HHS Public Access
Author manuscript
Int J Biling Educ Biling. Author manuscript; available in PMC 2022 January 01.

Published in final edited form as:
Int J Biling Educ Biling. 2021 ; 24(5): 736–756. doi:10.1080/13670050.2018.1510892.

Phonological Vulnerability for School-Aged Spanish-English-Speaking Bilingual Children

Jessie A. Erikson[a], **Mary Alt**[a], **Shelley Gray**[b], **Samuel Green**[b,†], **Tiffany P. Hogan**[c], **Nelson Cowan**[d]

[a]University of Arizona, 1131 E. 2nd St., PO Box 210071, Tucson, AZ, US 85721, jaerikson@email.arizona.edu; malt@email.arizona.edu

[b]Arizona State University, PO Box 870102, Tempe, AZ, US 85287, Shelley.Gray@asu.edu, samgreen@asu.edu

[c]MGH Institute of Health Professions, Charlestown Navy Yard, 36 1st Avenue, Boston, MA, US 02129, thogan@mghihp.edu

[d]University of Missouri – Columbia, 210 McAlester Hall, Columbia, MO, US 65211, CowanN@missouri.edu

Abstract

This study examined accuracy on syllable-final (coda) consonants in newly-learned English-like nonwords to determine whether school-aged bilingual children may be more vulnerable to making errors on English-only codas than their monolingual, English-speaking peers, even at a stage in development when phonological accuracy in productions of familiar words is high. Bilingual Spanish-English-speaking second- graders (age 7-9) with typical development (*n*=40) were matched individually with monolingual peers on age, sex, and speech skills. Participants learned to name sea monsters as part of five computerized word learning tasks. Dependent *t*-tests revealed bilingual children were less accurate than monolingual children in producing codas unique to English; however, the groups demonstrated equivalent levels of accuracy on codas that occur in both Spanish and English. Results suggest that, even at high levels of English proficiency, bilingual Spanish-English-speaking children may demonstrate lower accuracy than their monolingual English-speaking peers on targets that pattern differently in their two languages. Differences between a bilingual's two languages can be used to reveal targets that may be more vulnerable to error, which could be a result of cross-linguistic effects or more limited practice with English phonology.

Keywords

bilingualism; language transfer; childhood bilingualism; language skills

Corresponding author: Jessie A. Erikson, Department of Speech, Language, and Hearing Sciences, University of Arizona, 1131 E. 2nd St., Tucson, AZ 85721, jaerikson@email.arizona.edu.
†In memory of our colleague Samuel (Sam) Green, who passed away during the revision of this manuscript. We gratefully acknowledge his valuable contributions to this research.

Declaration of Interest Statement
The authors report no conflicts of interest.

Introduction

The purpose of this study was to investigate differences in the accuracy of phonological productions between bilingual Spanish-English-speaking and monolingual English-speaking children, ages 7-9, in the context of a word learning task. Lower accuracy for bilingual Spanish-English speaking children on specific phonological targets during a word-learning task would indicate that those targets are more vulnerable to error for the bilingual children than they are for their monolingual peers, even if errors are not produced for those targets in all communicative contexts. This vulnerability could be the result of cross-linguistic effects, such as phonological transfer from Spanish into English, or could be due to limited practice, as bilingual speakers have less experience with English phonology than their monolingual English-speaking peers.

The number of Spanish speakers in the United States has increased dramatically in recent years, with 24.4 million more speakers in 2009 than in 1980 (Ortman and Shin 2011). These changes have particularly impacted student populations; in 2013, 23.5% of students, K-12, in the United States were Hispanic (US Census Bureau, 2013). Fortunately, there has been a surge in research regarding the speech and language development of Spanish-English-speaking children (Anthony et al. 2009; Barlow, Branson, and Nip 2013; Fabiano-Smith and Goldstein 2010; Goldstein, Fabiano-Smith, and Washington 2005; Windsor et al. 2010). However, much of the research regarding the phonological skills of Spanish-English-speaking children has focused on children prior to second grade (Brice, Carson, and Dennis O'Brien 2009; Cooperson, Bedore, and Peña 2013; Fabiano-Smith and Goldstein 2010; Goldstein, Fabiano-Smith, and Washington 2005; Yavas and Core 2001).

Bilingual phonological acquisition and interaction

Multiple studies have investigated the phonological skills of Spanish-English bilingual preschoolers in the context of familiar words (e.g., *house, pato* 'duck') and have demonstrated differences between these preschoolers and their monolingual English-speaking peers (Fabiano-Smith and Barlow 2010; Fabiano-Smith and Goldstein 2010; Goldstein and Washington 2001), such as instances of phonological transfer from Spanish into bilingual children's English phonetic inventories (Fabiano-Smith and Barlow 2010; Fabiano-Smith and Goldstein 2010) and lower percent consonants correct for bilingual children (Fabiano-Smith and Goldstein 2010). These studies support an Interactional Dual Systems Model (de Houwer 1996; Genesee 1989; Paradis and Genesee 1996; Paradis 2001) in which a bilingual child's two languages are functionally separate from one another early on but may interact (e.g., transfer sounds from one language into the other) throughout development. Although the Interactional Dual Systems Model makes predictions about how two languages may interact in the acquisition of linguistic structures (e.g., phonemes, syllables), it is unclear how this model could be extended to make predictions about phonological interaction in older children for acquired phonemes or phonological structures.

However, evidence from adults indicates that in bilinguals, their two phonological systems continue to interact after early childhood and the acquisition of speech sounds. Research on phonetic production and discrimination in adult bilinguals suggests that a bilingual's two phonological systems may remain separate but continue to interact, resulting in differences from monolingual peers in speech production (Fowler et al. 2008; MacLeod, Stoel-Gammon, and Wassink 2009; Sundara, Polka, and Baum 2006), as well as perception (Sundara and Polka 2008). In addition, there is evidence from psycholinguistic research that bilingual adults activate the phonology of both languages (i.e., nonselective access) during word recognition (Dijkstra, Grainger, and van Heuven 1999; Zhou et al. 2010) and naming (Jared and Kroll 2001; Jared and Szucs 2002; Zhou et al. 2010).

The idea that a bilingual's two languages develop as separate systems that may interact is further supported by research in bilingual infant speech perception (Bosch and Sebastián-Gallés 1997; Bosch and Sebastián-Gallés 2001; Byers-Heinlein, Bums, and Werker 2010; Byers-Heinlein, Morin-Lessard, and Lew-Williams 2017). There is evidence that bilingual infants can distinguish between two familiar languages (i.e., used in the home) that are similar in phonology and prosody (e.g., Catalan and Spanish) as early as 4 months of age (Bosch and Sebastián-Gallés 2001), although they demonstrate equal preference for listening to each of their two languages and, unlike monolingual infants, demonstrate shorter reaction times when orienting to an unfamiliar language versus the maternal language (Bosch and Sebastián-Gallés 1997). Furthermore, infants whose mothers speak two languages that are prosodically different (e.g., Tagalog and English) can distinguish those two languages as newborns (Byers-Heinlein, Burns, and Werker 2010). In addition, there is evidence that maintaining this separation between two languages relies on a cognitive control mechanism in bilingual infants, which in turn leads to processing costs in some contexts, such as comprehension of sentences containing both languages (e.g., "Find the *chien!*" vs. "Find the dog!") (Byers-Heinlein, Morin-Lessard, and Lew-Williams 2017).

Although these lines of research indicate that a bilingual's two languages continue to interact throughout the lifespan, there remains little evidence suggesting what differences to expect between monolingual and bilingual children during the school-age years. Previous research in other age groups has demonstrated that interaction between a bilingual's two languages or cross-linguistic effects can be predicted, in part, by considering similarities and differences between two languages (e.g., differences in the phonetic inventories of Spanish and English are associated with lower accuracy on 'unshared' sounds; Fabiano-Smith and Goldstein, 2010). However, studies examining phonological differences between monolingual and bilingual preschoolers have typically used pictures to elicit preschoolers' phonological productions of familiar vocabulary (e.g. English *house*; Spanish *carro* 'car') to elicit (Fabiano-Smith and Barlow 2010; Fabiano-Smith and Goldstein 2010; Keffala, Barlow, and Rose 2016). High levels of phonological accuracy in monolingual and bilingual school-aged children in production of familiar words (Goldstein, Fabiano-Smith, and Washington 2005; Owens 2012; Sander 1972) could obscure subtle group differences and lead to the assumption that older bilingual children have English phonological skills identical to their monolingual peers. However, it is possible that phonological differences may be observed between school-aged bilingual children and their monolingual peers in a more challenging context, such as during a word learning task. In this context, school-aged bilingual children may be more likely to make errors on sounds or phonological structures that are not shared across their two languages, similar to bilingual preschoolers on familiar words (Fabiano-Smith and Goldstein 2010). This would suggest that differences observed in the preschool years (e.g., lower accuracy on unshared consonants) may not solely reflect differences in rates of acquisition but could also correspond to more long-term differences in phonological processing.

