and then))[CON] the owl got|get the pig and took|take him [g].

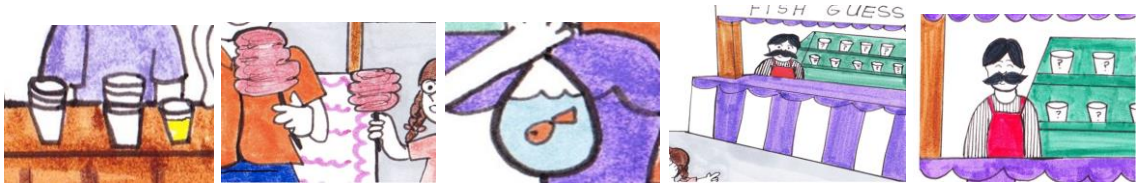
C ((and))[CON] the owl got|get the pig and took|take him into the barn [g].

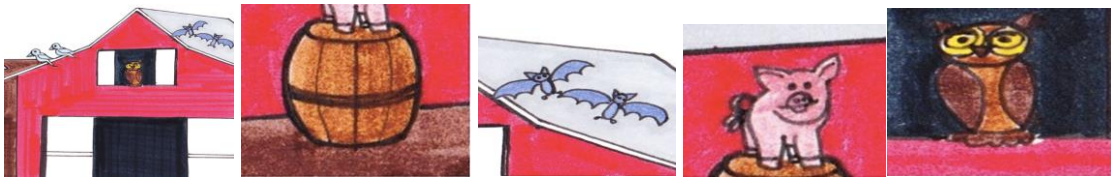
+[endbarn]

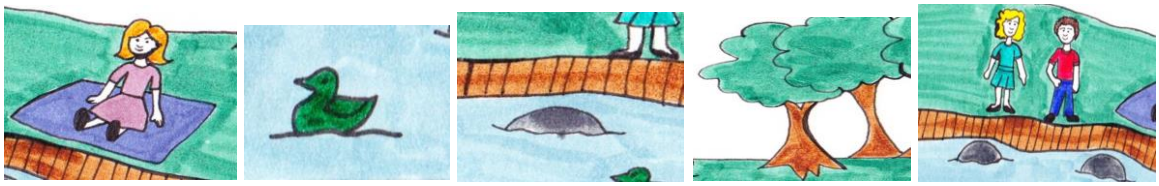
Appendix B

Vocabulary Task Images









Appendix C

Table C1: *Descriptive variables for individual narratives by group and condition*

