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The Longitudinal Study of Code-Switching in English-Instructed Spanish-English Bilingual Children

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THE LONGITUDINAL STUDY OF CODE-SWITCHING IN ENGLISH-INSTRUCTED SPANISH-ENGLISH BILINGUAL CHILDREN

A Master's Thesis

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In Partial Fulfillment

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Master of Science, Communication Sciences and Disorders

By

Molly Kathleen Gasior

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ABSTRACT

The population of bilingual children is growing in the U.S. Code-switching, a common occurrence in bilingual language production, is the use of words in the non-target language (e.g., English) when speaking the target language (e.g., Spanish). There are different approaches within the literature about how code-switching is dealt with. The purpose of this study is to longitudinally track changes in code-switching in English and Spanish narrative retell language samples, verify how code-switching impacts the lexical measure of number of different words, and whether code-switching may be indicative of Spanish language loss. Thirty-seven Spanish-English bilingual preschoolers who attended an English immersion school provided Spanish and English narrative samples across six semesters (waves). Code-switching was coded at the word level to analyze the proportion of code-switched words in each language over time. Growth-curve model estimates revealed non-significant deceleration in the proportion of code-switching over time in Spanish narrative retells and significant deceleration in code-switching in English narrative retells across 6 waves. The number of different words was impacted by the inclusion and exclusion of code-switching in narrative retells with the target language of Spanish, but not in English. Variations among individual participants and proportion of code-switching was noted in Spanish narrative retells. In English narrative retells, the proportion of code-switching was low, relatively uniform across participants, and did not occur after wave 2. Number of different words neither including nor excluding code-switching began at different points in Spanish narrative retells, but at approximately the same point in English. Language loss was not experienced by all participants. Further research on which variables influence code-switching may reveal more information on its potential connection to language loss.

KEYWORDS: code-switching, bilingual, Spanish, English, narrative retells, pre-school, English immersion

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I dedicate this thesis to my parents, Tracy and Mary Ann Gasior, and my brothers, Casey and Brett, for supporting me throughout my education.

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INTRODUCTION

The population of children who speak languages other than English has been growing across the U.S. As of 2018, 23% of school-aged children spoke a language other than English in the home, which was a 10% increase from 2008 (Federal Interagency Forum on Child and Family Statistics, 2018). According to the U.S. Census (2020), approximately 20% of children ages 5-17 were reported to speak a language other than English at home, with the majority of those children (71%) reported to speak Spanish.

Even though there is a relatively large and rapidly growing population of bilingual children in the U.S., there is a disproportionally low representation of speech-language clinicians who are bilingual. The American Speech-Language and Hearing Association (ASHA; 2021) reported 7.38% of ASHA members are bilingual speech-language pathologists, with 68.71% of those being Spanish-language ASHA certified SLPs. Due to the growing population of bilingual children, as well as limited knowledge of a second language by the majority of clinicians, there is a need to increase understanding of bilingual language development within the field of communication sciences and disorders.

In addition to this discrepancy between bilingual clinicians and the growing bilingual population, there is an emerging number of studies that address both languages of bilingual children in the current literature specifically based on narrative retell samples, which measure functional language production (e.g., Bitetti et al., 2020; Gámez & González, 2019; Squires et al., 2014). Narrative retell samples provide a basis for analysis of a variety of linguistic features such as syntax and lexical measures. There is a need for evidence-based literature to have a

greater inclusion that details the dual language development of bilingual children for future research and clinical purposes.

Code-switching has received relatively limited attention as a primary area of study in the current bilingual literature. Code-switching is a process by which a word, a phrase, a clause, or a sentence from the non-target language (e.g., English) is used when speaking in the target language (e.g., Spanish; Kapantzoglou et al. 2021; see Paradis, 2012 for a systematic review; Smolak et al. 2020). Code-switching is present in both typically developing and those with developmental disabilities (Kapantzoglou et al., 2021). Regardless of proficiency, code-switching is a linguistic tool utilized by multilingual-speakers. Use of a non-target word in a high proficiency speaker could have a variety of implications such as to clarify information, demonstrate membership to a cultural group, or to utilize larger repertoire of language to emphasis different linguistic functions (i.e., humor or highlighting information; Hughes et al., 2006). In those with low proficiency, code-switching utilizing the higher proficiency language may be used to supplement in order to maintain the fluidity of communication.

There are inconsistencies in the literature on what to do when confronted with code-switching within language samples or assessments such as inclusion or exclusion of code-switching in the samples or whether to consider instances of code-switching as errors. There needs to be increased transparency in documentation within the literature to help guide future research and clinical best practice. Researchers and speech-language clinicians in the field working with bilingual children will likely encounter code-switching.

Within the literature, it has been associated with both high proficiency or low proficiency of both the target and non-target language. Without proper recognition within the literature, it is difficult to make clinical decisions about children who code-switching, which is most if not all

bilingual children (see Paradis, 2012 for a systematic review). When taking the low proficiency perspective, code-switching can be indicative of language loss. If code-switching is truly an indicator of language loss, then clinicians must be able to recognize this to better support bilingual clients through intervention.

This study will examine code-switching in Spanish and English narrative retell language samples, the impact of code-switching on a measure of vocabulary, and code-switching as a potential indicator of language loss. The results will support future research as well as assessment and intervention strategies for clinicians working with bilingual children who code-switch.

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LITERATURE REVIEW

Code-switching, code-shifting, code-mixing, and translanguaging are words that have been used to define the interface between languages within the literature. For example, Smolak et al. (2020) defined code-switching as alternating languages between utterances or within utterances of a singular speaker. Lawton (1979) defined code-shifting as alternating the use of language or dialect. Greene et al. (2012) defined code-mixing as switches at the word level, occurring within phrases or utterances. Finally, Lyster (2019) defined translanguaging as a blending of languages without the speaker feeling the need to obey designated boundaries of non-target or target languages. Some have used code-switching and code-mixing to define two separate events. For example, Greene et al. (2012) and Hughes et al. (2006) used code-mixing to define word-level switches within connected speech. Outside of the realm of narrative retells, Ribot and Hoff (2015) described code-switching within the conversational context, in which a code-switch was considered an alternation of languages between conversational turns (e.g., a person asking a question in Spanish and the other person responding in English).