Bilingual phonology and word learning

An individual's ability to remember a particular sequence of sounds (i.e., phonemes) plays an important role in word learning (Gathercole and Baddeley 1990; Gathercole et al. 1997; see Gathercole 2006 for a discussion of this relationship). This ability has been attributed to phonological working memory, or the phonological loop component of Baddeley and Hitch's (Baddeley 2000; Baddeley and Hitch 1974) model of working memory (Baddeley, Gathercole, and Papagno 1998). This research helped establish the understanding that an individual's ability to remember a sequence of phonemes is indicative of their word learning (Gathercole and Baddeley 1990; Gathercole et al. 1997). Thus, a challenging non-word learning task has the capacity to provide information on phonological skills in monolingual and bilingual school-aged children.

To our knowledge previous research has not examined children's production accuracy of individual phonemes during a word learning task; however, phonology has been examined in bilingual word learning research. Several studies have investigated the relation between phonotactic probability and bilingual lexical development (Alt, Meyers, and Figueroa 2013; Messer et al. 2010; Messer et al. 2015). For example, in a longitudinal nonword recall study of monolingual Dutch-speaking and bilingual Turkish-Dutch-speaking preschoolers, Messer et al. (2015) found that bilingual children made more errors than monolingual children on nonwords with high phonotactic probability in Dutch, suggesting that the monolingual preschoolers' increased experience with Dutch improved their ability to recall common sound sequences. In a fast mapping study that manipulated phonotactic probability in English-like nonwords, Alt et al. (2013) observed that, while bilingual Spanish-English-speaking preschoolers were less accurate on naming than their monolingual peers, school-aged bilingual children performed equivalently to monolingual children, perhaps due to more experience with English phonology with age. This result suggests that by school-age, bilingual children use English phonotactic cues in the same way as their monolingual peers. These studies showed that phonotactic probability, or how frequently a sound or sequence of sounds occurs in the ambient language, can correspond with preschool children's accuracy in production or recall of newly learned nonword labels, with monolingual children generally demonstrating higher accuracy than their bilingual peers on words with high phonotactic probability in the shared language (Alt, Meyers, and Figueroa 2013; Messer et al. 2015). These studies suggest that increased experience or practice with the phonology of a language may facilitate naming or recall of lexical labels containing those sounds.

Although these studies provide insight into how experience with phonology supports the production or recall of newly learned lexical labels, our understanding of bilingual phonology during the school-age years remains limited. Comparing bilingual and monolingual accuracy on phonological targets during a word learning task, however, can provide insight into how the phonological skills of bilingual children may continue to differ from their monolingual peers during the school-age years. Although speech sound errors are expected to be highly infrequent for both monolingual and bilingual children in the context of familiar words (Goldstein, Fabiano-Smith, and Washington 2005; Sander 1972), phonological transfer (e.g., Fabiano-Smith and Goldstein 2010) or more limited practice with English, relative to their monolingual peers (e.g., Gollan et al. 2005), may impact the English phonological productions of bilingual school-aged children in other contexts. Previous research has demonstrated that other challenging tasks, such as a grammatical decision task, can reveal subtle group differences in other aspects of language during the school-aged years, even when bilinguals are highly proficient in both languages (Serratrice et al. 2009). In a word learning context, higher cognitive loads demanded by the task may impact phonological accuracy for both monolingual and bilingual children and allow for group differences on specific targets to be more easily observed. revealing whether those targets may still be more vulnerable to error for bilingual children than for their monolingual peers.

In addition to improving our basic understanding of phonology in older bilingual children, it is important to determine whether some phonological targets may be more vulnerable for bilingual children during the school-age years as a first step in understanding how phonological differences may impact educational outcomes in school-aged bilingual children. The current study contributes to our understanding of the English phonological skills of bilingual Spanish-English-speaking school-aged children by investigating phonological accuracy in the context of a difficult word learning task, in which school-aged children are more likely to make phonological errors due to the complexity and working memory demands of the task.

The current study

Our study examined school-aged bilingual Spanish-English-speaking children’s production accuracy of specific codas (i.e., syllable-final phonemes), in the context of learning novel English-like nonwords. We predicted that bilingual children would be less accurate than their monolingual English-speaking peers on codas that occur in English but not Spanish (i.e., ‘unshared codas’). Previous research has demonstrated that Spanish-English-speaking bilingual preschoolers are less accurate than their monolingual peers on phonological structures that are not shared across their two languages (Fabiano-Smith and Goldstein 2010). During the school-age years, Spanish-English-speaking bilingual children make few phonological errors on familiar words (Goldstein, Fabiano-Smith, and Washington 2005). However, previous research has demonstrated how subtle linguistic differences between monolingual and bilingual children may revealed in the context of a challenging task (Serratrice et al. 2009), even if those differences are not noticeable in other contexts. The word learning task employed in the current study was challenging and resulted in relatively low production accuracy for both monolingual and bilingual children. This allowed an opportunity to examine phonological differences that might be undetectable in everyday speech or the production of familiar words. Because unshared codas are present in English but not Spanish, we hypothesized that school-aged bilingual Spanish-English-speaking children may also demonstrate lower accuracy on English-only phonological structures (i.e., unshared codas) in the context of a word learning task, based on evidence of lower accuracy on unshared structures in bilingual pre-schoolers (Fabiano-Smith and Goldstein 2010).

Unshared codas—We investigated group differences in accuracy on what we call 'unshared codas,' or consonants that commonly occur in syllable-final position in English but do not occur or are highly uncommon in syllable-final position in Spanish [see Hualde (2005, 74-76) and Whitley (2002, 34) for more on possible and common codas in Spanish], For example, /k/ regularly occurs as a coda in English (e.g., pick /pɪk/) but not in Spanish, though it occurs as an onset in Spanish (e.g., *carro* /karo/ 'car').[1] In contrast, /n/, a shared coda, occurs in commonly in coda position in both Spanish (e.g., *razón* /rason/ 'reason') and English (e.g., *man* /mæm/). All codas in this study were consonants that occur in both English and Spanish. To our knowledge, other researchers have not directly compared the accuracy of monolingual and bilingual children on consonants which occur in both languages but commonly occur in a particular syllable position in one language only.

While it may be possible that group differences would be found for other syllable positions, we selected codas for analysis because there is little overlap between the phonotactic constraints, or language-specific rules regarding which sounds occur in which contexts, for syllable-final sounds in Spanish and English. The subset of consonants permitted in coda position is considerably more restricted in Spanish than in English (Whitley 2002). In contrast, onsets, or syllable-initial consonants, are more frequently shared between the two languages. The many consonants that exist in both languages, but occur regularly as codas only in English, enabled us to investigate group differences related to language-specific syllable constraints. Previous research in preschoolers has demonstrated that Spanish-English-speaking bilingual children are more accurate on sounds that are shared between their two languages than those that are not (Fabiano-Smith and Goldstein 2010), suggesting that overlap in phonological structure across a bilingual's two languages is related to phonological accuracy or performance. Therefore, we predicted that bilingual Spanish-English-speaking children would be less accurate than their monolingual English-speaking peers on unshared codas.

Similarly, it is possible that group differences in phonological accuracy may be observed due to factors other than bilingualism, such as dyslexia (Catts 1986; Catts 1989), developmental language disorder (Munson, Kurtz, and Windsor 2005; Roberts et al. 1998), or vocabulary size (Edwards, Beckman, and Munson 2004). However, the phonological target being examined in the current study (i.e., unshared codas) was selected because it represents a structural difference in the phonology of Spanish and English. Therefore, we would not expect to specifically find a group difference on 'unshared codas' within two groups of monolingual speakers of the same language.

Potential mechanisms—While the goal of our study was not to determine the underlying mechanism that may be responsible for group differences in phonological accuracy, lower accuracy on target phonemes for bilingual school-aged children in comparison to their monolingual peers may reflect the influence of several potential mechanisms. First, lower accuracy for bilinguals may be the result of phonological transfer (e.g., use of Spanish

[1]Although /k/ and other phonemes designated 'unshared codas' may occur in syllable-final position occasionally in Spanish (Hualde 2005), these sounds occur as codas infrequently in most standard dialects of Spanish and are found only in a few words, typically borrowed from other languages (e.g., *coñac* /koɲak/ 'cognac') (Whitley 2002).

phonemes in production of English words) or other kinds of cross-linguistic interaction (e.g., deceleration or slower acquisition of specific phonological targets when compared to monolingual peers), as has been observed in younger bilingual children (Fabiano-Smith and Barlow 2010; Fabiano-Smith and Goldstein 2010).

