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# Phonological Variation Among Young Spanish-English Dual Language Learners on an English Sentence Repetition Task

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## ABSTRACT

**Purpose -** There is a need for research informing best practices for assessing the language abilities of bilingual children, as well as research regarding typical phonological development of bilingual children. The purpose of the present paper is to contribute broadly to informing bilingual phonological assessment practice by examining phonological variation in Spanish-English speaking children's English sentence repetition responses and the relation between these phonological variations and performance on the English sentence repetition task.

**Method -** 20 Spanish-English speaking kindergarteners completed the English sentence repetition task of the Bilingual English-Spanish Assessment (BESA; Peña et al., 2014). The phonological variations present in their responses were analyzed by type of shift that occurred and whether the variation was consistent with Spanish phonology or language neutral variations. The relationship between the number of variations present and score on the English sentence repetition task was also examined.

**Results -** There was no significant correlation between the number of phonological variations present in the children's responses to the English sentence repetition task and their score on the task, as well as their score on other measures of language ability.

**Implications -** Examining phonological variation will allow for a more in depth understanding of the phonological development of bilingual children. Recording and categorizing each substitution revealed the vast variability in children's responses.

## LITERATURE REVIEW

As the United States becomes more linguistically diverse, it is increasingly important for speech-language pathologists, and anyone who works with children and families, to be aware of how linguistic differences influence assessment and service delivery. The Spanish-English speaking population is projected to represent 24% of the United States population and 29.2% of the school-aged population by the year 2050 (Ortiz et al., 2007). It is important that assessment techniques take into account the unique language skills and cultural experiences of these children.

There is a need for research informing best practices for assessing the speech and language abilities of bilingual children. This need for information has led to delays in the provision of diagnostic services and to misidentification of both typically developing children and children with communication disorders (Goldstein, 2001; McLeod et al., 2017; Caesar & Kohler, 2007). Specifically, further research regarding typical phonological development of bilingual children would allow for a more in depth understanding of the phonological abilities of bilingual children. This would provide a more reliable baseline for determining whether a child is exhibiting delayed phonological development. Adding to this knowledge base would improve diagnostic services for the bilingual population because it would form a more comprehensive base of norm-referenced data on typical phonological development to which delayed or disordered development could be compared (Fabiano-Smith & Barlow, 2010; Fabiano-Smith & Hoffman, 2018; Gildersleeve-Neumann et al., 2008). Improved diagnostic services would lead to improvements in school performance, literacy development, and overall well-being, as a child's oral language development serves as a foundation for academic and social success (Hammer et al., 2014).

Most research on phonological development relevant to children in the U.S. has been conducted focusing on monolingual English speakers, with a few studies focusing on phonological development in monolingual Spanish speakers. Because of the lack of information regarding phonological development of Spanish-English bilingual children and corresponding limited availability of standardized, norm-referenced measures of bilingual phonological development, speech-language pathologists commonly use assessments designed for monolingual speakers to assess the phonological abilities of bilingual children (Fabiano-Smith & Hoffman, 2018; Gildersleeve-Neumann et al., 2008). This practice assumes that bilingual phonological development aligns directly with monolingual phonological development.

While it has been found that bilingual children share similarities with monolingual children in their development of sound production patterns (Fabiano-Smith & Goldstein, 2010a), there is also evidence that bilingual and monolingual children may exhibit different phonological errors as they acquire language (Goldstein & Washington, 2001). There is interaction between bilingual children's two phonological systems, which leads to transfer of phonetic knowledge of one language to the other language (Fabiano-Smith & Goldstein, 2010b). Although both monolingual and bilingual children develop sounds from simple to complex, there is variation between monolingual and bilingual children in the timing at which specific sounds develop (Fabiano-Smith & Goldstein, 2010b). In one study, it was found that monolingual English speakers and bilingual speakers had similar percentage correct values for the manner of production classes of stops, nasals, glides, fricatives, affricates, and liquids, revealing a similarity in production of early-, middle-, and late-developing sounds (Goldstein & Washington, 2001). This same study also found that monolingual Spanish-speaking children and bilingual children showed differences in substitution patterns. For example, monolingual Spanish-speaking children most regularly substituted the flap (/ɾ/) for the trill (/r/), while bilingual children most regularly substituted /l/ for the trill (Goldstein & Washington, 2001).

Although the phonological systems of monolingual and bilingual children share similarities, these differences in developmental patterns reveal that they are not identical. This further emphasizes the need for bilingual assessment techniques, specifically in the phonological domain, for assessment of bilingual children to be informative. The purpose of the present paper is to contribute broadly to informing bilingual phonological assessment practice by examining phonological variation in Spanish-English speaking children’s English sentence repetition responses and the relationship between these phonological variations and performance on the English sentence repetition task.

**Comparison of Spanish and English Phonemic Inventories**

The phonemic inventories of Spanish and English are distinct and differ in the number of consonants and vowels, as well as how these consonants and vowels are produced. The English phonemic inventory has 15 vowel and diphthong sounds, while the Spanish phonemic inventory only has five. English has 23 consonant sounds while Spanish has 18 (Goldstein, 2001). The complete phonemic inventories for Spanish and English can be seen in Table 1.

**Table 1. Phonemic Inventories of Spanish and English**

| Manner of Production | Spanish | English |
|---|---|---|
| Stops | p b t d k g | p b t d k g |
| Fricatives | f s x | f v s z θ ð ʃ ʒ |
| Affricates | tʃ | tʃ dʒ |
| Glides | w j | w j |
| Nasals | m n ɲ | m n ŋ |
| Liquids | l | l ɹ |
| Flap | ɾ | |
| Trill | r | |

Adapted from (Goldstein, 2001).