Code-switching can be categorized through a lexical lens by considering each non-target word individually or categorized by the syntactical markers in which the non-target language occurs (Hughes et al., 2006; Kapantzolglou et al., 2021; see Paradis, 2012 for a systematic review; Smolak et al., 2020). Similar to individual definitions of Smolak et al. (2020), Lawton (1979), and Greene et al. (2012), the present study will define code-switching as using words in the non-target language when speaking in the target language; words will be counted on an individual level. Further, the proportion of code-switching is defined as the number of words

produced in the non-target language divided by the total words produced in either language in a given narrative retell sample.

Code-Switching in Prior Research

Narrative retells have been utilized by researchers to analyze different linguistic elements such as microstructure and macrostructure of storytelling (e.g., Squires et al., 2014); productivity and sentence organization (e.g., Bedore et al., 2010); or syntax, semantic, and syntax skills (e.g., Gámez & González, 2019). Code-switching is prevalent in previous bilingual studies that use narrative retells, but many researchers have differing methods for documenting or measuring the occurrence of code-switching.

When designing a study, a researcher must obtain a balance between having a holistic representation of the participant profile and creating a narrow and realistic measure. There are many reasons that may contribute to the decisions a researcher makes. Whether or not to incorporate and how to incorporate code-switching is one of those decisions. Within language analyses utilizing the format of narrative retells, code-switching has been included (e.g., Hiebert & Rojas, 2021), excluded by way of excluding utterances in which code-switching occurred (e.g., Castilla-Earls et al., 2019), marked as inaccurate (e.g., Gibson et al., 2018), coded as influenced (e.g., Bedore et al., 2010); or coded as a maze (e.g., Lucero, 2015; 2018). Researchers have also attempted to prevent code-switching (e.g., Bitetti & Scheffner-Hammer, 2021; Squires et al., 2014) or have not reported whether code-switching occurred or how it was handled (e.g., Gámez & González, 2019; Gorman et al., 2016).

Marking instances of code-switching as errors may occur as a reflection of how a monolingual speech-language pathologist may interact with code-switching (e.g., Gibson et al.,

2018). Others excluded code-switching from analyses to either not artificially inflate the number of errors present (e.g., Castilla-Earls, et al., 2019) or to measure language primarily produced in the target language (Rojas & Iglesias, 2013). Some narrative retell studies have qualified code-switching as mazing due to the low frequency of occurrences and wanting to study languages separately (Lucero, 2015; 2018).

Some researchers may have created narrative retell inclusion criteria to limit excessive code-switching within their analysis. For example, Rojas and Iglesias (2013) excluded narrative samples if less than 75% of the number of different words (NDW) produced in the narrative sample were in the target language. In Hiebert and Rojas (2021) participants needed to use at least 20% of the target language to be included in the study, however, the lexical measure (moving-average type-token ratio) was reported both including and excluding code-switching to demonstrate the impact of this decision in either direction. Other strategies mentioned by researchers were counterbalancing language testing and testing sessions to preemptively limit code-switching (e.g., Squires et al., 2014). The researchers also made sure all testing administration was done in the respective language to limit the external influence of the non-target language (Lucero, 2018). No overt references to the specific identification of code-switching can be seen in studies such as Gámez and González (2019) or Gorman et al. (2016). Unclear or absent documentation could be attributed to code-switching not being the focus of that study.

There have been few studies that have analyzed proportion of code-switching within the same circumstances of this study. Some bilingual Spanish-English studies with similar age groups have analyzed code-switching under a different type of language sample, such as within free-play spontaneous language samples (e.g., Smolak et al., 2019). Other bilingual Spanish-

English research has not been longitudinal (e.g., Gutiérrez-Clellen et al., 2009; Kapantzoglou et al., 2021). It also must be noted, as mentioned earlier, that code-switching may have been defined differently between studies, for example Hiebert and Rojas (2021) defined code-switching at the word level and Anderson (1999a) defined it at the utterance level.

Due to the varying methodological practices related to code-switching within the literature, and how code-switching effects on common measures of vocabulary, comparison of results across studies could be impacted. Hiebert and Rojas (2021) explored the impact of code-switching on a measure of lexical diversity (moving average type-token ratio) in Spanish narrative retells. They found there were differences in both the intercept and rate of change over time for this measure.

Relationship Between Language Loss and Code-Switching

As the amount of exposure to English increases in proportion to the minority language, language dominance shifts (Hoff & Core, 2013; see Iglesias & Rojas, 2012 for a review, see Paradis, 2012 for a systematic review). Language loss occurs when a bilingual child has a decrease in previously attained grammatical and lexical skills in what is often the minority status language, as the acquisition of the second and often the majority status language (i.e., English in the U.S.) increases (Anderson 1999a; 1999b; 2001; see Anderson, 2012 for a systematic review). Code-switching, referred to as code-mixing in Anderson (2012), has been observed in bilingual children as a part systematic minority language loss.

With the varying definitions of code-switching, it is unclear about the connection between code-switching and language loss. Previous studies which focused on a relationship between code-switching and language loss have mostly been conducted at the utterance level.

Guiberson et al. (2006) conducted a longitudinal study with Spanish-English bilingual pre-school students in schools with at least some English instruction. The study tracked number of code-switched utterances (referred to as code-mixing in the study; defined as alternating between languages in an utterance). The study found no relationship between the number of utterances with code-switching and language loss. Anderson (1999a), in a case-study tracking intersententially code-switched utterances longitudinally, found no change over time in a participant with language loss. However, Hiebert and Rojas (2021) reported a high proportion of code-switching when tracking English-instructed participants at the word level that were experiencing language loss. Thus, more longitudinal research is warranted to track code-switching at the work level in connection to language loss.