Second, bilingual Spanish-English-speaking children will likely have less experience with English phonology than their monolingual English-speaking peers, as a result of the input they receive being divided across two languages. This concept has been described by Gollan et al. (2005), who stated that "[bilinguals], by definition, speak each language less often than do monolinguals" (1222) and echoed by other researchers (Costa and Sebastián-Gallés 2014; Werker 2012). Although Gollan et al. (2005) were concerned with lexical retrieval, this principle may also be applied to phonology. In their fast mapping study, Alt et al. (2013) suggested that the division of experience across two languages could similarly affect how bilingual children use statistical regularities for phonology (e.g., phonotactic probability) that exist in each of their languages. In other words, phonological patterns that occur in only one of a bilingual's two languages would occur at a lower frequency for a bilingual speaker than a monolingual speaker with the same amount of total language experience. In support of this, Alt et al. (2013) found that greater exposure to English was associated with greater accuracy for bilingual children when fast mapping English-like nonwords. Similarly, less experience with English, relative to that of their monolingual peers, could result in lower accuracy for bilingual children on unshared codas. This finding would also be consistent with previous research that has demonstrated lower accuracy for bilingual preschool-aged children than their monolingual peers on phonological targets that are unshared or considerably more infrequent in one language, both at the phoneme (Fabiano-Smith and Goldstein 2010) and syllable level (Gildersleeve-Neumann et al. 2008).

Third, it is possible that the simultaneous activation of the phonology of two languages could result in an increased cognitive load for bilingual children, in turn negatively impacting accuracy. Lexical processing studies have demonstrated that bilinguals simultaneously activate competing lexical items both within and between languages (Blumenfeld and Marian 2011; Blumenfeld and Marian 2013; Marian and Spivey 2003). Furthermore, because of the need to inhibit the non-target language during language processing (Blumenfeld and Marian 2011; Blumenfeld and Marian 2013; Byers-Heinlein, Morin-Lessard, and Lew-Williams 2017), bilinguals experience processing costs when switching from one language to the other (Byers-Heinlein, Morin-Lessard, and Lew-Williams 2017). There is also evidence to support simultaneous activation at the phonological level during lexical access (see Kroll, Bobb, and Wodniecka 2006 for a discussion), including a facilitative effect of shared phonology between cognates (Costa, Caramazza, and Sebastian-Galles 2000). In addition, Colomé (2001) found that, when asked to decide whether or not a phoneme was present in a target word (e.g., /t/ in Catalan *taula* 'table'), bilinguals were slower to reject phonemes from translation equivalents (e.g., /m/ in Spanish *mesa* 'table') than control phonemes, suggesting that translation equivalents remain active and compete for access. Together, these findings demonstrate simultaneous activation during language processing, which can facilitate or interfere with processing depending on the phonological similarity between competing lexical items.

It is less clear to what extent simultaneous activation may manifest in the context of learning novel words in one language, which do not have a translation equivalent in the other language. However, Grosjean (2001) has proposed that, although various factors can impact the extent to which a bilingual's two languages are activated, it is unlikely that one language is ever fully deactivated. Providing support for this claim, Marian and Spivey (2003) found evidence of simultaneous activation of translation equivalents in Russian- English bilinguals in a context which was designed to decrease the extent to which one language was active (e.g., bilingual participants were tested in a monolingual English environment and were not aware the study goals were related to bilingualism). Therefore, both languages may remain active for bilingual children in the current study context as well, in which task instructions were in English and all nonwords were designed to reflect English phonology. It is possible that simultaneous activation of Spanish and English could result in processing costs (i.e., lower accuracy) for bilingual children on target phonemes, relative to their monolingual peers.

It is also possible that cross-linguistic interaction, relatively less experience with English, and an increased cognitive load could, together, lead bilingual children to demonstrate lower phonological accuracy than their monolingual peers. However, only cross-linguistic interaction or more limited experience with English would be expected to selectively impact phonological structures that occur in one language but not the other (e.g., unshared codas). In contrast, if lower accuracy was a result of higher cognitive load alone, due to the simultaneous activation of two phonological systems, we would expect bilingual children to be less accurate than their monolingual peers on shared codas as well.

Method

Participants

Eighty second-grade children (ages 7-9) with typically-developing speech and language skills participated in this study. Forty bilingual Spanish-English-speaking children were individually matched with monolingual English-speaking peers on age [+/− 6 months], sex, and percentile score on the *Goldman-Fristoe Test of Articulation – Second Edition* (+/− 13 percentile points) (GFTA-2; Goldman & Fristoe 2000) to reduce the possibility that differences in phoneme accuracy were not due to these factors. Because information on mother's level of education was not reported for all participants and was generally lower for bilingual participants, pairs were not matched individually on this variable. However, participants were selected so that mother's level of education was as similar as possible in the monolingual and bilingual groups (see Table 1). Parental consent and child assent were obtained for all children, as required by the Internal Review Boards of the participating institutions.

Nonword productions of all participants were collected as part of a larger study on working memory and word learning (POWWER[2]). Participants included in the current study represent a subset of participants in this larger study. Bilingual children in the current study

[2]Participants in this manuscript represent a portion of the participants in a larger sample from Profiles of Working Memory and Word Learning for Educational Research (POWWER), funded by NIH NIDHC grant R01 DC010784. The POWWER study includes the

were recruited from elementary schools in the cities of Nogales, AZ, and Tucson, AZ, which are within the US-Mexico border region. Monolingual children in the study were recruited from elementary schools in Tucson, AZ, and the greater Phoenix, AZ, metropolitan area. All children in the study were determined to have typical language development based on scores from the *Clinical Evaluation of Language Fundamentals – Fourth Edition* (CELF-4; Semel, Wiig, & Secord 2003) and for the bilingual children also the *Clinical Evaluation of Language Fundamentals – Fourth Edition, Spanish* (CELF-4 Spanish; Semel, Wiig, & Secord 2006) and did not have history of speech or language disorders per parental report.

Inclusionary criteria specific to monolingual children were as follows:

(1) To be classified as monolingual, English must have been used exclusively in the home and at school, as indicated by parental report.

(2) To rule out language impairment, a standard score of 88 or higher on the CELF-4.

Because bilingual children with typical development may score lower than their monolingual peers on standardized tests based on monolingual English-speaking normative groups (Kohnert 2010; Laing and Kamhi 2003), alternative inclusionary criteria were designed to rule out language impairment for bilingual children. Inclusionary criteria specific to bilingual children were as follows:

(1) To be classified as bilingual, the child must have been able to carry out conversations in both English and Spanish. Spanish must have been spoken in their home by at least one caregiver, and schooling must have been in English or both English and Spanish. If English was spoken in the home, schooling before kindergarten may have also been in Spanish. This information was obtained via parental report.

(2) To further support bilingual classification, a scaled score of 6 or higher on the CELF-4 Spanish subtest, Formulated Sentences (FS).

(3) To rule out language impairment, either a standard score of 88 or higher on the CELF-4, or a standard score between 78 and 88 on the CELF-4 and a standard score of 69 and higher on the CELF-4 Spanish[3].

Inclusionary criteria for all children in this study were as follows:

(1) In 2nd grade at the time of the study (between 7- and 9-years-old).

---

groups reported, as well as children with language impairment (LI), children with dyslexia, and children with comorbid dyslexia and LI. Participants in the POWWER study completed a total of six word learning games and a comprehensive battery of working memory tasks (see Cabbage et al. 2017), completed over the course of at least six days. A portion of the data for the monolingual children in this study was reported in Alt et al. 2017. Data from the POWWER data set have also been published in Cowan et al. 2017; Gray et al. 2017; and Green et al. 2016.

[3]The choice to use this cut-off point was data-based. Barragan et al. 2013 collected data on over 600 bilingual children in the greater Phoenix area. Had they used a standard score cut-off of 85 (1 *SD* below the mean) on the CELF-4 Spanish, more than 60% of the children in their study would have been classified as having language problems, which is implausible. Thus, 69 was 1 *SD* from their group mean and resulted in a more reasonable 11% of children below that score. More recently, using receiver operating characteristics (ROC) curve analysis to analyze scores from a subsample of 299 bilingual children, Barragan et al. 2018 identified a cut off score of 78, which resulted in 9.6% of children being classified as having a language impairment and had sensitivity of 86% and a specificity of 80%.

(2) To rule out speech impairment, a percentile score of 31 or higher on the *Goldman- Fristoe Test of Articulation – Second Edition* (GFTA-2; Goldman & Fristoe 2000). The GFTA-2 is a standardized assessment used to measure articulation of English consonants and consonant clusters in single words from ages 2;0 to 21; 11. For this assessment, an examiner presented each participant with images from the stimulus booklet that corresponded to words containing target sounds (e.g., a picture of a house to elicit /h/) in word-initial, word-medial, and word-final position. Based on participants' productions of target sounds in this single-word context, number of errors, as well as the child's phonetic inventory, may be calculated. Percentile scores are based on the number of errors.