One of the differences in production between English and Spanish consonants is in the place of production for specific consonants. For example, the /d/ sound in English is generally produced by the tongue contacting the alveolar ridge, while the /d/ sound in Spanish is typically dentalized, with the tongue contacting the teeth. This same contrastive allophonic variation is seen in the production of the English and Spanish /t/ sound. Another difference is in the presence of the tap and trill sound classes in Spanish, and the absence of the English rhotic /ɹ/ (Goldstein, 2001).

Another difference is that Spanish does not contain all the consonant clusters that are present in English, and because of this, bilingual children may delete consonants in some consonant blends when speaking English. For example, there are no word initial consonant clusters that begin with /s/ in Spanish (Goldstein, 2001).

Like monolingual children, bilingual children develop sounds that are easier to articulate first, and then progress to sounds that are more difficult to articulate (Fabiano-Smith & Barlow, 2010; Fabiano-Smith & Goldstein, 2010a). Phonological processes occur as children simplify complex sounds or sound combinations (Donegan & Stampe, 2009). As motor movements are refined, enabling production of more complex sounds, phonological processes will be suppressed (Gildersleeve-Neumann et al., 2008). For example, cluster reduction is a process that simplifies speech by eliminating a consonant sound and reducing the motor movements that must occur to produce multiple consonant sounds in succession. An example of cluster reduction in English would be "blue" being pronounced as "bu". In Spanish, an example of cluster reduction would be "playa" being pronounced as "paya".

There is also evidence that there may be differences in the types of errors produced and substitution patterns used between bilingual Spanish-English speaking children and monolingual Spanish or English-speaking children (Goldstein & Washington, 2001). For example, the percentage of occurrence for the phonological processes of cluster reduction, unstressed syllable deletion, and liquid simplification were found to be different in a study comparing monolingual English speaking children and bilingual Spanish-English speaking children (Goldstein & Washington, 2001), highlighting that bilingual children may use some processes more frequently than monolingual children and that monolingual children may use other processes more frequently than bilingual children. This again emphasizes the need for specific assessment techniques designed for bilingual children.

It is important to make a distinction between phonological disorders and phonological variations. Phonological disorders focus on predictable, rule-based errors that affect more than one sound (Speech sound disorders: Articulation and phonology, n.d.), while phonological variations are attributable to differences in language and dialect exposure. This project will be examining phonological variations, as consonant production among bilingual children is influenced by their exposure to multiple languages that interact with each other (Goldstein, 2001; Hambly et al., 2013).

**Theoretical Framework**

Theoretical frameworks informing research on bilingual phonological development have focused primarily on speech perception, and not phonological production. For this paper, The *Processing Rich Information from Multidimensional Interactive Representations* (PRIMIR) model (Werker & Curtin, 2005), a model for bilingual speech perception, has been expanded to provide a lens for considering bilingual speech production. The PRIMIR Model is a framework for how infants process and organize information from the receptive speech signal (Werker & Curtin, 2005). The model consists of three “dynamic filters" that influence processing and direct attention to certain information: initial biases, the child’s developmental level, and the specific language task requirements. The model also includes representational planes for storing information: The General Perceptual plane, a Word Form plane, and an emerging Phonemic plane. The General Perceptual plane includes all information from the speech signal, both phonetic and indexical. Language-specific categories within this plane help form the Word Form plane, which, “consists of extracted units without meaning attached” (Werker & Curtin, 2005). Infants begin to form meaningful words by linking Word Forms with concepts (word learning). As the infant's vocabulary expands, a system of contrastive phonemes emerges (Phonemic plane) which helps focus attention on the information within the Word Form that allows the infant to make a new word-object link (Curtin et al., 2011; Werker & Curtin, 2005).

One core aspect of the PRIMIR model relevant to the present work is a compare and contrast mechanism, which helps organize information into the representational spaces (Curtin et al., 2011). Some phonological forms in English and Spanish cannot be contrasted because they are the same in both languages. According to the PRIMIR model, these forms are stored in the same phonemic space and may be used both in English productions and in Spanish productions (Werker & Curtin, 2005). For example, all Spanish vowels are found in English, as are certain consonants such as /k/ and /s/. Other phonological forms such as /r/, /t/, and /v/ are generally contrastive in English and Spanish and would be stored as two separate phonemes. If these phonemic contrasts are not yet fully developed and stored in separate spaces, Spanish and English productions may overlap. The presence of an overlap in Spanish and English phonologies results in the phonemes of Spanish being produced during English productions and English phonemes being produced during Spanish productions. This is often described as "Spanish-influenced English." The degree of Spanish-influenced English that occurs in each child's productions may serve as a proxy for the child's relative exposure and/or proficiency in each language (Hambly et al., 2013).

**Phonology in the Context of Sentence Repetition**

Drawing on the theoretical foundation of the PRIMIR model and considering application to clinical speech-language pathology practice, this thesis focused on two constructs of interest. First, we examined Spanish-English bilingual children's general performance on standardized assessments of language in Spanish and English. We assessed Spanish, English, and conceptual vocabulary and, focally, performance on the English sentence repetition task of the Bilingual English-Spanish Assessment (BESA;

Peña et al., 2014). The sentence repetition task involves the examiner verbally giving the child a set of sentences one at a time and asking them to repeat the sentences word-for word. The task is part of the morphosyntactic subtest of the BESA, and it is intended to measure the child's knowledge of grammatical morphemes and sentence structure (Peña et al., 2014).

The second focus variable was the children's phonological variation in response to the sentence repetition task (Goldstein et al., 2004) and the Expressive One-Word Picture Vocabulary Test 4: Spanish-Bilingual Edition (EOWPVT-4 SBE; Martin, 2013) . We focused on consonant variation, similar to previous studies focusing on cross-linguistic phonological variation, because consonant accuracy is a measure that is often used to examine bilingual children's phonemic knowledge in Spanish and English (Fabiano-Smith & Goldstein, 2010; Goldstein et al., 2005).