In addition to being connected with language loss, code-switching has been documented as both an indicator of high and low proficiency in each of the two languages (Anderson, 1999a; 1999b; 2001; Hughes et al., 2006; see Paradis, 2012 for a systematic review). Low proficiency is characterized by switching between the languages due to a lack of vocabulary, a strong preference for one language over the other, and being consciously aware of the switches (Hughes et al., 2006). This difficulty comes from a reliance on the more proficient language. It should also be noted that young children who are bilingual are not necessarily balanced bilinguals, meaning that many are not comparably proficient in both of their languages (see Paradis, 2012 for a systematic review).

Research Questions:

1) Does code-switching increase over time in Spanish narrative samples produced by bilingual children instructed in English?
2) Does code-switching decrease over time in English narrative samples produced by bilingual children instructed in English?

3) Is a common measure of vocabulary (NDW) impacted by inclusion or exclusion of code-switching?
4) Is code-switching an indicator of language loss?

Based on the literature, it is hypothesized that with increased English input, in this case by way of English only instruction in school beginning in preschool, the amount of code-switching in both languages will shift (i.e., Hoff & Core, 2013; see Iglesias & Rojas 2012 for a review). Greene et al. (2012) and Gutiérrez-Clellen et al., (2009) found English dominant children of similar ages, were less likely to code-switch when speaking English and code-switched more when speaking Spanish. Castilla-Earls et al. (2019) found over time those in English-only school programs had a lower percentage of grammatical utterances in Spanish when compared to English and detailed a shift from Spanish language proficiency to English. Kapantzoglou et al. (2021), found a statistically significant higher likelihood for typically developing children between five and seven years of age, to code-switch in Spanish narrative retells, compared to English.

Due to the impact of code-switching on lexical diversity, as documented in Spanish narrative retells by Hiebert and Rojas (2021), it is projected that code-switching in Spanish will impact a common measure of vocabulary (NDW). A shift in language proficiency can create a reliance on the lexical knowledge of the more proficient language (in this case English) to that of the less proficient language (Spanish; see Anderson, 2012 for a review). With increased reliance on English, code-switching may occur more often in Spanish and increase over time. This shift in language proficiency may co-occur or be indicative of Spanish language loss as demonstrated in Hiebert and Rojas (2021).

METHODS

Participants

This study was conducted as an extension of Hiebert and Rojas (2021). Both this study and Hiebert and Rojas (2021) utilized archival data from a larger ongoing longitudinal study. This study was approved by the Institutional Review Board at the University of Texas at Dallas and Missouri State University on November 30, 2021 and received Approval #IRB-FY2021-190 (See Appendix). Participants were recruited in preschool (three or four years of age) and attended an English Immersion school in Dallas, Texas for the duration of the study. In the first and second years of preschool, though instruction was primarily in English, participants were able to clarify information in Spanish. In kindergarten instruction was entirely in English.

A total of 37 participants (17 male, 20 female) were included in the present study. The participants were from a school where over 90% of the students were Hispanic, and a majority (>80%) qualified for free/reduced lunch. Each of the participants was bilingual, per parent report, in Spanish and English. For more information about language proficiency and parent reports, see Hiebert and Rojas (2021). These participants were followed for three years, with data collected each semester (for a total of six semesters) of their first year of preschool, second year of preschool, and kindergarten. Semesters will be referred to as "waves" for the duration of the study.

Participant and Transcript Inclusionary Criteria

All students were typically developing, had normal hearing, and enrolled in an English immersion school. For a full list of inclusionary criteria, see Hiebert and Rojas (2021). Language

samples of 10 or more intelligible and complete utterances were included, as this sample length criterion for Spanish-English bilingual children has been previously established (Gusewski & Rojas 2017; Miller et al., 2006; Rojas & Iglesias, 2013). It should be noted regarding transcript inclusionary criteria, that there was a difference in comparison to Hiebert and Rojas (2021). Narrative retell samples with at least one word in the target language were included in the present study. This was done to provide a full description of the range of code-switching from the target to non-target language that occurred in typically developing Spanish-English bilingual children. Given this added factor, there were three additional participants included in the present study when compared to Hiebert and Rojas (2021).

In the present study, 11 narrative samples were excluded because they were not successfully collected, and six samples did not meet the sample length criterion. The total number of English samples from the 37 participants was 166, and the number of Spanish samples was 139, across 6 waves of data collection. Growth curve modeling allows for missing data due to the use of likelihood estimates. Language sample data in Spanish and English and descriptive statistics can be found in Tables 1 and 2.

Procedure

In the fall and spring semesters of each academic year, each of the participants provided a narrative retell language sample in Spanish and English. Narrative retells were elicited using the following wordless picture story books: *Frog, Where Are You?*, (Mayer, 1969); *Frog Goes To Dinner*, (Mayer, 1974); *Frog On His Own*, (Mayer, 1975a); and *One Frog Too Many* (Mayer, 1975b). The books were counterbalanced by story and target language of elicitation.

Bilingual examiners, who were fluent speakers of Spanish and English, elicited the narrative retell samples while sitting next to or across from the participant. They first modeled the narrative with the target language script (i.e., Spanish or English) and a book, and then instructed the participant, using the target language, to retell the story, utilizing the same picture story book as a reference. Target language use by the bilingual examiner as well as prompts to continue in the target language was used to facilitate target language use by the participant. As this was a longitudinal study, a rapport was built between the participants and the bilingual examiners. Bilingual examiners did not answer any questions but could repeat the participant's last utterances and provide backchannel responses (e.g., "aha," "sí," and "yes"). The narrative retells were audio-recorded and labeled utilizing alphanumeric codes to provide anonymity.

Coding of Outcome Measures

Systematic Analysis Language Transcripts (SALT) software was utilized to conduct the narrative language sample analyses (LSA) (Miller & Iglesias, 2018). Narrative samples were transcribed orthographically. These transcriptions were coded within SALT by trained research assistants who had native or near-native oral and written proficiency in both Spanish and English (see Tables 3 and 4).