(3) To rule out dyslexia, a standard score of 96 or higher on the *Test of Word Reading Efficiency – Second Edition* (TOWRE-2; Torgesen, Wagner, & Rashotte 2012), using grade-based norms.

(4) To rule out intellectual disability, a standard score of 75 or higher on the Nonverbal Scale of the *Kaufman Assessment Battery for Children – Second Edition* (KABC-II; Kaufman & Kaufman 2004).

(5) No history of neuropsychiatric disorders (e.g., Autism Spectrum Disorder, ADHD) as indicated by parent report.

(6) No history of speech or language impairment, special education, or repetition of a grade as indicated by parent report.

(7) Normal near visual acuity (better than 20/32 or 20/40 in bad lighting conditions).

(8) Normal color vision.

(9) Pass hearing screening at 20 dB for 1000, 2000, and 4000 Hz.

Descriptive data were also collected on reading ability and expressive vocabulary using the *Woodcock Reading Mastery Test-Paragraph Comprehension – Third Edition* (WRMT-III; Woodcock 2011), *Expressive Vocabulary Test – Second Edition* (EVT-2; Williams 2007), and *Expressive One-Word Picture Vocabulary Test – Spanish-Bilingual Edition* (EOWPVT; Brownell 2001). Participant demographic information and scores are reported in Table 1.

Descriptive data on percentage input/output and age of acquisition in each language were not collected for bilingual participants. However, as described earlier, information about participants' exposure to English and Spanish at home and in school were collected in order to determine group classification. Based on this information, the majority of bilingual participants may be considered simultaneous bilinguals, as parent report indicated that 94.8% (37 of 39)[4] of bilingual participants were exposed to both languages in the home. Furthermore, 59% (23 of 39) of all bilingual participants were reported to be exposed to both languages via one or more primary caregivers (e.g., one parent spoke English and the other spoke Spanish; one parent spoke both languages and the other spoke one). An

[4]Although the study included 40 bilingual participants, one child's parent report did not provide information on home languages.

additional 35.8% (14 of 39) of bilingual children experienced both languages at home through interaction with siblings, grandparents, or other family members who lived with them.

Procedures

After securing parental consent and participant assent, all inclusionary and descriptive testing was administered to participants to ensure they met the inclusionary criteria. This typically took two to three sessions of 60-75 minutes each. Testing began once children were qualified for the study, and children were tested over six sessions. For this study, production data were scored and analyzed for nonwords from five naming tasks.

The five naming tasks manipulated different independent variables to determine their effects on word learning (e.g., degree of phonological similarity between nonwords, stable or variable location of referents). For each word learning game, children were presented with four novel sea monsters on a touch-screen computer. They would hear the name of a monster and have to touch the monster that represented that name. They received immediate feedback on their response in the form of a virtual coin for a correct answer and a virtual rock for an incorrect response. There were four blocks of this type of learning. At the end of each block, children were presented with the image of a monster and asked to produce its name, resulting in a total of four productions of each nonword. Therefore, each child had four opportunities to produce the codas of the target syllables. Data were audio-recorded and scored off-line by trained research assistants. Responses were scored for accuracy at both the whole-word level and the segment level (i.e., correct or incorrect). For the five word learning tasks, an average of 23.8% of responses were double-scored with an average point-to-point reliability of .92.

Materials

Stimuli—Twelve syllables containing unshared target codas from two-syllable CVCCVC nonwords were selected from a larger set of stimuli used as part of the POWWER study. These included voiced and voiceless stops (/p, t, k, b, g/), as well as /f/, /v/, and /m/. Two shared codas in three nonwords were included to confirm that group differences between monolingual and bilingual children were specific to unshared codas. The only shared codas available for analysis were nasal consonants (/n/ and /m/). Codas to be analyzed occurred in either word-medial or word-final position. In some cases, multiple codas were analyzed for a single word (e.g., /m/ and /v/ in /gompæv/).

A total of twelve two-syllable nonwords were selected from the larger set of stimuli to represent a variety of sounds in word-medial and word-final coda position that differed in voicing, manner, and place of articulation. See Appendix A for a list of nonwords and target codas (Tables A1 and A2), as well as the distribution of codas by voicing, place, and manner of articulation (Table A3). While phonotactic probability was controlled for each word learning task within the larger POWWER study, phonotactic probability for target coda biphones (i.e., phonotactic probability of target codas and preceding target vowels) varied for both shared (M = 0.001267, SD = 0.000902) and unshared codas (M = 0.00085, SD = 0.000676), due to the post-hoc nature of this study. However, the unequal distribution of phoneme characteristics (e.g., voicing, phonotactic probability) was not considered to be a confounding variable for this analysis, as the study had a within-subject design with all participants completing the same production tasks with the same nonwords.

Scoring—Scoring of children's production accuracy was based on transcriptions of audio recordings made by trained research assistants as part of the POWWER study. Research assistants performed broad transcriptions of child productions of the target nonwords, using Klattese transcription conventions (Vitevitch and Luce 2004). Transcribers aligned the phonemes of a child's production with the phonemes of the target word. Alignment of the child's production with the target word was required to retain the syllable structure of the child's production. For example, if a child produced a CVCV word, deleting syllable codas, both consonants produced were required to be aligned with target onsets in transcription. Therefore, target codas were scored as incorrect if they were produced in onset position.

Productions of codas were scored as correct if they matched the target (e.g., target /m/ was produced as [m]). Productions of codas were scored as incorrect if an alternative consonant was produced (e.g., target /m/ was replaced with [k]) or if the target sound or syllable was deleted. Because our research question focused on the number of errors, not error type, any absence of a correct response, including no response (NR), was incorrect. Because there was no penalty for guessing, not responding may have reflected use of an individual strategy (e.g., withholding a response until certain about all phonemes of a word), as opposed to a lack of participation in the task. Out of a total of 3840 data points (for both shared and unshared codas), 601 were recorded as NR and thus scored as incorrect, with 341 in the monolingual group and 260 in the bilingual group. Target sounds were not scored as incorrect if the child produced an error for that sound on the *Goldman-Fristoe Test of Articulation – Second Edition* (GFTA-2; Goldman & Fristoe 2000); these data were excluded from analysis. Missing data due to technical difficulties were also removed from analysis.

Results

Percent accuracy was calculated for unshared, as well as shared, target codas. Percent accuracy on unshared codas was calculated by averaging production scores for all attempts (i.e., all four productions) at nonword syllables containing the target unshared codas. Similarly, percent accuracy on shared codas was calculated by averaging production scores for all attempts at nonword syllables containing the target shared codas (see Appendix A for targets included in analysis). This resulted in a percent accuracy score for unshared codas and a percent accuracy score for shared codas for each participant. In the case of data missing at random (e.g., due to technical difficulties), scores for all available responses were included when averaging production scores for both shared and unshared codas. Dependent *t*-tests were used to determine whether production accuracy was significantly different between monolingual and bilingual pairs for unshared codas and shared codas, respectively. Dependent *t*-tests were used rather than independent *t*-tests because, as described in the Method, bilingual children were matched individually by age, sex, and percentile scores on the GFTA-2 to a subset of monolingual participants from the larger study. Matching at the individual level introduces dependency [See Kenny and Judd (1986) for a discussion of violation of the independence assumption in analysis of variance and effects on the results.]

Monolingual children were significantly more accurate in production of unshared codas than their bilingual peers, $t(39) = 3.23$, $p = 0.0025$, $d = 0.51$. However, accuracy on shared coda productions did not differ significantly for monolingual and bilingual children, $t(39) = -0.33$, $p = 0.74$, $d = -0.05$. Percent accuracy for monolingual and bilingual groups on shared and unshared codas is depicted in Figure 1.

Discussion

Previous research has demonstrated that bilingual Spanish-English-speaking preschoolers may be less accurate producing consonants that occur only in English than those that occur in both Spanish and English (Fabiano-Smith and Goldstein 2010). At the school-age level, both bilingual and monolingual children may exhibit high levels of accuracy on English phonemes in everyday speech. However, phonological patterns that occur in English but not Spanish may continue to be more vulnerable to errors in production for bilingual children. In the context of a challenging word learning task, we uncovered a difference in phonological accuracy between school-aged bilingual Spanish-English-speaking children and their monolingual English-speaking peers. We found, as predicted, that bilingual children were significantly less accurate on unshared codas than their monolingual peers, with a medium between-group effect size, but they did not differ significantly on shared codas.