The BESA sentence repetition task is an assessment used to measure morphosyntactic ability, while recording phonological variation measures phonological ability (Peña et al., 2014). The domains of phonology and morphosyntax can be expected to interact as they are both important factors in language development, and a change in one has been seen to effect change in the other (Tyler et al., 2002). For example, children with both morphosyntax and phonological impairments showed improvements in both domains after intervention that targeted morphosyntax (Tyler et al., 2002). This suggests that there will be an association between phonological variation that is inconsistent with Spanish phonology and sentence repetition task score.

For this project, we focused on examining phonological variation in the context of a sentence repetition task. Sentence repetition tasks provide a connected speech sample, while also being a closed response assessment, which reduces the impact of background knowledge. We examined this within a sample of bilingual Spanish-English speaking 5-year-olds. We decided to sample children who were five years old because by this age, children are at the end of phonological development and there will not be as many phonological processes present, except for those that are in line with phonological development level or phonological disorder. Also, by the age of five, bilingual children demonstrate comparable speech sound accuracy as monolinguals of the same age (Goldstein et al., 2005), allowing for more fine-grained analysis of general phonological variation demonstrated by bilingual children.

The following research questions were addressed:

1) What types of phonological variations appear in the responses of Spanish-English bilingual kindergarteners on an English sentence repetition task?
2) What is the association between these phonological variations and performance on the English sentence repetition task and EOWPVT-4 SBE?

Based on the expectation of overlapping productions in Spanish and English in children whose phonemic contrasts are not yet fully developed (i.e., before the age of 5), we expected that there would be no association between phonemic variations that are consistent with Spanish phonology and sentence repetition task score. This is because productions that are consistent with Spanish phonology are developmentally expected and would not be consistent with possible phonological disorder revealed in sentence repetition task score. We expected that there would be an association between variation that is inconsistent with Spanish phonology and sentence repetition task score, as language-neutral variations may be more likely to be indicative of possible phonological disorder connected to language development.

## METHOD

The participant sample included in the present study was a subsample obtained from data already collected from Spanish-English speaking children in grades 4K – Grade 1. All participants attended a local elementary school, where data was collected in-person during the fall of 2019 and spring of 2020. The children completed a battery of dual language and literacy assessments. These included subtests from the Bilingual English-Spanish Assessment (BESA; Peña et al., 2014) and the Expressive One-Word Picture Vocabulary Test 4: Spanish-Bilingual Edition (EOWPVT-4 SBE; Martin, 2013). Trained undergraduate and graduate research assistants administered the assessments in Spanish and English. For the BESA sentence repetition task, raw and norm-referenced scores were obtained in both Spanish and English. For the EOWPVT-4 SBE, raw and norm-referenced scores were obtained for both Spanish and English. A conceptual vocabulary score was also computed, which gave participants credit for correct responses in either English or Spanish.

### Participants

Our sample consists of a subsample of 20 Spanish-English speaking children in kindergarten who completed the English version of the sentence repetition task from the Bilingual English-Spanish Assessment (Peña et al., 2014). For the purpose of the present work, we excluded children who were not in kindergarten, those who had one or more 0-credit sentences on the sentence repetition task, and those whose audio recordings were difficult to hear. We focused our sample on children who were in kindergarten because most children in kindergarten are 5 years old, which is the age we wanted to sample. We excluded children whose audio recordings were difficult to hear because this would result in a less accurate sample of the child's speech and language ability. We excluded children who had one or more 0-credit sentences so that each child in the sample would have a response for all nine sentences. The remaining subsample included 20 children.

**Transcription**

The transcription process required several steps. First, to provide baseline phonetic comparisons for children's productions from each sentence of the BESA sentence repetition task, each sentence repetition prompt was transcribed phonetically. The transcription was conducted by the primary author (Coleman) and reviewed by a certified speech-language pathologist. Then, using the audio files from the sentence repetition task, each variation from the base transcription that the child produced was transcribed. This process was repeated for each child and each sentence, focusing only on words that were scored as "correct". Words were scored as correct even if the word contained an articulation or phonological variation, as long as the target word was still identifiable (Theodorou, Kambanaros, & Grohmann, 2017). This was done because the sentence repetition task is a measure or morphosyntactic ability, not phonological or articulation ability. For example, if a child produced "streed" instead of the word "street" it would be scored as correct and the child would have received credit for the word "street" on the English sentence repetition task. In the context of the present study, the child would have received credit for the phonemes /s/, /t/, and /ɹ/, but not for the word final phoneme /t/ because they produced the phoneme /d/ instead.

For each sentence, the number of phonological variations from the target that each child made and the number of total possible consonants that each child could have produced (based on the prompt and the words the child repeated) was recorded. These counts varied somewhat across the children because they repeated different numbers of words in each sentence.

Percent consonants correct for each child were calculated by dividing the number of consonants the child produced by the number of consonants they could have produced (based on their response), as well as dividing the number of consonants the child produced by the total possible consonants in the sentence. This process was repeated for each sentence.

Finally, the variations in children's responses were coded by the type of sound shift. The coding process involved making a list of each consonant variation that was produced for each sentence, including substitutions and deletions, but not including any additions of consonants that were not present in the model sentence. An overall list of phonological variations present was compiled. Each variation on the list was then categorized by phonological process and whether the variation was consistent with Spanish phonology. Analysis of phonological processes was carried out by characterizing each variation according to changes in place, manner, and voicing. The place of production is the location in the vocal tract where the phoneme is produced. For example, the phoneme /p/ has a bilabial place of production. The manner of production is how the phoneme is produced in the vocal tract. For example, /s/ is a fricative because it is produced by air flowing through a restriction. Voicing is determined by whether the vocal folds vibrate during production of the phoneme. For example, /p/ is not voiced while /b/

is voiced. Once shifts in place, manner, and voicing were identified for each variation, the variations were described according to the shift. For example, when the word “mother” is produced as “muder”, the shift from the sound “th” to /d/ is a shift in manner because it goes from a fricative to a stop. This variation is described as stopping.