Code-switching was coded at the word level. In the context of this study, code-switching will be used to describe utilizing Spanish or English words while speaking the other language or alternating between languages while speaking. The proportion of code-switching was determined by dividing the number of code-switched words by the number of total words produced in the target language. The total number of words did not include words within mazes. A maze is defined by SALT as instances of reformulations, false starts, repetitions, and filled pauses, coded

within parenthesis. (SALT Software, LLC, 2018). An example of a maze within a Spanish narrative retell would be “(los uh) fueron|ir a la casa” with “los uh” coded as a maze.

NDW including code-switching was determined by the number of unique words in a narrative retell including both target and non-target words (For example, if a participant stated “el perro vio el otro perro” would have a NTW of 6, but an NDW of 4 as the words “el” and “perro” were both used twice). NDW excluding code-switching was determined by the number of unique words in a narrative retell only including target words. The presence of language loss was determined by a decrease in NDW excluding code-switching in Spanish narrative retells with an increase in proportion of code-switching in Spanish narrative retells.

Transcript cleaning procedure included checking for and correcting errors regarding words, utterance segmentation, or coding. After cleaning of utterance transcriptions, inter-rater reliability was determined through randomly selecting and reviewing 25% of the transcripts to determine the reliability of coding agreement. The word-for-word transcription accuracy for this group of participants ranged from 96% to 100% in English and 92% to 100% in Spanish. The coding accuracy ranged from 90% to 98% in English and 87% to 99% in Spanish

As per Hiebert (2020), when the target language was Spanish, the coding accuracy range was 87% to 99% and the word-for word transcription accuracy range was 92% to 100%. When the target language was English, the coding accuracy range was 90% to 98% and the word for word transcription accuracy was 96% to 100%.

Non-target languages can influence target languages in other ways than code-switching in terms of syntax, phonology, or morphology. These influences are not considered code-switching and therefore were not coded as such in this study (see Anderson, 2012 for a review).

Analytic Approach

Data was analyzed utilizing growth curve modeling (GCM). These estimations were made utilizing IBM SPSS Statistics 26.0 software for Mac (IBM corp., 2021). GCM was utilized to estimate change over time (across 6 waves) and to determine prototypical growth curves. Outcome measures were estimated for both Spanish and English narrative retells and included proportion of code-switching and number of different words (NDW) including and excluding of code-switching. First, unconditional means models were estimated for each measurement, without time as a variable. Time was then utilized as an independent variable to estimate linear and quadratic unconditional fixed GCMs. The best fitting models for each measurement were determined by the negative 2 log-likelihood (-2LL).

RESULTS

Spanish Narrative Retells

Proportion of Code-Switching. The fixed linear unconditional GCM was the best fitting model to represent proportion of code-switching in Spanish narrative language samples. It had the lowest goodness-of-fit deviance statistic (-2LL = 9.11, p =.28, for a $\chi 2$ distribution on 1 *df*), a -2LL decrease, and the model converged. The average initial status was estimated by the fixed effects of the final chosen model. The onset growth starting at wave 1 was $\gamma 00 = 0.35$, $p < .001$, with a nonsignificant decrease in growth over time ($\gamma 10 = -0.01$, $p = .28$; see Figure 1). The pseudo R^2 of this model was 0.01, and the change in χ^2 was 1.19 compared to the previous model (See Table 1).

NDW Including Code-Switching. The fixed quadratic unconditional quadratic GCM was the best fitting model to represent NDW with code-switching in Spanish narrative language samples. It had the lowest goodness-of-fit deviance statistic (-2LL = 1217.75, $p < .05$, for a $\chi 2$ distribution on 1 *df*). The average initial status was estimated by the fixed effects of the final chosen model. The onset growth starting at wave 1 was $\gamma 00 = 43.41$, $p < .001$, with a significant and positive rate of change ($\gamma 10 = 11.21$, $p < .01$), and significant curvilinear deceleration ($\gamma 20 = -1.41$, $p < .05$; see Figure 2). The pseudo R^2 of this model was 0.04, and the change in χ^2 was 4.87 compared to the previous model (See Table 1).

NDW Excluding Code-Switching. The fixed linear unconditional GCM was the best fitting model to represent NDW without code-switching in Spanish narrative language samples. It had the lowest goodness-of-fit deviance statistic (-2LL = 1191.39, $p < .001$, for a $\chi 2$ distribution on 1 *df*) and a -2LL decrease. The average initial status was estimated by the fixed

effects of the final chosen model. The onset growth starting at wave 1 was γ00 = 32.73, $p < .001$, with a significant and positive rate of change (γ10 = 11.21, $p < .001$; see Figure 2). The pseudo R^2 of this model was 0.14, and the change in χ^2 was 15.44 compared to the previous model (See Table 1).

English Narrative Retells

Proportion of Code-switching. The fixed quadratic unconditional GCM was the best fitting model to represent proportion of code-switching in English narrative language samples. It had the lowest goodness-of-fit deviance statistic (-2LL = -693.85, $p = .01$, for a χ2 distribution on 1 *df*) and a -2LL decrease. The average initial status was estimated by the fixed effects of the final chosen model. The onset growth starting at wave 1 was γ00 = 0.03, $p < .001$, with a significant negative linear rate of change (γ10 = -0.02, $p < .001$), and significant curvilinear acceleration (γ20 = 0.003, $p < .001$; see Figure 1). The pseudo R^2 of this model was 0.05, and the change in χ^2 was 7.74 compared to the previous model (See Table 2).