In addition to demonstrating that phonological differences may persist into the school-age years, our results suggested that such differences in accuracy may be revealed by different phonotactic constraints (e.g., which sounds can occur as codas) in Spanish and English, even when the target sounds are present in the phonologies of both languages. If group differences had also been observed for shared codas, it could be argued that bilingual children are less accurate on codas, overall, than their monolingual peers, perhaps due to increased cognitive load related to activation of phonology in both languages. However, lower accuracy only on unshared codas suggested that the observed differences in accuracy are not associated with consonants in coda position more generally or solely the result of an additional cognitive load, due to simultaneous activation of both languages. Rather, the difference in accuracy appears to be associated with differences between phonotactic constraints for codas in the two languages. Furthermore, because all the consonants included in this study occur in the phonologies of English and Spanish, group differences in accuracy cannot be attributed to the targets sounds being entirely unshared, as has been observed with bilingual Spanish-English-speaking preschoolers (Fabiano-Smith and Goldstein 2010). Because the purpose of the study was to identify whether school-aged, Spanish-English-speaking bilingual children made more errors than their monolingual English-speaking peers on English-only codas, this study addressed the number of errors rather than error type. It is unknown whether bilingual children's errors on unshared codas were more likely to result in phoneme sequences that are legal in Spanish, such as substitution of an unshared coda with a shared coda or deletion of the coda, or whether error patterns may be similar to monolingual English-speaking peers, only occurring more frequently.

While our study provided evidence of a phonological difference between monolingual English-speaking and bilingual Spanish-English-speaking school-aged children, questions remain regarding the mechanism underlying this difference. Previous research has shown that bilingual lexical access involves simultaneous activation of both languages (Blumenfeld and Marian 2011; Blumenfeld and Marian 2013; Marian and Spivey 2003; Byers-Heinlein, Morin-Lessard, and Lew-Williams 2017) and that bilinguals inhibit the non-target language for efficient comprehension (Byers-Heinlein, Morin-Lessard, and Lew-Williams 2017). In comparison with monolinguals, this creates a greater cognitive load that can result in processing costs, such as lower comprehension accuracy when switching from one language to another (Byers-Heinlein, Morin-Lessard, and Lew-Williams 2017). In the current study, word learning tasks were carried out in a primarily monolingual English context, all nonwords were designed to reflect English phonology and task instructions were in English. However, as Marian and Spivey (2003) have demonstrated, bilinguals retain access to both languages (i.e., simultaneous activation), even in highly monolingual contexts. Together, these findings suggest that bilinguals would be required to inhibit Spanish for efficient processing even when learning English-like nonwords. The need to control their languages creates an increased cognitive load that could result in costs such as lower accuracy on target phonemes. However, it is unclear why an increased cognitive load would result in lower accuracy on unshared codas but not shared ones. Furthermore, previous research has focused on the costs that may occur in lexical or sentence-level processing, when a phonologically-similar cross-language competitor has been presented (Blumenfeld and Marian 2013; Marian and Spivey 2003) or a translation equivalent exists (Byers-Heinlein, Morin-Lessard, and Lew-Williams 2017). Because our study investigates phonological errors on novel words, for which there are no obvious cross-language competitors, interpretation of the current results in relation to previous research is limited. Instead, we consider cross-linguistic interaction (e.g., phonological transfer) and/or more limited experience with English more satisfactory potential explanations for the group difference in accuracy on unshared codas.

Cross-linguistic differences in the distribution of sounds may lead bilingual children to make more errors on unshared codas, even when the target consonants may occur in other parts of the syllable (non-coda position) in both languages. One possibility is that lower accuracy on unshared codas by bilingual children was a direct result of phonological transfer, or the influence of the phonology of one language on the production of sounds in a bilingual’s other language (e.g., use of the Spanish trill in an English production of the word “car”) (Fabiano-Smith and Goldstein 2010). Because all the target sounds examined in this study exist in both Spanish and English, we are not suggesting that bilingual children exhibited phonological transfer in the sense of replacing English-only sound with Spanish-only sounds. However, bilingual children’s errors on unshared codas may be the result of transferring syllable structure rules from Spanish to their productions of English nonwords, resulting in either the deletion or substitution of target codas with sounds that may occur in coda position in Spanish (e.g., /n/). Therefore, lower accuracy on unshared codas in the bilingual group may have been due to the transfer of syllable structure rules from Spanish (as opposed to individual Spanish-only phonemes), in which a more restricted set of sounds may occur in coda position than in English.

Several studies have investigated cross-linguistic effects at the level of syllable structure and found evidence of acceleration in bilingual children (Keffala, Barlow, and Rose 2016; Lleó et al. 2003; Tamburelli et al. 2015). For example, Keffala and colleagues (2016) found that bilingual Spanish-English-speaking preschoolers were more accurate on onset clusters in both languages than their monolingual peers. Similarly, Tamburelli and colleagues (2015) found that school-aged Polish-English-speaking bilingual children were more accurate on /s/ + *obstruent* clusters, which occur more frequently in Polish than English, than their monolingual English-speaking peers. In contrast, our results indicated lower levels of accuracy for bilingual children on English-only codas, which could be interpreted as delay or deceleration (Paradis and Genesee 1996; Fabiano-Smith and Goldstein 2010). However, because we do not suspect that lower accuracy observed in the word learning task is likely to be reflected in bilingual children's production of familiar words, we do not consider this to be evidence of deceleration for English-only codas in bilingual Spanish-English-speaking children. To our knowledge, there have been no other studies investigating possible cross-linguistic effects at the syllable structure level in children who are not expected to make errors on the target structure in production of familiar words.

While bilingual children's lower accuracy on unshared codas may have been based on transfer of syllable structure rules from Spanish to English, it is also possible that the difference observed was the result of bilingual children having more limited experience with phonological patterns in English than their monolingual peers (Alt, Meyers, and Figueroa 2013). Although bilingual children develop two phonemic inventories in approximately the same amount of time that monolingual children develop one (Costa and Sebastián-Gallés 2014), it is possible that relatively less experience in each language can still impact the phonological productions of bilingual children in certain contexts or at certain points in development. For example, in Fabiano-Smith and Goldstein's (2010) study of phonological acquisition in bilingual Spanish-English-speaking pre-schoolers, they found bilingual children were significantly less accurate than their monolingual Spanish-and English-speaking peers for select manner classes, despite performing within the typical range for monolingual children, in both languages. Similarly, relatively less experience with English may have resulted in lower accuracy on unshared codas in our study.

Although monolingual English-speaking children, as a group, should have more experience with English-only codas than their bilingual peers, there may also be individual differences among bilingual Spanish-English-speaking children. One potential way to investigate this question would be to assess bilingual children's accuracy on unshared codas in relation to their percent input/output in English or overall English language use (i.e., how much of the child's daily routine involves speaking and listening in English). Previous research has found that language use, as well as language proficiency, predicts a child's phonological abilities in that same language (Goldstein et al. 2010; Ruiz-Felter et al. 2016; although see Goldstein, Fabiano-Smith, and Washington 2005 for an exception). Gildersleeve-Neumann et al. (2008) found that the rate of final consonant deletion in Spanish-English-speaking preschoolers was inversely related to the amount of exposure to English, which could reflect, more specifically, greater experience with syllables containing English-only codas. In addition, Parra, Hoff, and Core (2011) found that the amount of input in each language was related to bilingual children's language-specific phonological memory for nonwords.

Although percent input/output is not a perfect measure of experience with English phonology, in future research, it could provide a useful approximation for examining the role of language exposure in bilingual children's accuracy on unshared codas.

Another potentially useful measure for examining language experience and phonological skills during the school-age years is age of acquisition. In the current study, information regarding age of acquisition was not collected, so it is not possible to determine the relation between when a bilingual child acquired Spanish or English and accuracy on unshared codas. In particular, there may be concern that some children in our study acquired English following the end of a critical period for phonology. However, there are several reasons that we do not consider this an issue for our interpretation of results. First, as described earlier, 94.8% of bilingual participants (37 of 39) in this study use both Spanish and English in the home. The majority of these children (62.16%; 23 of 37) were exposed to both languages via one or more primary caregiver, suggesting that they were likely raised as simultaneous bilinguals. Second, all of the bilingual participants in our study demonstrated highly proficient speech and language skills in both languages, including accurate production of target sounds in familiar words. Although critical periods have been proposed for native language phonology (Werker and Hensch 2015), the participants in our study did not demonstrate difficulty perceiving and producing English phonemes in a familiar-word context (i.e., an articulation test). We consider it unlikely that the bilingual children in our study would be successful at perceiving and producing sounds accurately in an articulation test but not on a word learning task, as a result of acquiring English after the close of a critical period for phonology. Finally, in a recent study, Ruiz-Felter et al. (2016) found that simultaneous and sequential Spanish-English-speaking kindergarteners demonstrate minimal differences in their English phonological skills. Based on their findings, Ruiz-Felter et al. (2016) determined that "children learning a second language at school entry and those who have been exposed to two languages since early childhood will show similar performance rather quickly" (378). Therefore, although we do not rule out a possible effect of age of acquisition on unshared coda accuracy, we do not believe that our findings were driven by bilingual children who acquired English later.