Each variation was also categorized according to whether it was consistent with Spanish phonology. This was done by first determining if the target consonant appears in the Spanish phonetic inventory and then determining if the consonant the child produced appears in the Spanish phonemic inventory. If the target consonant was not in the Spanish phonemic inventory, but the consonant that the child produced was in the Spanish phonemic inventory, then the variation was categorized as consistent with Spanish phonology. For example, when the word “fever” is produced as “feber”, the variation of /v/ to /b/ would be considered consistent with Spanish phonology because /v/ is not in the Spanish phonemic inventory but /b/ is. If the target consonant was present in the Spanish phonemic inventory or the resulting consonant was not present in the Spanish phonemic inventory, then the variation was categorized as language neutral, meaning that it was most likely not consistent with any specific language influence.

**Reliability Checking**

To check for reliability of transcriptions, a trained graduate student in speech-language pathology with background in both phonetic transcription and language sample analysis reviewed 20% of the transcribed responses. The second transcriber completed both word-by-word and phoneme-by-phoneme transcriptions of the subset of samples. These transcriptions were compared to the transcriptions completed by the author (Coleman). The final phoneme-by-phoneme reliability by sentence was 94.0% (*SD* =

7.1%). Consensus was reached through re-examination by the author and discussion with an independent reviewer as needed.

## Analytic Approach

To address the first research question, we examined the number of phonological variations produced by (1) type of phonological process, and (2) consistency with Spanish phonology. To address the second research question, we examined the correlations between children's standardized scores on measures of Spanish and English language (vocabulary and morphosyntax) and: (1) the total number of phonological variations observed; (2) the number of phonological variations observed that were categorized as *consistent* with Spanish phonology; and (3) the number of phonological variations observed that were categorized as *inconsistent* with Spanish phonology.

# RESULTS

Descriptive results from the sample are provided in Table 2, including scores from the English and Spanish sentence repetition tasks and the English and Spanish EOWPVT-4 SBE, the conceptual vocabulary scores computed from the EOWPVT-4 SBE, and the age in years of children in the sample. The children included in the sample were in eight different classrooms, all of which used English-only instruction.

**Table 2. General Sample Descriptives**

| **Measure** | ***n*** | **Mean** | ***SD*** | **Min** | **Max** |
|---|---|---|---|---|---|
| English SR Raw Score | 20 | 23.35 | 7.52 | 4 | 32 |
| English SR Scale Score | 20 | 8.75 | 2.99 | 2 | 12 |
| English SR Standardized Score | 19 | 93.16 | 15.11 | 60 | 110 |
| Spanish SR Raw Score | 18 | 21.44 | 7.01 | 4 | 30 |
| Spanish SR Scale Score | 18 | 8.94 | 2.60 | 4 | 12 |
| Spanish SR Standardized Score | 17 | 94.71 | 13.40 | 70 | 110 |
| English EOWPVT Raw Score | 20 | 44.65 | 15.78 | 8 | 69 |
| English EOWPVT Standard Score | 20 | 98.90 | 16.80 | 58 | 122 |

| | | | | | |
|---|---|---|---|---|---|
| Spanish EOWPVT Raw Score | 20 | 30.15 | 14.27 | 1 | 56 |
| Spanish EOWPVT Standard Score | 18 | 86.44 | 14.10 | 66 | 115 |
| Conceptual EOWPVT Raw Score | 20 | 50.80 | 12.85 | 25 | 73 |
| Conceptual EOWPVT Standard Score | 20 | 105.70 | 13.09 | 74 | 126 |
| Age in Years | 20 | 5.70 | 0.31 | 5.17 | 6.08 |

*Note*. SR = Sentence Repetition. EOWPVT = Expressive One-Word Picture Vocabulary Test 4, Spanish-Bilingual Edition.

Table 3 displays the overall descriptive information for the phonological variations observed within the audio file recordings. On average, each child exhibited 19.05 phonological variations (*SD* = 5.89) across the entirety of the sentence repetition task, and correctly produced 85% (*SD* = 0.05) of the consonants. This percentage of consonants produced correctly was based only on the consonants in the words that the child produced. It does not include words that the child did not repeat, making it a more accurate metric for phonology than the percent consonants correct value based on the total words in the target sentence. Of the phonological variations present in the children's responses, an average of 10.90 (*SD* = 4.69) were consistent with Spanish phonology.

**Table 3. Descriptive Information for Phonological Variations**

| **Description** | ***n*** | **Mean** | ***SD*** | **Min** | **Max** |
|---|---|---|---|---|---|
| Sum of Errors across All Sentences | 20 | 19.05 | 5.89 | 9.00 | 29.00 |
| Sum of Consonants Produced Correctly across All Sentences | 20 | 102.95 | 25.94 | 51.00 | 134.00 |
| Average Errors per Sentence | 20 | 2.12 | 0.65 | 1.00 | 3.22 |
| Average Consonants Produced Correctly per Sentence | 20 | 11.44 | 2.88 | 5.67 | 14.89 |
| Percent Correct Consonants (from child's word productions) | 20 | 0.85 | 0.05 | 0.76 | 0.94 |
| Total Number of Instances of Errors Consistent with Spanish Phonology | 20 | 10.90 | 4.69 | 4.00 | 18.00 |

| | | | | | |
|---|---|---|---|---|---|
| Total Number of Instances of Language-Neutral Phonological Errors | 20 | 7.40 | 2.52 | 3.00 | 14.00 |

**Types of Phonological Variations**

To address the first research question, we organized the types of phonological variations present in the children's responses according to singleton consonant variations and consonant cluster variations, and by type of variation and consistency with Spanish phonology. The singleton consonant phonological variations that occurred most frequently were final /t/ -> deletion, final /z/ -> /s/, and initial /ð/ -> /d/. Final /t/ deletion occurred in the responses of 16 children, with the average number of occurrences per child being 1.88 (*SD* = 0.50). Substitution of an /s/ in place of a word final /z/ occurred in the responses of 15 children, with the average number of occurrences per child being 1.67 (*SD* = 1.11). Substitution of a /d/ in place of a word initial /ð/ occurred in the responses of 17 children, with the average number of occurrences per child being 5.12 (*SD* = 3.28).