NDW Including Code-Switching. The fixed quadratic unconditional GCM was the best fitting model to represent NDW with code-switching in English narrative language samples. It had the lowest goodness-of-fit deviance statistic (-2LL = 1406.81, $p < .01$, for a χ2 distribution on 1 *df*). The average initial status was estimated by the fixed effects of the final chosen model. The onset growth starting at wave 1 was γ00 = 28.78, $p < .001$, with a significant and positive linear rate of change (γ10 = 23.65, $p < .001$), and significant curvilinear deceleration (γ20 = -2.54, $p < .001$; see Figure 3). The pseudo R^2 of this model was 0.21, and the change in χ^2 was 27.07 compared to the previous model (See Table 2).

NDW Excluding Code-Switching. The fixed linear unconditional GCM was the best fitting model for NDW without code-switching in English narrative language samples. It had the lowest goodness-of-fit deviance statistic (-2LL = 1434.30 $p < .001$, for a $\chi 2$ distribution on 1 *df*) and a -2LL decrease. The average initial status was estimated by the fixed effects of the final chosen model. The onset growth starting at wave 1 was $\gamma 00 = 41.02$, $p < .001$, with a positive and significant linear rate of change ($\gamma 10 = 9.83$, $p < .001$; see Figure 3). The pseudo R^2 of this model was 0.52, and the change in χ^2 was 97.25 compared to the previous model (See Table 2).

DISCUSSION

Summary

This study investigated the change in the proportion of code-switching in Spanish and English, the effect of code-switching on a common measure of vocabulary (number of different words; NDW), and whether code-switching could be an indicator of language loss. Growth curve modeling (GCM) was used to estimate changes of these measures using narrative retell language samples obtained from Spanish-English bilingual children from preschool through kindergarten.

Research Question 1: Does Code-Switching Increase Over Time in Spanish Narrative Retell Samples?

It was hypothesized there would be an increase in code-switching over time when producing narrative retell language samples in Spanish. The results did not support this hypothesis. Though the results of the GCM did not indicate significant change over time, variations were notable on an individual level (see Figure 4). Individual participants demonstrated higher frequencies of code-switching than that of the prototypical growth curve (see Figure 1), while others demonstrated lower frequencies of code-switching. Examples of frequent or more varied code-switchers include JL 075, JL 060, and JL 084; and examples of infrequent code-switchers include JL 055, JL 079, and JL 099 (See Figure 4). Although the prototypical growth curve indicated no change over time in code-switching in language samples produced in Spanish, this may have been due to the heterogeneity of the samples.

While direct comparisons cannot be made to other studies, there are some parallels within the results of the present study. The proportion of code-switching in wave 6 of the present study

was 29% for participants' approximate mean age of 5;5-6 years of age. Kapantzoglou et al. (2021), conducted an investigation of code-switching in typically developing bilingual children ages five to seven years. Their participants code-switched into English when the target language was Spanish with a mean frequency of 4.65%. The higher likelihood of code-switching in Spanish narrative samples in Kapantzoglou et al. (2021) was statistically significant.

Research Question 2: Does Code-Switching Decrease Over Time in English Narrative Retell Samples?

It was hypothesized there would be a decrease in code-switching when the target language was English in narrative retell language samples. Consistent with the hypothesis, there was a decrease in code-switching as time progressed when the target language of narrative retell samples was English, although the initial proportion of code-switching was low (0.03). As opposed to the Spanish narrative retells, the prototypical growth curve was more representative of the participants overall. This was because there was less variance in the participants' samples in English.

Again, while direct comparisons cannot be made to other studies, there are some parallels within the results. In the present study, the proportion of code-switching in wave 6 of this study was 0%. Kapantzolglou et al. (2021) found the percent of code-switching in typically developing children to be 12% when the target language was English. The lower likelihood of code-switching in the English narrative samples in Kapantzoglou et al. (2021) was statistically significant.

Research Question 3: Is a Common Measure of Vocabulary (NDW) Impacted by Inclusion or Exclusion of Code-Switching?

It was hypothesized that there would be a difference in NDW when either including or excluding code-switching. The results partially supported this hypothesis. There was a difference in the lexical measure in Spanish and English narrative language samples. NDW including and excluding code-switching grew over time in both languages. Greater number of Spanish NDW from Spanish narrative retells including as compared to excluding code-switching prototypical was maintained over time. There were different growth trajectories in English NDW from English language narrative retells, but the use of code-switching did not vary in a meaningful way in waves 3-6 as no code-switching occurred in these waves.

Spanish Narrative Retells: NDW Including and Excluding Code-Switching. When the target language was Spanish, NDW at wave 1 was greater when code-switching was included than when it was excluded. The differences began to diverge to a greater magnitude at approximately wave 3 and wave 4 and converge again at approximately wave 5. Similar to the findings in the present study, Hiebert and Rojas (2021) found that rates of growth for the lexical measure, moving-average type-token ratio, decelerated over time in Spanish narrative samples.

English Narrative Retells: NDW Including and Excluding Code-Switching. When the target language was English one of the models was quadratic (NDW including code-switching) and the other was linear (NDW excluding code-switching). There are some differences across the graphs; however, after wave 2 the participants did not continue to code-switch.

Research Question 4: Is Code-Switching an Indicator of Language Loss?

It was hypothesized that code-switching could be a sign of language loss. When looking at the data at an individual level, some participants demonstrated an increase in code-switching when the target language was Spanish and a decrease in Spanish NDW excluding code-switching.

Overall, the results partially supported the hypothesis that code-switching was a sign of language loss. Further inspection of the previously identified examples of frequent or more varied code-switchers (JL 075, JL 060, and JL 084), as well as examples of infrequent code-switchers (JL 055, JL 079, and JL 099), show that some participants may have experienced language loss, and others may not have. Comparing JL 060, a frequent/varied code-switcher, and JL 099, an infrequent code-switcher, there are many differences in the narrative language samples provided by these participants across waves.