Limitations and future directions

One limitation of this study is that, because this was a post-hoc analysis, the stimuli included were not originally designed to test hypotheses related to shared and unshared codas. Ideally, stimuli designed to test this hypothesis would include more diversity in both shared and unshared shared codas to control for other potential influences on accuracy. For example, the stimuli used in this study limited our ability to control for effects of sonority, which is defined by Yavas and Core (2001) as "a sound's relative loudness compared to other sounds with the same length, stress, and pitch" (35). As codas in Spanish are typically restricted to more sonorous consonants, the task of distinguishing the effect of sharedness from that of sonority is challenging. In future studies, including more sonorous sounds that do not occur in coda position in Spanish, such as /ŋ/, as well as less sonorous sounds that occur in coda position in both English and Spanish, such as /ð/ may be useful in determining to what extent sonority effects contribute to differences in accuracy. For example, a preference for codas with high sonority, such as nasal consonants, could lead Spanish-English-speaking children to be less accurate than their monolingual English-speaking peers on the fricative, /ð/, in syllable-final position, despite the sound occurring as a coda in both languages. It would also be of interest to examine performance on codas that occur in Spanish but not in English. It is possible that bilingual Spanish-English-speaking children would be more accurate than their monolingual English-speaking peers on Spanish-only codas. In addition, because of the post-hoc nature of this study, children's productions were scored only for accuracy and not the type of error. Therefore, we were unable to analyze children's error patterns, which may provide insight into the underlying mechanism (e.g., phonological transfer, practice effects) that could be driving differences in accuracy. Future studies investigating phonological productions of school-aged children should attempt to address this issue.

For the purposes of this study, we did not collect information regarding language exposure and use (e.g., percent input/output) or age of acquisition in English and Spanish for bilingual children, which may be useful in exploring the potential role of language experience in bilingual children's accuracy on unshared codas. Therefore, we were unable to investigate how English language exposure/use or age of acquisition may have been associated with accuracy on unshared codas. Information regarding the relationship between language exposure/use and accuracy on language-specific targets like English-only codas could provide important insight into mechanisms (e.g., amount of English experience) driving phonological differences for bilingual children during the school-age years.

In addition, we were not able to examine children's individual errors patterns, which could provide insight into whether bilingual children's lower accuracy on unshared codas is the result of phonological transfer. While the results of our study revealed that bilingual school-aged Spanish-English-speaking children differed from their monolingual English-speaking peers as a group, investigating what drove this group difference was outside of the purpose and scope of this study. To determine underlying mechanisms that may be driving phonological differences in accuracy in school-aged children, future research in this area should account for relevant individual differences between bilingual children (e.g., percent input/output) and examine children's error patterns.

In addition to examining what factors or mechanisms may drive this difference, future research should also explore the potential real-world relevance of this difference. Our study uncovered a phonological difference between bilingual children and their monolingual peers in the context of a challenging word learning task. Our claim that bilingual children may be more vulnerable to making errors on unshared codas than their monolingual peers could appear inflammatory or extreme. However, we do not suggest that this difference in accuracy signifies a lack of proficiency in English. On the contrary, because all children in the current study demonstrated typically-developing speech skills, it is unlikely that this difference would be reflected in speech errors in familiar words. It is likely that the difficulty of the word learning task was taxing on children's phonological systems in a way that allowed a subtle difference, or potential vulnerability, to be observed. It is unknown, however, how this difference manifests outside of this task. While production of familiar words may not be affected, Spanish-English-speaking bilingual children may be more likely to make errors on unshared codas in word learning contexts more generally, such as in the classroom. It is also unknown to what extent the development of semantic knowledge may be impacted when learning words that contain vulnerable phonological targets. While the purpose of our study was to determine the presence of phonological differences during the school-age years, future research should investigate whether—and how—such differences may matter for bilingual children. Despite the limitations of the current study, this was the first study to use a word learning paradigm in order to examine the accuracy of school-aged bilingual children on shared sounds that occur in a specific syllable position (e.g., coda) in only one language. Therefore, this study represents an important first step in understanding how phonological differences during the school-age years have the potential to present challenges for older bilingual children in some contexts, such as learning new words.

Summary and implications

Our study provided evidence that phonological differences between bilingual children and their monolingual peers can be observed during the school-age years, when phonological inventories are mostly complete. Furthermore, lower accuracy was observed for unshared but not shared codas, suggesting that group differences are not simply the result of an increased cognitive load for bilingual children relative to their monolingual peers. Second, we demonstrated that linguistic differences in a bilingual child's two languages, such as different phonotactic constraints for codas in Spanish and English, can reveal phonological targets more vulnerable to error. In particular, we found that Spanish-English-speaking children were less accurate on codas that occur in English but not Spanish than their monolingual English-speaking peers, within the context of a word learning task.

The importance of this work is that even when bilingual children can speak English with a high level of proficiency, they continue to face phonological challenges when learning new words in English. These challenges have the potential to impact learning success. For example, vulnerabilities on unshared codas or other sounds could negatively impact word learning, particularly when minimal sound changes result in changes in meaning (e.g., *climatic* and *climactic*). However, future research is needed to resolve the potential impact of this difference on bilingual children's language development. The results of the current study provide a useful basis for additional investigations into the phonological systems of bilingual Spanish-English-speaking children during the school-age years. Our findings may also remind clinicians and teachers that the phonologies of bilingual children are not the same as their monolingual peers during the school-age years, despite high levels of accuracy on familiar words, and that differences between bilingual children and their monolingual peers may be more or less evident depending on the context and the difficulty of a task.

Acknowledgements

This work was supported by funding from the National Institutes of Health NIDCD Grant #R01 DC010784. It was the subject of the first author's Master's thesis, and portions of this work were first shared at the Symposium on Research in Child Language Disorders in Madison, WI, in June of 2016. We are deeply grateful to the staff, research associates, school administrators, teachers, children, and families who participated. Key personnel included (in alphabetical order) Shara Brinkley, Gary Carstensen, Cecilia Figueroa, Karen Guilmette, Trudy Kuo, Bjorg LeSueur, Annelise Pesch, and Jean Zimmer. Many students also contributed to this work including (in alphabetical order) Genesis Arizmendi, Lauren Baron, Alexander Brown, Nora Schlesinger, Nisha Talanki, Hui-Chun Yang, and Atha Zimmermann.

Appendix A: Unshared and shared codas

Table A1

Unshared codas

Target phoneme	Nonword
/p/	/tʌpwib/
/t/	/tughɑʊt/
/k/	/jiktuf/
/b/	/tʌpwib/
/g/	/wʌgjed/
/f/	/jiktuf/
/v/	/gompæv/
	/bʌvdep/
	/buvjib/
	/jevhɑʊt/
/m/	/kaimjeg/
	/jitgaɪm /

Table A2

Shared codas

Target phoneme	Nonword
/m/[1]	/dimbaɪg/
	/gompæv/
/n/	/fugboɪn/

[1] /m/ was considered a shared coda only when followed by bilabial consonants (i.e., /p/ or /b/) to reflect nasal assimilation processes present in Spanish (e.g., in Spanish *impossible* 'impossible'). All other targets of /m/ in coda position, including word-final /m/, were unshared.

Table A3

Distribution of shared and unshared target codas by voice, manner, and place of articulation

	Shared codas	Unshared codas
Voicing	100% voiced	66.67% voiced
Manner	100% nasals	41.67% stops
		41.67% fricatives
		16.67% nasals
Place	66.67% bilabial	33.3% bilabial
	33.33% alveolar	8.33% alveolar
		16.67% velar
		41.67% labiodental

References

Alt Mary, Hogan Tiffany, Green Samuel, Gray Shelley, Cabbage Kathryn, and Cowan Nelson. 2017. “Word Learning Deficits in Children with Dyslexia.” Journal of Speech Language and Hearing Research 60: 1012–28. doi:10.1044/2016_JSLHR-L-16-0036.

Alt Mary, Meyers Christina, and Figueroa Cecilia. 2013. “Factors That Influence Fast Mapping in Children Exposed to Spanish and English.” Journal of Speech, Language, and Hearing Research 56 (4): 1237–48. doi:10.1044/1092-4388(2012/11-0092).