		Mean (SD)	CON	REP	INT	LREV	PREV	GREV	Revision total	NDW	MLU	%GRA
BIL	Low Uncertainty	Lemon	2.81	1.60	1.24	.63	.03	.21	6.54	25.51	6.62	57.89
			(2.08)	(1.53)	(2.35)	(.92)	(.17)	(.59)	(5.35)	(7.97)	(1.50)	(26.70)
		Carnival	2.27	1.69	.87	.66	.03	.18	5.72	23.48	6.26	61.54
			(1.85)	(2.73)	(1.4)	(.95)	(.17)	(.58)	(4.41)	(8.99)	(.96)	(26.54)
		School	2.0	1.42	1.03	.42	0	.12	5.00	25.15	7.47	49.89
			(2.16)	(1.45)	(1.26)	(.70)	(0)	(.54)	(3.52)	(8.25)	(1.45)	(28.93)
	High Uncertainly	Barn	3.12	2.75	1.72	1.18	.06	.18	9.03	27.69	7.55	53.25
			(3.26)	(2.69)	(2.28)	(1.40)	(.24)	(.46)	(6.41)	(9.91)	(1.88)	(29.45)
		Pond	2.84	2.0	.81	.48	0	.06	6.21	28.63	7.32	61.03
			(3.70)	(2.17)	(1.5)	(.66)	(0)	(.24)	(5.40)	(9.45)	(1.35)	(27.36)
		Tornado	3.24	2.63	1.24	.81	.12	.21	8.27	32.15	7.91	64.12
			(2.56)	(3.46)	(1.69)	(1.10)	(.54)	(.64)	(5.99)	(11.73)	(1.92)	(21.95)
		Apples	2.21	1.30	1.06	.78	0	.24	5.60	24.78	7.12	57.45
			(2.53)	(1.62)	(1.14)	(1.02)	(0)	(.43)	(3,89)	(8.34)	(1.64)	(30.06)
LM	Low Uncertainty	Lemon	2.84	2.09	1.93	1.09	0	0	7.96	26.56	5.72	54.48
			(2.30)	(1.97)	(2.15)	(1.32)	(0)	(0)	(5.58)	(11.04)	(2.21)	(21.15)
		Carnival	2.93	1.96	1.21	.78	0	.03	6.93	25.37	5.97	60.46
			(2.52)	(2.27)	(1.73)	(1.21)	(0)	(.17)	(5.74)	(9.92)	(1.98)	(29.01)
		School	3.06	1.71	1.59	.59	0	.09	7.06	28.03	6.21	55.07
			(3.52)	(1.81)	(2.21)	(1.07)	(0)	(.39)	(6.34)	(14.21)	(2.25)	(29.86)
	High Uncertainly	Barn	3.06	2.28	1.53	1	0	.06	7.93	27.09	6.22	55.69
			(2.39)	92.42)	(1.62)	(1.39)	(0)	(.35)	(5.50)	(9.90)	(1.80)	(27.12)
		Pond	4.09	2.84	1.43	1.15	0	.03	9.56	31.58	6.34	61.74
			(3.99)	(3.68)	(2.60)	(1.74)	(0)	(.17)	(9.38)	(15.38)	(1.89)	(26;43)
		Tornado	5.09	3.28	1.34	1.18	0	.12	11.03	36.34	6.29	64.44
			(4.01)	(3.87)	(1.80)	(1.30)	(0)	(.42)	(8.57)	(18.13)	(2.15)	(27.08)
		Apples	3.06	2.81	1.46	.71	0	.06	8.12	27.40	6.43	59.46
			(3.41)	(3.29)	(2.01)	(.81)	(0)	(.24)	(7.46)	(14.53)	(2.15)	(31.05)
AM	Low Uncertainty	Lemon	3.05	3.78	1.94	.59	.02	.18	9.59	30.27	6.83	88.30
			(2.27)	(5.14)	(2.24)	(1.03)	(.16)	(.46)	(7.48)	(11.19)	(1.07)	(16.38)
		Carnival	2.56	1.89	.86	.56	.10	.08	6.08	26.97	6.93	89.98
			(2.27)	(3.01)	(1.03)	(.92)	(.31)	(.27)	(4.71)	(8.00)	(1.63)	(21.35)
		School	2.64	1.83	1.40	.70	0	.13	6.72	30.43	8.78	88.73
			(2.21)	(2.21)	(2.40)	(1.22)	(0)	(.41)	(5.21)	(10.32)	(1.89)	(15.74)
	High uncertainty	Barn	4.51	3.97	1.97	.70	.05	.29	11.51	36.72	8.01	90.17
			(2.64)	(5.04)	(1.77)	(.96)	(.22)	(1.02)	(7.79)	(10.81)	(1.78)	(11.25)
		Pond	3.37	2.78	1.48	.89	.08	.13	8.75	35.02	7.72	93.04
			(2.28)	(3.62)	(1.57)	(1.17)	(.27)	(.41)	(5.48)	(10.56)	(1.86)	(11.97)
		Tornado	4.02	2.67	1.32	.54	.05	.13	8.75	35.67	8.11	90.60
			(3.24)	(2.58)	(1.24)	(.80)	(.22)	(.34)	(5.59)	(11.85)	(2.17)	(13.90)
		Apples	3.13	2.91	1.56	1.02	.10	1.16	8.83	29.75	8.71	84.50
			(2.83)	(2.47)	(1.96)	(1.46)	(.39)	(1.80)	(4.64)	(11.08)	(2.17)	(19.14)

Note. The revision total column represents the summed value of the connectors, repetitions, interjections, lexical revisions, grammatical revisions and phonological revisions exhibited in each story for each group.

References

Ambrose, N.G., & Yairi, E. (1999). Normative disfluency data for early childhood stuttering. *Journal of Speech, Language, and Hearing Research*, *42*, 895-909.

Bedore, L. M., Fiestas, C.E., Peña, E.D., & Nagy, V.J. (2006). Cross-language comparisons of maze use in Spanish and English in functionally monolingual and bilingual children. *Bilingualism: Language and Cognition*, *9*(3), 233-247.

Bedore, L.M., Peña, E.D., Summers, C.L., Boerger, K.M., Resendiz, M.D., Greene, K., Bohman, T.M., & Gillam, R.B. (2012). The measure matters: Language dominance profiles across measures in Spanish-English bilingual children. *Bilingualism: Language and Cognition.*

Bernstein Ratner, N., & Benitez, M. (1985). Linguistic Analysis of a Bilingual Stutterer. *Journal of Fluency Disorders, 10,* 211-219.