In wave 1, 50% of JL 060's utterances were coded as ungrammatical. Ninety-seven percent of the utterances were three words or less, with a majority of the utterances simply being article and noun combinations (e.g., *"*un plant"). Several utterances used alternating gender for articles. For example, in a sequence of four utterances, the first utterance was "un plant," then "una plant," "una plant," and finally "uno plant." There were a total number of 60 utterances. All of these examples may be indicative of language loss. In contrast to this example, when looking at JL 099 as a representative of those who had lower instances of code-switching, only 4% of all utterances were ungrammatical, and only 20% of utterances contained three words or less. There were no instances of code-switching, with 25 utterances total.

Detailed inspection at wave 3 for the same participants showed that JL060 had a decrease in ungrammatical utterances with only 35% of utterances being coded as ungrammatical, but an increase in ungrammaticality in wave 6 with 63% of utterances being ungrammatical.16% of

utterances containing three words or less at wave 3 but increased to 100% of utterances by the final wave. There was a total of 31 utterances but decreased to 24 utterances by the final wave.

JL 099 had only 8% of utterances ungrammatical in the third wave, this remained steady through wave 6 with 9% of utterances. Only 13% of utterances containing three words or less, and 12% at wave 6. JL 099 also had no instances of code-switching in wave 6 and had a total of 38 utterances in wave 3, and 33 utterances in wave 6.

Code-switching exclusively cannot be used as an indicator of language loss; however, it may be included as an indicator in the example of JL 060. Anderson (2012) additionally described the following lexical patterns that have been associated with language loss: use of general terms when speaking Spanish, lexical borrowing, and meaning extensions. Iglesias and Rojas (2012) noted that the reduced use of the minority language would influence the growth of that language. Furthermore, Anderson (2012) noted that an increase in code-switching in the minority language could be a sign of a shift in language dominance. Due to the probable increased input in English as the participants in the present study began attending an English immersion school, there may have been participants that experienced Spanish language loss (e.g., Anderson 2012; Iglesias & Rojas, 2012).

Clinical Implications

Bilingual language development varies greatly based on regional location, language of academic instruction, age, maternal level of education, as well as many other factors. Both languages must be included in the assessment. As the findings of this study based on proportion of code-switching, two languages can manifest differently in children with similar backgrounds.

It is also beneficial to assess bilingual children at multiple points in time, as measures such as proportion of code-switching and NDW can vary over time in both languages.

Excluding code-switching when considering common measures of vocabulary can lead to an assumption that a child has a restricted overall vocabulary. Including code-switching when assessing language skills, such as total vocabulary, allows for analysis of the child's true linguistic ability rather than only within the confines of a child's ability to maintain speaking a target language. As code-switching affects common measures of vocabulary, studies should disclose how code-switching was handled, as the inclusion or exclusion could lead to different outcomes. In order to help clinicians interpret results, and provide a standard for future research, they should also provide a rationale for their decisions.

Limitations and Future Studies

There are a limited number of studies that describe code-switching over time. Because of this, there was a limited number of existing studies with which relative comparisons could be made. There were sizable differences in the proportion of code-switching in Spanish narrative retells as well as Spanish NDW. When looking at code-switching in Spanish narrative retells, some participants code-switched frequently across time, while others did not. Additionally, there were some who may have experienced language loss (see Hiebert & Rojas, 2021). This indicates that there may be additional variables beyond those that were similar across participants in the present study. Further analysis could provide information on what contributes to differences in the quantity of code-switching in each language and potential language loss.

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Table 1. Growth Curve Models Spanish Proportion of Code-Switching (PCS), Spanish and English Number of Different Words (NDW) Including Code-Switching (CS) and Excluding CS

Parameter		Spanish PCS[a]	Spanish NDW[b] (Including CS[c])	Spanish NDW[b] (Excluding CS[c])
Fixed effects: γ (SE)				
Intercept	γ00	0.35*** (0.06)	43.41*** (5.90)	0.73*** (0.03)
Linear Slope	γ10	-0.01 (0.01)	11.21** (3.84)	-0.02** (0.007)
Quadratic Slope	γ20		-1.42* (0.63)	
Goodness-of-fit -2LL[d]		9.11	1217.75	1191.39

Note:

[a]PCS= Proportion of Code-Switching

[b]NDW= Number of Different Words

[c]CS= Code-Switching

[d]2LL = -2 log-likelihood deviance statistic.

*$p < .05$. **$p < .01$. ***$p < .001$.

Table 2. Growth Curve Models English Proportion of Code-Switching (PCS), Spanish and English Number of Different Words (NDW) Including Code-Switching (CS) and Excluding CS

Parameter		English PCS[a]	English NDW[b] (Including CS[c])	English NDW[b] (Excluding CS[c])
Fixed effects: γ (SE)				
Intercept	γ00	0.03*** (0.006)	28.78*** (4.10)	41.02*** (3.48)
Linear Slope	γ10	-0.02*** (0.005)	23.65*** (2.61)	9.83*** (0.82)
Quadratic Slope	γ20	0.003**	-2.54*** (0.46)	
Goodness-of-fit				
-2LL[d]		-693.85	1406.81	1434.30

Note:

[a]PCS= Proportion of Code-Switching

[b]NDW= Number of Different Words

[c]CS= Code-Switching

[d]2LL = -2 log-likelihood deviance statistic.

*$p < .05$. **$p < .01$. ***$p < .001$.

Table 3. Descriptive Statistics of Spanish Number of Transcripts, Number of Total Words (NTW), Number of Different Words (NDW), and Proportion of Code-Switching (PCS)

	Waves					
	Wave 1	Wave 2	Wave 3	Wave 4	Wave 5	Wave 6
Number of Transcripts	8	10	29	28	31	33
Spanish NTW[a]	110.75	103.90	154.24	154.57	194.19	175.24
	(50.89)	(45.16)	(57.24)	(61.27)	(76.13)	(82.11)
Spanish NDW[b]	47.50	50.80	62.17	62.46	70.45	63.03
	(21.54)	(19.60)	(20.62)	(18.71)	(24.40)	(25.59)
Spanish PCS[d]	0.29	0.14	0.26	0.27	0.27	0.24
	(0.36)	(0.30)	(0.38)	(0.34)	(0.34)	(0.29)

Note:

[a]Number of total words

[b]Number of different Words

[c]Code-switching

[d]Proportion of code-switching.