The consonant cluster phonological variation that occurred most frequently was consonant cluster (/ldr/) /r/ -> deletion. This variation occurred in the responses of 12 children, with the mean number of occurrences per child being 1.25 (*SD* = 0.45). Of these four phonological variations, final /z/ -> /s/, initial /ð/ -> /d/, and consonant cluster (/ldr/) /r/ -> deletion were consistent with Spanish phonology.

The phonological variations that were present in the responses of the children were categorized according to deletion, cluster reduction, shifts in manner, shifts in place, and shifts in voicing. Some of the more frequent manner shifts include stopping, gliding, and frication. Some of the more frequent place shifts include alveolarization and dentalization. See Tables 4 and 5 for a full list of phonological variations categorized by type.

The two variation types consistent with Spanish phonology that occurred most frequently were shifts in place (*M* = 6.30, *SD* = 3.73) and shifts in manner (*M* = 6.55, *SD* = 3.82). Shifts in voicing that were consistent with Spanish phonology occurred an average of 2.05 times per child (*SD* = 1.90). For language neutral variations, place shifts occurred an average of 2.3 times per child (*SD* = 1.30), manner shifts occurred an average of 2.05 times (*SD* = 1.61), and voicing shifts occurred an average of 0.95 times (*SD* = 0.89). Language neutral deletions occurred an average of 2.85 times (*SD* = 1.23) per child and language neutral cluster reductions occurred an average of 1.10 times (*SD* = 0.85). Deletions and cluster reductions consistent with Spanish phonology occurred more frequently, 1.20 (*SD* = 1.15) and 2.00 (*SD* = 1.08) respectively.

**Table 4. Phonological Variations Consistent with Spanish Phonology**

| Description | *n* | Mean | *SD* | Min | Max | Deletion | Reduction | Manner Shift | Place Shift | Voicing Shift |
|---|---|---|---|---|---|---|---|---|---|---|
| Initial /d/ -> /d̪/ | 1 | 1 | - | 1 | 1 | | | | Dentalization | |
| Initial /h/ -> /k/ | 1 | 1 | - | 1 | 1 | | | Stopping | Velarization | |
| Final /ŋ/ -> /n/ | 9 | 1.11 | 0.33 | 1 | 2 | | | | Alveolarization | |
| Final /ŋ/ -> deletion | 1 | 1 | - | 1 | 1 | Final consonant deletion | | | | |
| Initial /r/ -> /w/ | 3 | 1 | 0 | 1 | 1 | | | Gliding | Labialization | |
| Final /r/ -> /w/ | 5 | 1 | 0 | 1 | 1 | | | Gliding | | |
| Final (postvocalic) /r/ -> deletion | 5 | 1 | 0 | 1 | 1 | Final consonant deletion | | | | |
| Postvocalic /v/ -> /d/ | 1 | 1 | - | 1 | 1 | | | Stopping | Alveolarization | |
| Postvocalic /v/ -> /b/ | 7 | 1.14 | 0.38 | 1 | 2 | | | Stopping | | |
| Final /v/ -> /d/ | 1 | 1 | - | 1 | 1 | | | Stopping | Alveolarization | |
| Final /v/ -> /b/ | 2 | 1.5 | 0.71 | 1 | 2 | | | Stopping | | |
| Final /v/ -> /f/ | 1 | 1 | - | 1 | 1 | | | | | Devocalization |
| Final /v/ -> /s/ | 1 | 1 | - | 1 | 1 | | | | Alveolarization | Devocalization |
| Initial /z/ -> /s/ | 4 | 1.5 | 0.58 | 1 | 2 | | | | | Devocalization |
| Final /z/ -> /s/ | 15 | 1.67 | 1.11 | 1 | 5 | | | | | Devocalization |
| Final /z/ -> /s̪/ | 2 | 1 | 0 | 1 | 1 | | | | Dentalization | Devocalization |
| Final /z/ -> /z̪/ | 2 | 1 | 0 | 1 | 1 | | | | Dentalization | |
| Final /z/ -> deletion | 8 | 1.12 | 0.35 | 1 | 2 | Final consonant deletion | | | | |
| Initial /ð/ -> /t/ | 1 | 1 | - | 1 | 1 | | | Stopping | Alveolarization | Devocalization |
| Initial /ð/ -> /d/ | 17 | 5.12 | 3.28 | 1 | 10 | | | Stopping | Alveolarization | |
| Initial /ð/ -> /s/ | 1 | 1 | - | 1 | 1 | | | | Alveolarization | Devocalization |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Initial /ð/ -> /n/ | 3 | 1 | 0 | 1 | 1 | | | Nasalization | Alveolarization | |
| Initial /ð/ -> deletion | 6 | 1.33 | 0.52 | 1 | 2 | Initial consonant deletion | | | | |
| Postvocalic /ð/ -> /d/ | 3 | 1 | 0 | 1 | 1 | | | Stopping | Alveolarization | |
| Initial /tʃ/ -> /t/ | 3 | 1 | 0 | 1 | 1 | | | Stopping | Alveolarization | |
| | | | | | | | | | | |
| Consonant cluster (/ldr/) /d/ -> /tʃ/ | 2 | 1 | 0 | 1 | 1 | | Cluster reduction | Affrication | Palatalization | Devocalization |
| Consonant cluster (/ldr/) /d/ -> deletion | 4 | 1.25 | 0.5 | 1 | 2 | | Cluster reduction | | | |
| Consonant cluster /d/ -> /d̪/ | 1 | 1 | - | 1 | 1 | | | | Dentalization | |
| Consonant cluster (/mw/) /m/ -> deletion | 1 | 1 | - | 1 | 1 | | Cluster reduction | | | |
| Consonant cluster (/br/) /r/ -> /w/ | 1 | 1 | - | 1 | 1 | | Cluster reduction | Gliding | | |
| Consonant cluster (/br/) /r/ -> deletion | 1 | 1 | - | 1 | 1 | | Cluster reduction | | | |
| Consonant cluster and prevocalic /r/ -> /w/ | 1 | 1 | - | 1 | 1 | | Cluster reduction | Gliding | | |
| Prevocalic /r/ (in consonant cluster) -> /w/ | 5 | 1 | 0 | 1 | 1 | | Cluster reduction | Gliding | | |
| Consonant cluster (/ldr/) /r/ -> deletion | 12 | 1.25 | 0.45 | 1 | 2 | | Cluster reduction | | | |
| Initial consonant cluster /s/ -> deletion | 3 | 1 | 0 | 1 | 1 | Initial consonant deletion | Cluster reduction | | | |
| Initial consonant cluster /s/ -> /ʃ/ | 2 | 1 | 0 | 1 | 1 | | | | | Devocalization |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Consonant cluster /s/ -> deletion | 1 | 1 | - | 1 | 1 | Initial consonant deletion | Cluster reduction | | | |
| Consonant cluster (/tʃt/) /tʃ/ -> /t/ | 3 | 1 | 0 | 1 | 1 | | Cluster reduction | Stopping | Alveolarization | |
| Post consonantal /ɚ/ -> deletion | 1 | 1 | - | 1 | 1 | | Cluster reduction | | | |
| Consonant cluster (/wɚ/) /ɚ/ -> deletion | 1 | 1 | - | 1 | 1 | | Cluster reduction | | | |