Anthony Jason L., Solari Emily J., Williams Jeffrey M., Schoger Kimberly D., Zhang Zhou, Branum-Martin Lee, and Francis David J.. 2009. “Development of Bilingual Phonological Awareness in Spanish-Speaking English Language Learners: The Roles of Vocabulary, Letter Knowledge, and Prior Phonological Awareness.” Scientific Studies of Reading 13 (6): 535–64. doi:10.1080/10888430903034770.

Baddeley Alan D. 2000. “The Episodic Buffer: A New Component of Working Memory?” Trends in Cognitive Sciences 4(11): 417–23. http://www.ncbi.nlm.nih.gov/pubmed/11058819. [PubMed: 11058819]

Baddeley Alan D., Gathercole Susan, and Papagno C. 1998. “The Phonological Loop as a Language Learning Device.” Psychological Review 105 (1): 158–73. http://www.ncbi.nlm.nih.gov/pubmed/9450375. [PubMed: 9450375]

Baddeley Alan D., and Hitch Graham J.. 1974. “Working Memory.” In Psychology of Learning and Motivation, 8:47–89. doi:10.1016/S0079-7421(08)60452-1.

Barlow Jessica A., Branson Paige E., and Nip Ignatius S. B.. 2013. “Phonetic Equivalence in the Acquisition of /1/ by Spanish–English Bilingual Children.” Bilingualism: Language and Cognition 16 (01): 68–85. doi:10.1017/S1366728912000235.

Barragan Beatriz, Castilla-Earls Anny, Martinez-Nieto Lourdes, Restrepo M. Adelaida, and Gray Shelley. 2018. “Performance of Low-Income Dual Language Learners Attending English-Only Schools on the Clinical Evaluation of Language Fundamentals – Fourth Edition, Spanish.” Language, Speech, and Hearing Services in Schools, 1–14. doi:10.1044/2017_LSHSS-17-0013.

Barragan Beatriz, Restrepo M. Adelaida, Castilla-Earls Anny, Olivares William, and Gray Shelley. 2013. “Performance of Low-Income Spanish-Speaking Children in English-Only Schools on the CELF-4 Spanish.” Presentation at the American Speech Language and Hearing Annual Convention, Chicago, 11 14–16.

Blumenfeld Henrike K., and Marian Viorica. 2013. “Parallel Language Activation and Cognitive Control during Spoken Word Recognition in Bilinguals.” Journal of Cognitive Psychology 25 (5): 547–67. doi:10.1080/20445911.2013.812093.

Blumenfeld Henrike K, and Marian Viorica. 2011. “Bilingualism Influences Inhibitory Control in Auditory Comprehension.” Cognition 118 (2). Elsevier B.V.: 245–57. doi:10.1016/j.cognition.2010.10.012. [PubMed: 21159332]

Bosch Laura, and Sebastián-Gallés N. 1997. “Native-Language Recognition Abilities in 4-Month-Old Infants from Monolingual and Bilingual Environments.” Cognition 65 (1): 33–69. http://www.ncbi.nlm.nih.gov/pubmed/9455170. [PubMed: 9455170]

Bosch Laura, andSebastián-Gallés Núria. 2001. “Evidence of Early Language Discrimination Abilities in Infants from Bilingual Environments.” Infancy 2 (1): 29–49. doi:10.1207/S15327078IN0201_3. [PubMed: 33451225]

Brice Alejandro E., Carson Cecyle K., and O’Brien Jennifer Dennis. 2009. “Spanish-English Articulation and Phonology of 4- and 5-Year-Old Preschool Children: An Initial Investigation.” Communication Disorders Quarterly 31 (1): 3–14. doi:10.1177/1525740108327447.

Brownell Rick. 2001. Expressive One-Word Picture Vocabulary Test – Spanish-Bilingual Edition. Novato, CA: Academic Therapy Publications.

Byers-Heinlein Krista, Burns Tracey C., and Werker Janet F.. 2010. “The Roots of Bilingualism in Newborns.” Psychological Science 21 (3): 343–48. doi:10.1177/0956797609360758. [PubMed: 20424066]

Byers-Heinlein Krista, Morin-Lessard Elizabeth, and Lew-Williams Casey. 2017. "Bilingual Infants Control Their Languages as They Listen." Proceedings of the National Academy of Sciences 114(34): 9032–37. doi:10.1073/pnas.1703220114.

Cabbage Kathryn, Brinkley Shara, Gray Shelley, Alt Mary, Cowan Nelson, Green Samuel, Kuo Trudy, and Hogan Tiffany P.. 2017. "Assessing Working Memory in Children: The Comprehensive Assessment Battery for Children—Working Memory (CABC-WM)" Journal of Visualized Experiments, no. 124: 1–11. doi:10.3791/55121.

Catts Hugh W. 1989. "Speech Production Deficits in Developmental Dyslexia." Journal of Speech and Hearing Disorders 54 (3): 422. doi:10.1044/jshd.5403.422.

Catts Hugh W. 1986. "Speech Production/Phonological Deficits in Reading-Disordered Children." Journal of Learning Disabilities 19 (8): 504–8. doi:10.1177/002221948601900813. [PubMed: 3760705]

Colomé Àngels. 2001. "Lexical Activation in Bilinguals' Speech Production: Language-Specific or Language-Independent?" Journal of Memory and Language 45 (4): 721–36. doi:10.1006/jmla.2001.2793.

Cooperson Solaman J., Bedore Lisa M., and Peña Elizabeth D.. 2013. "The Relationship of Phonological Skills to Language Skills in Spanish–English-Speaking Bilingual Children." Clinical Linguistics & Phonetics 27 (5): 371–89. doi:10.3109/02699206.2013.782568. [PubMed: 23635337]

Costa Albert, Caramazza Alfonso, and Sebastian-Galles Nuria. 2000. "The Cognate Facilitation Effect: Implications for Models of Lexical Access." Journal of Experimental Psychology: Learning Memory and Cognition 26 (5): 1283–96. doi:10.1037/0278-7393.26.5.1283.

Costa Albert, and Sebastián-Gallés Nüria. 2014. "How Does the Bilingual Experience Sculpt the Brain?" Nature Reviews Neuroscience 15 (5). Nature Publishing Group: 336–45. doi:10.1038/nrn3709. [PubMed: 24739788]

Cowan Nelson, Hogan Tiffany P., Alt Mary, Green Samuel, Cabbage Kathryn L., Brinkley Shara, and Gray Shelley. 2017. "Short-Term Memory in Childhood Dyslexia: Deficient Serial Order in Multiple Modalities." Dyslexia 23: 209–33. doi:10.1002/dys.1557. [PubMed: 28497530]

Davis Jessica, and Bauman Kurt. 2013. School Enrollment in the United States: 2011. Washington, D.C.: U.S. Census Bureau. http://census.gov/prod/2008pubs/p20-559.pdf.

de Houwer Annick. 1996. "Bilingual Language Acquisition." In The Handbook of Child Language, edited by Fletcher Paul and MacWhinney Brian, 219–50. Blackwell Reference Online: Blackwell Publishing. http://www.blackwellreference.com.ezproxy4.library.arizona.edU/subscriber/tocnode.html?id=g9780631203124_chunk_g978063120312410.

Dijkstra Ton, Grainger Jonathan, and van Heuven Walter J. B.. 1999. "Recognition of Cognates and Interlingual Homographs: The Neglected Role of Phonology." Journal of Memory and Language 41: 496–518. doi:10.1006/jmla.1999.2654.

Edwards Jan, Beckman Mary E., and Munson Benjamin. 2004. "The Interaction between Vocabulary Size and Phonotactic Probability Effects on Children's Production Accuracy and Fluency in Nonword Repetition." Journal of Speech, Language, and Hearing ResearchLanguage and Hearing Research 47 (2): 421. doi:10.1044/1092-4388(2004/034).

Fabiano-Smith Leah, and Barlow Jessica A.. 2010. "Interaction in Bilingual Phonological Acquisition: Evidence from Phonetic Inventories." International Journal of Bilingual Education and Bilingualism 13 (1): 81–97. doi:10.1080/13670050902783528. [PubMed: 20126516]

Fabiano-Smith Leah, and Goldstein Brian A.. 2010. "Phonological Acquisition in Bilingual Spanish–English Speaking Children." Journal of Speech, Language, and Hearing Research 53 (2): 160–78. doi:10.1044/1092-4388(2009/07-0064).

Fowler Carol A., Sramko Valery, Ostry David J., Rowland Sarah A., and Hallé Pierre. 2008. "Cross Language Phonetic Influences on the Speech of French-English Bilinguals." Journal of Phonetics 36 (4): 649–63. doi:10.1016/j.wocn.2008.04.001. [PubMed: 19802325]

Gathercole Susan E. 2006. "Nonword Repetition and Word Learning: The Nature of the Relationship." Applied Psycholinguistics 27: 513–43. doi:10.1017/S0142716406060383.