Table 4. Descriptive Statistics of English Number of Transcripts, Number of Total Words (NTW), Number of Different Words (NDW), and Proportion of Code-Switching (PCS)

	Waves					
	Wave 1	Wave 2	Wave 3	Wave 4	Wave 5	Wave 6
Number of Transcripts	16	16	33	34	34	33
English NTW	87.25	145.81	183.58	199.26	252.24	243.06
	(65.84)	(56.69)	(76.64)	(80.45)	(84.01)	(61.68)
English NDW	31.50	58.19	67.45	72.62	86.24	83.45
	(19.66)	(19.15)	(19.76)	(20.42)	(22.19)	(14.60)
English PCS	0.04	0.00	0.00	0.00	0.00	0.00
	(0.10)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)

Note:

[a]Number of total words

[b]Number of different Word

[c]Code-switching

[d]Proportion of code-switching.

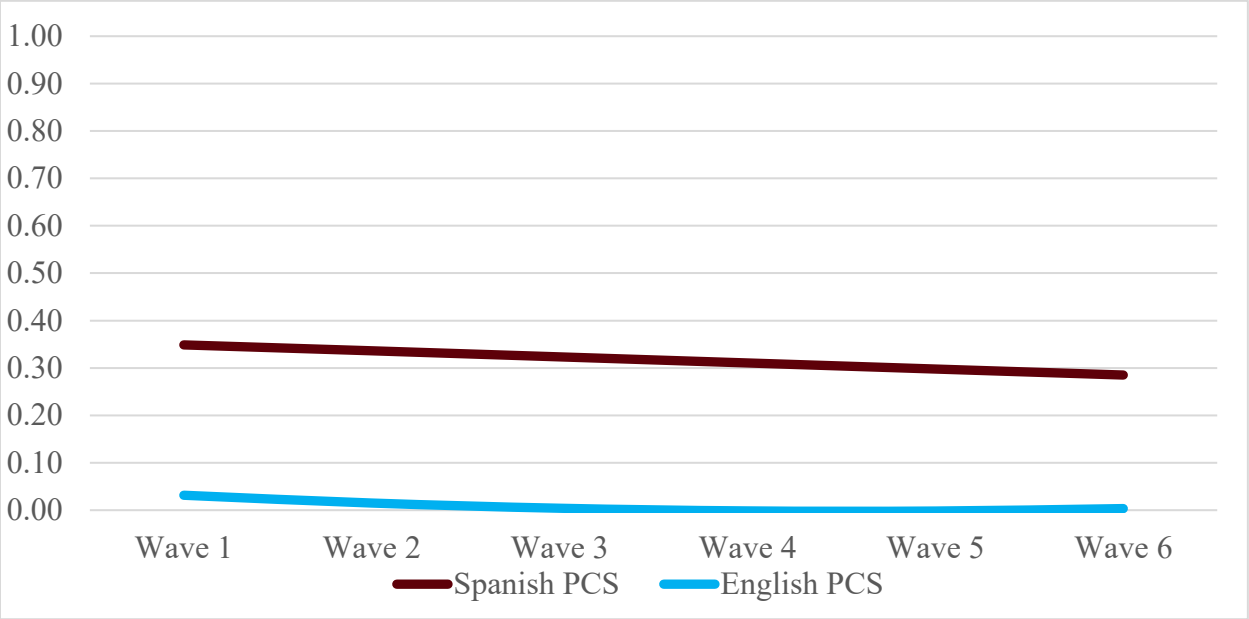

Figure1. Proportion of Code-Switching (PCS) in Spanish and English Across 6 Waves

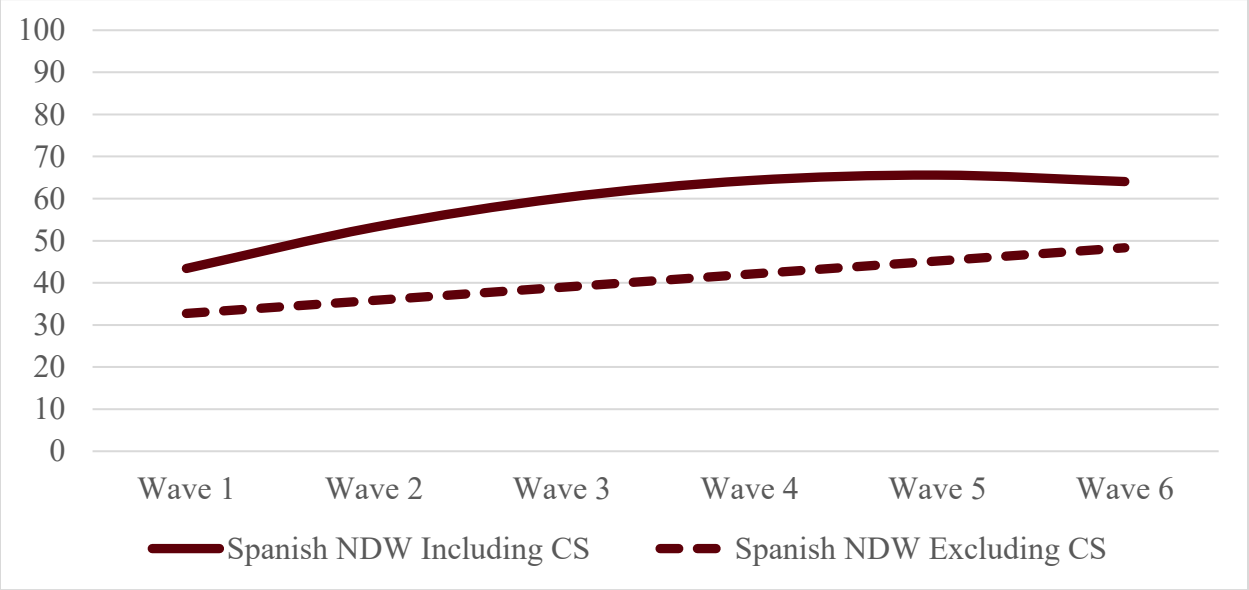

Figure 2. Spanish Number of Different Words (NDW) Including and Excluding Code-Switching (CS)