**Table 5. Phonological Variations Not Consistent with Spanish Phonology**

| **Description** | ***n*** | **Mean** | ***SD*** | **Min** | **Max** | **Deletion** | **Reduction** | **Manner Shift** | **Place Shift** | **Voicing Shift** |
|---|---|---|---|---|---|---|---|---|---|---|
| Initial /b/ -> /d/ | 1 | 1 | - | 1 | 1 | | | | Alveolarization | |
| Initial /b/ -> /f/ | 1 | 1 | - | 1 | 1 | | | Fricatization | | Devocalization |
| Initial /b/ -> /p/ | 2 | 1.5 | 0.71 | 1 | 2 | | | | | Devocalization |
| Initial /b/ -> deletion | 1 | 1 | - | 1 | 1 | Initial consonant deletion | | | | |
| Initial /d/ -> /s/ | 1 | 1 | - | 1 | 1 | | | Fricatization | | Devocalization |
| Initial /d/ -> /t/ | 1 | 1 | - | 1 | 1 | | | | | Devocalization |
| Initial /d/ -> deletion | 1 | 1 | - | 1 | 1 | Initial consonant deletion | | | | |
| Final /d/ -> /b/ | 2 | 1 | 0 | 1 | 1 | | | | Labialization | |
| Final /d/ -> /f/ | 3 | 1 | 0 | 1 | 1 | | | Fricatization | Labiodentalization | Devocalization |
| Final /d/ -> /t/ | 1 | 1 | - | 1 | 1 | | | | | Devocalization |
| Final /d/ -> /v/ | 2 | 1 | 0 | 1 | 1 | | | Fricatization | Labiodentalization | |
| Final /d/ -> /z/ | 1 | 1 | - | 1 | 1 | | | | | |
| Final /d/ -> deletion | 1 | 1 | - | 1 | 1 | Final consonant deletion | | | | |
| Initial /f/ -> /h/ | 1 | 1 | - | 1 | 1 | | | | Glottalization | |
| Initial /f/ -> /v/ | 1 | 1 | - | 1 | 1 | | | | | Vocalization |
| Final /g/ -> /k/ | 1 | 1 | - | 1 | 1 | | | | | Devocalization |
| Final /g/ -> deletion | 1 | 1 | - | 1 | 1 | Final consonant deletion | | | | |
| Initial /k/ -> /t/ | 1 | 1 | - | 1 | 1 | | | | Fronting | |
| Final /k/ -> /t/ | 1 | 1 | - | 1 | 1 | | | | Fronting | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Final /k/ -> deletion | 5 | 1.2 | 0.45 | 1 | 2 | Final consonant deletion | | | | |
| Postvocalic /k/ -> deletion | 4 | 1 | 0 | 1 | 1 | Medial consonant deletion | | | | |
| Final /l/ -> deletion | 5 | 1 | 0 | 1 | 1 | Final consonant deletion | | | | |
| Final /n/ -> deletion | 2 | 1 | 0 | 1 | 1 | Final consonant deletion | | | | |
| Final /r/ -> /r‿/ | 3 | 1 | 0 | 1 | 1 | | | Derhoticization | | |
| Final /s/ -> deletion | 4 | 1 | 0 | 1 | 1 | Final consonant deletion | | | | |
| Initial /t/ -> /tʃ/ | 1 | 1 | - | 1 | 1 | | | Affrication | Palatalization | |
| Initial /t/ -> /θ/ | 1 | 1 | - | 1 | 1 | | | Fricatization | Dentalization | |
| Initial /t/ -> deletion | 2 | 1 | 0 | 1 | 1 | Initial consonant deletion | | | | |
| Final /t/ -> /d/ | 2 | 1 | 0 | 1 | 1 | | | | | Vocalization |
| Final /t/ -> /k/ | 1 | 1 | - | 1 | 1 | | | | Backing | |
| Final /t/ -> /ɪn/ | 1 | 1 | - | 1 | 1 | | | | | |
| Final /t/ -> /ŋ/ | 1 | 1 | - | 1 | 1 | | | Nasalization | Backing | Vocalization |
| Final /t/ -> /ʃ/ | 1 | 1 | - | 1 | 1 | | | Fricatization | Palatalization | |
| Final /t/ -> /s/ | 2 | 1 | 0 | 1 | 1 | | | Fricatization | | |
| Final /t/ -> deletion | 16 | 1.88 | 0.5 | 1 | 3 | Final consonant deletion | | | | |
| Postvocalic /v/ -> /h/ | 1 | 1 | - | 1 | 1 | | | | Glottalization | Devocalization |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Final /v/ -> /z/ | 1 | 1 | - | 1 | 1 | | | | Alveolarization | |
| Initial /w/ -> /b/ | 1 | 1 | - | 1 | 1 | | | Stopping | | |
| Initial /ʃ/ -> /ʃ̪/ | 1 | 1 | - | 1 | 1 | | | | Dentalization | |
| Initial /ʃ/ -> /h/ | 8 | 1.5 | 0.53 | 1 | 2 | | | | Glottalization | |
| Initial /ʃ/ -> /tʃ/ | 1 | 1 | - | 1 | 1 | | | Affrication | | |
| Final /ɚ/ -> /ə/ | 4 | 1 | 0 | 1 | 1 | | | | | |
| Final /ɚ/ -> /ɚ‿/ | 5 | 1 | 0 | 1 | 1 | | | Derhoticization | | |
| Middle /ɝ/ -> /ɝ‿ / | 1 | 1 | - | 1 | 1 | | | Derhoticization | | |
| | | | | | | | | | | |
| Consonant cluster (/ldr/) /d/ -> /d͡ʒ/ | 8 | 1 | 0 | 1 | 1 | | Cluster reduction | Affrication | Palatalization | |
| Consonant cluster (/ldr/) /l/ -> deletion | 2 | 1 | 0 | 1 | 1 | | Cluster reduction | | | |
| Consonant cluster (/sn/) /n/ -> /t/ | 1 | 1 | - | 1 | 1 | | Cluster reduction | Stopping | | Devocalization |
| Consonant cluster (/sn/) /s/ -> /s̪/ | 3 | 1 | 0 | 1 | 1 | | Cluster reduction | | Dentalization | |
| Consonant cluster /s/ -> /s̪/ | 1 | 1 | - | 1 | 1 | | Cluster reduction | | Dentalization | |
| Consonant cluster /s/ -> /ʃ/ or /s̠/ | 1 | 1 | - | 1 | 1 | | Cluster reduction | | Palatalization | |
| Post consonantal (consonant cluster) /t/ -> /tʃ/ | 1 | 1 | - | 1 | 1 | | | Affrication | Palatalization | |
| Post consonantal /t/ -> /d/ | 1 | 1 | - | 1 | 1 | | | | | Vocalization |
| Consonant cluster /t/ -> deletion | 1 | 1 | - | 1 | 1 | | Cluster reduction | | | |
| Post consonantal (consonant cluster) /t/ -> deletion | 1 | 1 | - | 1 | 1 | | Cluster reduction | | | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Post consonantal /t/ -> deletion | 1 | 1 | - | 1 | 1 | | Cluster reduction | | | |
| Consonant cluster (/wɚ/) /ɚ/ -> /ɚ‿/ | 4 | 1 | 0 | 1 | 1 | | | Derhoticization | | |
| Post consonantal /ɚ/ -> /ə/ | 3 | 1 | 0 | 1 | 1 | | Cluster reduction | Derhoticization | | |