Boey, R.A., Wuyts, F.L., Van de Heyning, P.H., De Bodt, M.S., & Heylen, L. (2007). Characteristics of stuttering like disfluencies in Dutch-speaking children. *Journal of Fluency Disorders, 10,* 310-329.

Bortfeld, H., Leon, S.D., Bloom, J.E., Schober, M.F., & Brennan, S.E. (2001). Disfluency rates in conversation: effects of age, relationship, topic, role, and gender. *Language and Speech, 44(2),*123-147.

Bialystock, E., Luk, G., Peets, K.F., & Yang, S. (2010). Receptive vocabulary differences in monolingual and bilingual children. *Bilingualism: Language and Cognition, 13,* 525-531.

Brocklehurst, P.H. (2013). Stuttering prevalence, incidence and recovery rates depend on how we define it: Comment on Yairi & Ambrose' article Epidemiology of stuttering: 21st century advances. *Journal of Fluency Disorders, 38,* 290-293.

Byrd, C.T, Bedore, L.M., & Ramos, D. (2015). The disfluent speech of bilingual Spanish-English Children: Considerations for Differential Diagnosis of Stuttering. *Language, Speech and Hearing Services in Schools, 46,* 30-43.

Byrd, C.T., Logan, K. J., & Gillam, R.B. (2012) Speech disfluency in school age children's conversational narrative discourse. *Language Speech and Hearing Services in the Schools, 43,* 153-163.

Carias, S., & Ingram, D. (2006). Language and disfluency: Four case studies on Spanish-English bilingual children. *Journal of Multilingual Communication Disorders*, *4*(2), 149-157.

De Andrade, C.R.F., & Martins, V.D.E. (2007). Fluency variation in adolescents. *Clinical Linguistics & Phonetics, 21(10),* 771-782.

Dollaghan, C.A., & Campbell, T.F. (1992). A procedure for classifying disruptions in spontaneous language samples. *Topics in Language Disorders, 12(2),* 56-68.

Dollaghan, C.A., Campbell, T.F., Paradise, J.L., Feldman, H.M., Janosky, J.E., Pitcaim, D.N., & Kurs-Lasky, M. (1999). Maternal education and measures of early speech and language. *Journal of Speech, Language and Hearing Research, 42,* 1432-1443.

Dollaghan, C.A., Campbell, T.F. & Tomlin, R. (1990). Video narration as language sampling context. *Journal of Speech and Hearing Research*, *55*, 582-590.

Ecke, P. (2004). Words on the tip of the tongue: A study of lexical retrieval failures in Spanish-English bilinguals. *Southwest Journal of Linguistics, 23,* 1-31.

Einsardottir, J., & Ingham, R., J. (2005). Have disfluency type measures contributed to the understanding and treatment of developmental stuttering? *American Journal of Speech-Language Pathology, 14,* 260-273.

Evans, M.A. (1985). Self-Initiated speech repairs: a reflection of communicative monitoring in young children. *Cognitive Psychology, 21(2),* 365-371.

Fagan, W.T. (1982). The relationship of the "maze" to language planning and production. *Research in the Teaching of English, 16(1),* 85-95.

Fey, M.E., Catts, H.W., Proctor-Williams, K., Tomblin, J.B., & Zhang, X. (2004). Oral and written story composition skills of children with language impairment. *Journal of Language, and Hearing Research, 47,*1301-1318.

Fiestas, C.E. & Peña, E.D. (2004). Narrative discourse in bilingual children: Language and task effects. *Language, Speech and Hearing Services in the Schools, 35,* 155-166.

Finneran, D.A., Leonard, L.B., & Miller, C.A. (2009). Speech disruptions in the sentence formulation of school-age children with specific language impairment. *International Journal of Language and Communication Disorders,* 44(3), 271-276.

Gollan, T. H., Montoya, R. I., Cera, C., & Sandoval, T. C. (2008). More use almost always means a smaller frequency effect: Aging, bilingualism, and the weaker links hypothesis. *Journal of Memory and Language, 58,* 787-814.

Gollan, T. H., Sandoval, T. C., & Salmon, D. P. (2011). Cross-language intrusion errors in aging bilinguals reveal the link between executive control and language selection. *Psychological Science, 22*, 1155-1164.

Green, D. (1998). Mental control of the bilingual lexico-semantic system. *Bilingualism: Language and Cognition, 1,* 67-81.

Guo, T., Liu, H., Mistra, M., & Kroll, J.F. (2011). Local and global inhibition in bilingual word production: fmri evidence from Chinese-English bilinguals. *Neuroimage, 56,* 2300-2309.