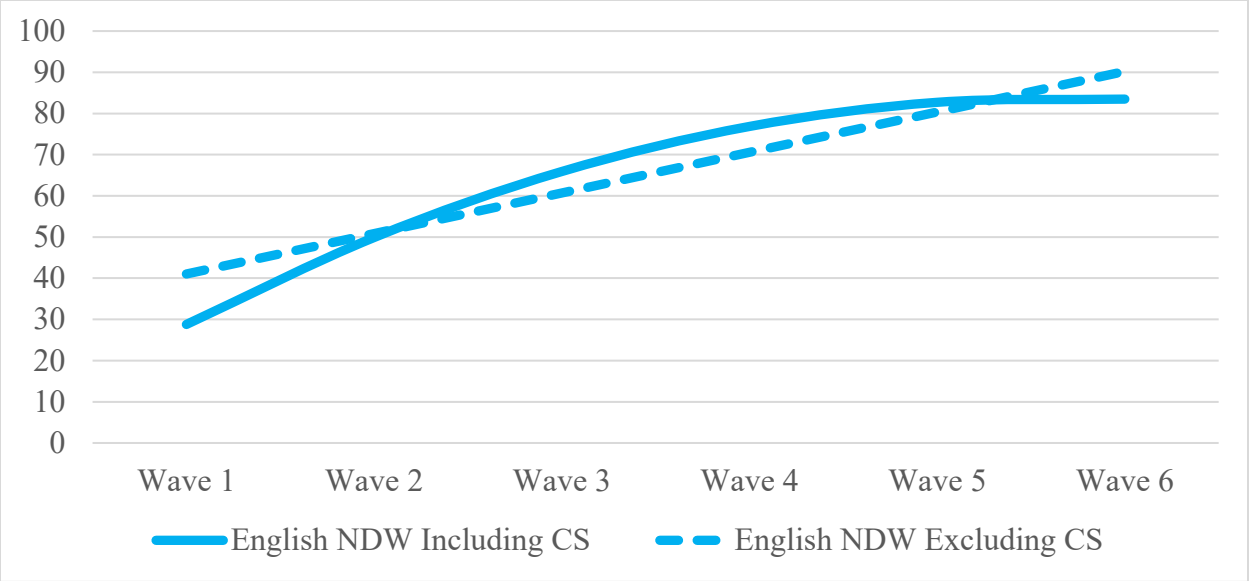

Figure 3. English Number of Different Words (NDW) Including and Excluding Code-Switching (CS)

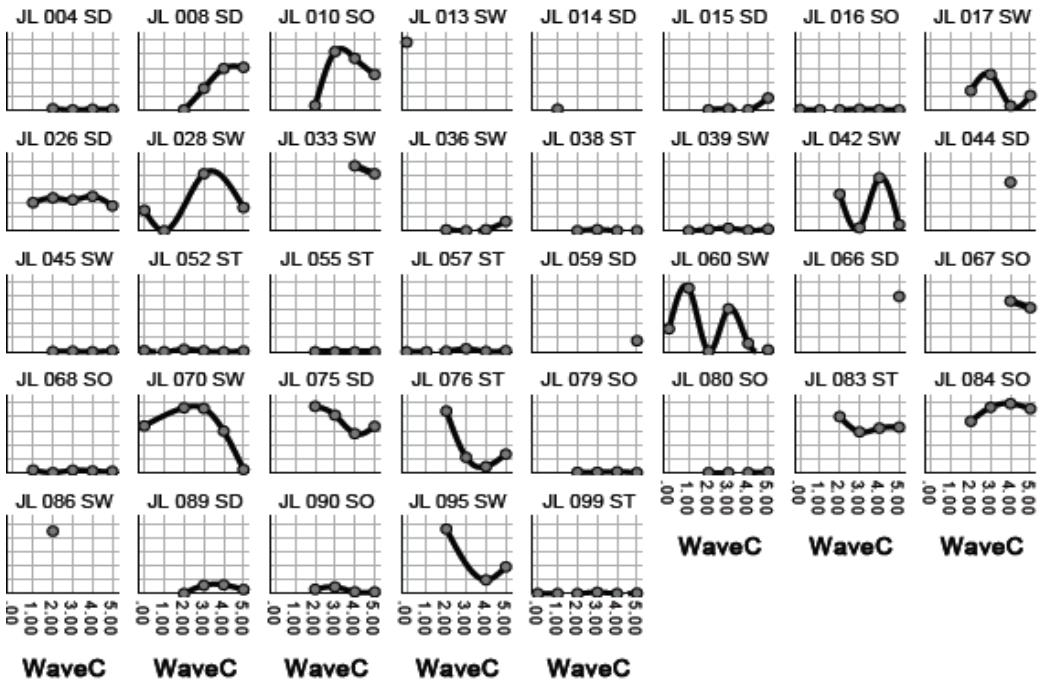

Figure 4. Individual Growth Trajectories for Spanish Proportion of Code-Switching

APPENDIX

Appendix. Human Subjects IRB Approval

Date: 11-30-2021

IRB #: IRB-FY2021-190
Title: Longitudinal analysis of first language deceleration and second language growth in Spanish-English bilingual children
Creation Date: 10-6-2020
End Date:
Status: Approved
Principal Investigator: Lindsey Hiebert
Review Board: MSU
Sponsor:

Study History

Submission Type Initial	**Review Type** Expedited	**Decision** Approved
Submission Type Modification	**Review Type** Expedited	**Decision** Approved
Submission Type Modification	**Review Type** Expedited	**Decision** Approved

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