### Association Between Phonological Variation and Performance on the English Sentence Repetition Task

No significant correlations were observed between the sum total of phonological variations consistent with Spanish phonology and any of the standardized language scores in Spanish or English. No significant correlations were found between the sum total of language neutral phonological variations and any of the standardized language scores in Spanish or English. The only variable that had significant correlations to either phonological variations consistent with Spanish phonology or language neutral phonological variations was the mean error on the sentence repetition task. This variable was positively correlated at $r = .91$, 95% CI [.79, .96]. This was expected because the phonological variations consistent with and not consistent with Spanish phonology would have been included in the total errors. See Table 6 for the full correlation table.

**Table 6. Correlations**

| Variable | *M* | *SD* | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|---|---|
| 1. English SR Scaled | 8.75 | 2.99 | 1 | | | | | | | |
| 2. Spanish SR Scaled | 8.94 | 2.60 | -.02 [-.48, .45] | 1 | | | | | | |
| 3. English EOWPVT SS | 98.90 | 16.80 | .74** [.44, .89] | -.06 [-.51, .42] | 1 | | | | | |
| 4. Spanish EOWPVT SS | 86.44 | 14.10 | -.42 [-.74, .06] | .62** [.20, .85] | -.19 [-.61, .30] | 1 | | | | |
| 5. Concept EOWPVT SS | 105.70 | 13.09 | .33 [-.13, .68] | .23 [-.27, .63] | .80** [.55, .92] | .26 [-.23, .65] | 1 | | | |
| 6. Mean Errors/Sentence | 2.12 | 0.65 | .35 [-.11, .69] | -.14 [-.57, .35] | .30 [-.16, .66] | -.06 [-.51, .42] | .12 [-.34, .53] | 1 | | |
| 7. Mean % Cons Correct | 0.85 | 0.05 | .42 [-.02, .73] | .09 [-.39, .53] | .37 [-.09, .70] | -.25 [-.64, .24] | .31 [-.15, .66] | -.57** [-.81, -.17] | 1 | |
| 8. Total Instances of Possible Spanish-Influence English | 10.90 | 4.69 | .40 [-.06, .71] | -.06 [-.51, .42] | .33 [-.14, .67] | .07 [-.41, .52] | .18 [-.29, .57] | .91** [.79, .96] | -.44 [-.74, .01] | 1 |
| 9. Total Instances of Language-Neutral Variations | 7.40 | 2.52 | .06 [-.39, .49] | -.21 [-.62, .28] | .09 [-.37, .51] | -.14 [-.57, .35] | -.02 [-.46, .43] | .61** [.23, .83] | -.46* [-.75, -.02] | .25 [-.21, .63] |