Guo, L., Tomblin,B.J., & Samelson,V. (2008).Speech disruptions in the narratives of English-speaking children with specific language impairment. *Journal of Speech Language and Hearing Research, 51*, 722-738.

Gutierrez-Clellen, V.F., & Kreiter, J. (2003). Understanding child bilingual acquisition using parent and teacher reports. *Applied Psycholinguistics, 24(2),* 267-288.

Gutierrez-Clellen, V. F., & Simon-Cereijido, G. (2007). The discriminant accuracy of a grammatical measure with Latino English-speaking children. *Journal of Speech, Language, and Hearing Research, 50*(4), 968-981.

Hall, M.E., Yamashita, T.S., & Aram, D.M. (1993). Relationship between language and fluency in children with developmental language disorders. *Journal of Speech Language and Hearing Research, 36(3),* 568-579.

Hammer, C. S., Komaroff, E., Rodriguez, B. L., Lopez, L. M., Scarpino, S. E., & Goldstein, G. (2012). Predicting Spanish–English bilingual children's language abilities. *Journal of Speech, Language, and Hearing Research, 55,* 1251–1264

Hart, B., & Risley, T. (2005). *Meaningful Differences in the everyday experience of young American children.* Baltimore, MD: Brookes.

Hartsuiker, R.J., & Kolk, H.H. J. (2001). Error Monitoring in Speech Production: A Computational Test of the Perceptual Loop Theory. *Cognitive Psychology, 42,*113-157.

Hopper, J. (2014). Learning Two Languages: Maze Behaviors in Narrative Discourse in Spanish-English Bilinguals. *All Graduate Plan B and other reports. Paper 440.*

Howell, P., Ruffle, L., Fernández-Zúñiga, A., Gutiérrez,R., Fernández, A. H., O'Brien, M. L., Tarasco, M., Vallejo-Gomez, I., & Au-Yeung, J. (2004). Comparison of exchange patterns of stuttering in Spanish and English monolingual speakers and a bilingual Spanish-English speaker. In A. Packman, A. Meltzer & H. F. M. Peters (Eds.), *Theory, research and therapy in fluency disorders* (415-422). Nijmegen: Nijmegen University Press.

Howell, P., Davis, S., & Williams, R. (2009). The effects of bilingualism on speakers who stutter during late childhood. *Archives of Disease in Childhood, 94,* 42–46.

Kaur, R., Medha, H., T.S., Shruti, Kumaraswamy,S., & Subba Rao, T.A. (2011). Mazes in typically developing bilingual children. *Asia Pacific Journal of Speech and Hearing, 14(4),* 197-203.

Kroll, J.F., Bobb, S.C., Mistra, M. M., & Guo, T. (2008). Language selection in bilingual speech: Evidence for inhibitory processes. *Acta Psychologica, 128,*416-430.

Kroll, J. F., Bobb, S. C., & Wodniecka, Z. (2006). Language selectivity is the exception, not the rule. Arguments against a fixed locus of language selection in bilingual speech. *Bilingualism: Language and Cognition, 9,* 119-135.

Kroll, J. F., & Gollan, T. H. (2014). Speech Planning in Two Languages: What Bilinguals Tell us about Language Production. In M. Goldrick, V. Ferreira & M. Miozzo.(Eds.) *The Oxford Handbook of Language Production* (165-181). Oxford: Oxford University Press.

Leadholm, B. J., & Miller, J. (1995). *Language sample analysis: The Wisconsin guide*. Madison, WI: Wisconsin Department of Public Health.

Levelt, W. (1989). *Speaking: From intention to articulation*. Cambridge, MA: Bradford Books.

Lickely, R.J. (September, 2001). Dialogue moves and disfluency rates. Proceedings of Disfluency in Spontaneous Speech Workshop, Göteborg University, Sweden.

Loban, W. (1976). *Language development:kindergarten through grade twelve.* Urbana, Illinois: National Council of Teachers of English.

Lugo-Neris, M. J., Peña, E.D., Bedore, L.M., & Gillam, R.B. (manuscript in press). Utility of a Language Screening Measure for Predicting Risk in Spanish-English Bilinguals. *American Journal of Speech-Language Pathology.*

Lutz, K. C., & Malllard, A. R. (1986). Disfluencies and rate of speech in young adult nonstutterers. *Journal of Fluency Disorders, 11,* 307-316.

Miller, J. (1991). Quantifying productive language disorders. In J. F. Miller (Ed.), Research on child language disorders: A decade of progress (pp. 211-220). Austin, TX: Pro-Ed.