*Note*. *M* and *SD* are used to represent mean and standard deviation, respectively. Values in square brackets indicate the 95% confidence interval for each correlation (Cumming, 2013). * indicates $p < .05$. ** indicates $p < .01$

# DISCUSSION

The phonological systems of monolingual and bilingual children are not identical, and this emphasizes the need for bilingual assessment techniques that account for the differences between bilingual and monolingual phonologies. In this paper, we examined phonological variations produced by bilingual Spanish-English speaking kindergarteners on an English sentence repetition task, and the relations between these variations and performance on the English sentence repetition task. This work contributes broadly to informing phonological assessment techniques for bilingual children by providing more information on the variations that may exist in the speech of Spanish-English speaking children, and how these variations may relate to other measures of language ability.

To examine phonological variation, each variation that was made in the children's responses to the English sentence repetition task was recorded and categorized according to type of shift and whether it could be considered consistent with Spanish phonology. The two variation types consistent with Spanish phonology that occurred most frequently were shifts in place and shifts in manner. This is consistent with information in the literature review, as there are several phonemes that have different places of production in Spanish compared to English. There are also manner classes that include phonemes in English that are not present in Spanish. For example, there are more fricatives in the English phonemic inventory than there are in the Spanish phonemic inventory, and because of this, stopping of fricatives (a shift in manner) may be common. The variations that were not consistent with Spanish phonology all occurred at similar frequencies, which could be expected, because by the age of 5, most phonological processes have been suppressed.

In regards to the types of phonological variations that were present in the responses of the children to the English sentence repetition task, we found that the average number of variations that could be considered consistent with Spanish phonology per child was larger than the average number of language neutral variations per child, meaning that for the whole sentence repetition task, variations consistent with Spanish phonology were generally used more frequently than language neutral variations. This emphasizes the importance of bilingual assessment techniques that account for the potential influence of cross-language phonology to discriminate between normal variations and indicators of speech sound disorder.

We found that sound-based variations in the children's responses did not significantly correlate with language measures such as score on the English sentence repetition task or score on the EOWPVT-4 SBE. These standardized scores that we used examine language ability, while the measures that we used to assess phonological variation, such as percent consonants correct and total number of errors, could be measuring articulation ability as opposed to phonological ability. While not mentioned in the literature review of this paper, the distinction between articulation, or motor based, sound errors and phonological, or language based, sound errors is important to consider, and this importance has been reinforced by the results of this study. Articulation is concerned with the motor movements and placements of the articulators to produce speech, while phonology is concerned with the language aspect of combining sounds and sound sequences to produce speech. Because the results of this study revealed that there was no significant correlation between sound-based variations and measures of language ability, there is reason to believe that the variations we examined could be attributable to articulation and not phonology. Variation in articulation would not align with language ability because articulation is a result of motor ability. Although percent consonants correct has been found to be a good measure of phonological ability in bilingual children (Fabiano-Smith & Hoffman, 2018), it is still possible that a number of the sound-based variations recorded in this study were due to articulation instead of phonology.

## Limitations

There are several limitations to the study that could have impacted results. One possible limitation is how consistency with Spanish phonology was defined. If the target phoneme was not present in the Spanish phonemic inventory, but the phoneme that the child produced was in the Spanish phonemic inventory, then we classified the variation as possibly being consistent with Spanish influenced English. This classification system could have resulted in labeling variations as consistent with Spanish phonology when they really were not based on Spanish phonology. A more specific approach that considers the differences in the Spanish and English phonemic inventories and what consonants from the Spanish inventory might phonemically make sense to use in place of consonants in the English inventory could lead to a more accurate classification.

Another limitation to the study could be the small sample size that was used. Increasing the sample size would improve the accuracy of the correlations and would produce more precise results.

The transcription and variation identification process could also be a limitation of this study. While listening to the audio recordings, variations could have been missed or incorrectly identified, as the responses were not transcribed by native Spanish speakers.

Because of this, the language abilities of the author (Coleman) could have influenced how the children's productions were transcribed and what variations were identified.

**Future Directions**

This study examined variations present in the bilingual children's English productions, but we did not examine variation present in their Spanish productions. To accurately assess a child's speech and language abilities, assessments need to be completed in all of the child's languages (Bedore & Peña, 2008). Future studies that examine variations in both of a bilingual child's languages would provide a more complete picture of the child's speech and language abilities. Studies that include variations in Spanish-English speaking children's Spanish productions would also provide the opportunity to evaluate instances of English-influenced Spanish, which may also be an important aspect of a bilingual language development.

Consistency with Spanish phonology was used in this study to examine the possible influence of Spanish on a child's English productions, but because of how consistency with Spanish phonology was defined, we were not able to say whether a variation was consistent with Spanish-influenced English specifically. Future studies applying a linguistics definition of Spanish-influenced English to the field of speech-language pathology may help acknowledge differences in language use among bilingual children during assessment.

**Conclusion**

This project aimed to examine the phonological variations present in the responses of Spanish-English speaking kindergarteners on an English sentence repetition task. Phonological variations were recorded and categorized according to consistency with Spanish phonology and type of shift. Correlations between sound-based variations and measures of language were also assessed, and it was found that there was no significant correlation between variations and language measures. This highlighted the importance of acknowledging the difference in variations due to articulation and those due to phonology. This project also highlighted the vast variability that occurs in the English responses of Spanish-English speaking children, emphasizing the importance of assessment techniques specific to this population.

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