Miller, J., & Chapman, R. (2004). Systematic analysis of language transcripts. *Madison, WI: Language Analysis Laboratory*.

Miller, J. & Iglesias, A. (2012). Systematic Analysis of Language Transcripts (SALT), Research version 2012 [Computer Software], SALT Software, LLC.

Mayer, M. (1973). *Frog On His Own.* New York: Dial Books for Young Readers.

Murphy, K. R., & Myors, B. (2004). *Statistical Power Analysis:A Simple and General Model for Traditional and Modern Hypothesis Tests, Volume 1*. New Jersey: L. Erlbaum Associates.

Murray, W.S., & Forster, K.I. (2004). Serial mechanisms in lexical access: The rank hypothesis. *Psychological Review, 111,* 721-756.

Navarro-Ruiz, M. I., & Rallo-Fabra, L. (2001). Characteristics of mazes produced by SLI children. *Clinical Linguistics and Phonetics*, 15 (1 & 2), 63–66.

Nettelbladt, U., & Hansson,K (1999). Mazes in Swedish pre-school children with specific language impairment. *Clinical Linguistics & Phonetics, 13(6),* 483-497.

Oller, D.K., & Eilers, R.E. (Eds.). (2002).Language and literacy in bilingual children. Clevedon, United Kingdom: Multilingual Matters.

Oppenheim, G.M., Dell, G.S., & Schwartz, M.E. (2010) The dark side of incremental learning: A model of cumulative semantic interference during lexical access in speech production. *Cognition, 114,* 227-252.

Paradis, J., & Genesee, F. (1996). Syntactic acquisition in bilingual children: Autonomous or interdependent? *Studies in Second Language Acquisition, 18,* 1-15.

Pellowski, M.W., & Conture, E. G. (2002). Characteristics of speech disfluency and stuttering behaviors in 3- and 4- year- old children. *Journal of Speech, Language, and Hearing Research, 45,* 20-34.

Peña, E. D., Bedore, L. M., Iglesias, A., Gutiérrez-Clellen, V. F., & Goldstein, B. A. (2008). *Bilingual English Spanish Oral Screener – Experimental Version (BESOS).*

Peña, E. D., Gutiérrez-Clellen, V. F., Iglesias, A., Goldstein, B. A., & Bedore, L. M., (2014). *Bilingual English Spanish Assessment (BESA).* AR Clinical Publications: San Rafael, CA.

Peña, E.D., Bedore, L.M., & Zlatic-Giunta, R. (2002). Category-generation performance of bilingual children: the influence of condition, category and language. *Journal of Speech Language and Hearing Research, 45,* 938-947.

Peugh, J.L. (2010). A practical guide to multilevel modeling. *Journal of School Psychology, 48(1),* 85-112.

Restrepo, M A. (1998). Identifiers of predominantly Spanish-speaking children with language impairment. *Journal of Speech, Language, and Hearing Research, 41,* 1398-1411.

Shriberg, E. (1996, October). Disfluencies in switchboard. In *Proceedings of International Conference on Spoken Language Processing* (Vol. 96, pp. 11-14).

The Entire World of Celebrations and Seasons Sequence Cards (2007). www.sayitright.org

Taliancich-Klinger, C.L., Byrd, C.T., & Bedore, L.M. (2013). The disfluent speech of a Spanish-English bilingual child who stutters. *Clinical Linguistics and Phonetics, 27(12),* 888-904.

Thordardottir, E., & Ellis Weismer, S. (2002). Content mazes and filled pauses on narrative language samples of children with specific language impairment. *Brain and Cognition*, 48 (2–3), 587–592.

Watkins, R., Kelly, D., Harbers, H., & Hollis, W. (1995). Measuring children's lexical diversity: Differentiating typical and impaired language learners. *Journal of Speech and Hearing Research, 38,* 1349-1355.

Wagner, C.R., Nettelbladt, U., Sahlen, B., & Nilholm, C. (2000) Conversation versus narration in pre-school children with language impairment. *International Journal of Language and Communication Disorders, 35(1),* 83-93.

Yairi, E., & Ambrose, N. (1992). Onset of stuttering in preschool children: Selected factors. *Journal of Speech and Hearing Research, 35,* 782-788.

Yairi, E. (1972). Disfluency rates and patterns of stutterers and nonstutterers. *Journal of Communication Disorders, 5,* 225-231.

Zackheim, C.T., & Conture, E.G. (2003). Childhood stuttering and speech disfluencies in relations to children's mean length of utterance: A preliminary study. *Journal of Fluency Disorders, 28,* 115-142.