Gathercole Susan E., and Baddeley Alan D.. 1990. “Phonological Memory Deficits in Language Disordered Children: Is There a Causal Connection?” Journal of Memory and Language 29 (3): 336–60. doi:10.1016/0749-596X(90)90004-J.

Gathercole Susan E., Hitch Graham J., Service Elisabet, and Martin Amanda J.. 1997. “Phonological Short-Term Memory and New Word Learning in Children.” Developmental Psychology 33 (6): 966–79. doi:10.1037/0012-1649.33.6.966. [PubMed: 9383619]

Genesee Fred. 1989. “Early Bilingual Development: One Language or Two?” Journal of Child Language 16: 161–79. doi:10.1017/S0305000900013490. [PubMed: 2647777]

Gildersleeve-Neumann Christina E, Kester Ellen S., Davis Barbara L., and Pena Elizabeth D.. 2008. “English Speech Sound Development in Preschool-Aged Children from Bilingual English-Spanish Environments.” Language, Speech, and Hearing Services in Schools 39 (7): 314–28. doi:10.1044/0161-1461(2008/030).

Goldman Ronald, and Fristoe Macalyne. 2000. Goldman-Fristoe Test of Articulation – Second Edition. Circle Pines, MN: American Guidance Service, Inc.

Goldstein Brian A., Bunta Ferenc, Lange Jenny, Rodriguez Jenny, and Burrows Lauren. 2010. “The Effects of Measures of Language Experience and Language Ability on Segmental Accuracy in Bilingual Children.” American Journal of Speech-Language Pathology 19: 238–47. doi:10.1044/1058-0360(2010/08-0086). [PubMed: 20484707]

Goldstein Brian A., Fabiano-Smith Leah, and Washington Patricia Swasey. 2005. “Phonological Skills in Predominantly English-Speaking, Predominantly Spanish-Speaking, and Spanish-English Bilingual Children.” Language, Speech, and Hearing Services in Schools 36: 201–18. doi:10.1044/0161-1461(2005/021).

Goldstein Brian A., and Washington Patricia Swasey. 2001. “An Initial Investigation of Phonological Patterns in Typically Developing 4-Year-Old Spanish-English Bilingual Children.” Language Speech and Hearing Services in Schools 32 (3): 153. doi:10.1044/0161-1461(2001/014).

Gollan Tamar H, Montoya Rosa I, Fennema-Notestine Christine, and Morris Shaunna K. 2005. “Bilingualism Affects Picture Naming but Not Picture Classification.” Memory & Cognition 33 (7): 1220–34. http://www.ncbi.nlm.nih.gov/pubmed/16532855. [PubMed: 16532855]

Gray S, Green S, Alt M, Hogan T, Kuo T, Brinkley S, and Cowan N. 2017. “The Structure of Working Memory in Young Children and Its Relation to Intelligence.” Journal of Memory and Language 92. Elsevier Inc.: 183–201. doi:10.1016/j.jml.2016.06.004. [PubMed: 27990060]

Green Samuel B., Yang Yanyun, Alt Mary, Brinkley Shara, Gray Shelley, Hogan Tiffany, and Cowan Nelson. 2016. “Use of Internal Consistency Coefficients for Estimating Reliability of Experimental Task Scores.” Psychonomic Bulletin and Review 23 (3). Psychonomic Bulletin & Review: 750–63. doi:10.3758/s13423-015-0968-3. [PubMed: 26546100]

Grosjean Francois. 2001. “The Bilingual’s Language Modes.” In One Mind, Two Languages: Bilingual Language Processing, edited by Nicol Janet L., 1–22. Oxford: Blackwell.

Hualde Ignacio José. 2005. The Sounds of Spanish. New York, NY: Cambridge University Press.

Jared Debra, and Kroll Judith F.. 2001. “Do Bilinguals Activate Phonological Representations in One or Both of Their Languages When Naming Words?” Journal of Memory and Language 44: 2–31. doi:10.1006/jmla.2000.2747.

Jared Debra, and Szucs Carrie. 2002. “Phonological Activation in Bilinguals: Evidence from Interlingual Homograph Naming.” Bilingualism: Language and Cognition 5 (3). University of Arizona: 225–39. doi:10.1017/S1366728902003024.

Kaufman Alan S., and Kaufman Nadeen L.. 2004. Kaufman Assessment Battery for Children – Second Edition. San Antonio, TX: NCS Pearson, Inc.

Keffala Bethany, Barlow Jessica A., and Rose Sharon. 2016. “Interaction in Spanish–English Bilinguals’ Acquisition of Syllable Structure.” International Journal of Bilingualism, doi:10.1177/1367006916644687.

Kenny David A., and Judd Charles M.. 1986. “Consequences of Violating the Independence Assumption in Analysis of Variance.” Psychological Bulletin 99 (3): 422–31. doi:10.1037/0033-2909.99.3.422.

Kohnert Kathryn. 2010. "Bilingual Children with Primary Language Impairment: Issues, Evidence and Implications for Clinical Actions." Journal of Communication Disorders 43 (6): 456–73. doi:10.1016/j.jcomdis.2010.02.002. [PubMed: 20371080]

Kroll Judith F., Bobb Susan C., and Wodniecka Zofia. 2006. "Language Selectivity Is the Exception, Not the Rule: Arguments against a Fixed Locus of Language Selection in Bilingual Speech." Bilingualism 9 (2): 119–35. doi:10.1017/S1366728906002483.

Laing Sandra P., and Kamhi Alan. 2003. "Alternative Assessment of Language and Literacy in Culturally and Linguistically Diverse Populations." Language, Speech, and Hearing Services in Schools 34: 44–55. doi:10.1044/0161-1461(2003/005).

Lleó Conxita, Kuchenbrandt Imme, Kehoe Margaret, and Trujillo Cristina. 2003. "Syllable Final Consonants in Spanish and German Monolingual and Bilingual Acquisition." In (In)Vulnerable Domains in Multilingualism, edited by Müller Natascha, 191–220. Philadelphia, PA: John Benjamins Publishing Company.

MacLeod Andrea A.N., Stoel-Gammon Carol, and Wassink Alicia B.. 2009. "Production of High Vowels in Canadian English and Canadian French: A Comparison of Early Bilingual and Monolingual Speakers." Journal of Phonetics 37 (4). Elsevier: 374–87. doi:10.1016/j.wocn.2009.07.001.

Marian Viorica, and Spivey Michael. 2003. "Competing Activation in Bilingual Language Processing: Within- and between-Language Competition." Bilingualism: Language and Cognition 6 (2): 97–115. doi:10.1017/S1366728903001068.

Messer Marielle H., Leseman Paul P. M., Boom Jan, and Mayo Aziza Y.. 2010. "Phonotactic Probability Effect in Nonword Recall and Its Relationship with Vocabulary in Monolingual and Bilingual Preschoolers." Journal of Experimental Child Psychology 105 (4): 306–23. doi:10.1016/j.jecp.2009.12.006. [PubMed: 20116805]

Messer Marielle H., Verhagen Josje, Boom Jan, Mayo Aziza Y., and Leseman Paul P. M.. 2015. "Growth of Verbal Short-Term Memory of Nonwords Varying in Phonotactic Probability: A Longitudinal Study with Monolingual and Bilingual Children." Journal of Memory and Language 84: 24–36. doi:10.1016/j.jml.2015.05.001.

Munson Benjamin, Kurtz Beth A., and Windsor Jennifer. 2005. "The Influence of Vocabulary Size, Phonotactic Probability, and Wordlikeness on Nonword Repetitions of Children with and without Specific Language Impairment." Journal of Speech, Language, and Hearing Research Language and Hearing Research 48 (5): 1033. doi:10.1044/1092-4388(2005/072).

Ortman Jennifer M., and Shin Hyon B.. 2011. "Language Projections: 2010 to 2020." Paper Presented at the Annual Meeting of the American Sociological Association. Las Vegas, 8 20–23. http://www.census.gov/hhes/socdemo/language/data/acs/Ortman_Shin_ASA2011_paper.pdf.

Owens RE Jr. 2012. Language Development: An Introduction. Pearson. Upper Saddle River, NJ.

Paradis Johanne. 2001. "Do Bilingual Two-Year-Olds Have Separate Phonological Systems?" International Journal of Bilingualism 5 (1): 19–38. doi:10.1177/13670069010050010201.

Paradis Johanne, and Genesee Fred. 1996. "Syntactic Acquisition in Bilingual Children: Autonomous or Interdependent?" Studies in Second Language Acquisition 18: 1–25. doi:10.1017/S0272263100014662.

Parra Marisol, Hoff Erika, and Core Cynthia. 2011. "Relations among Language Exposure, Phonological Memory, and Language Development in Spanish-English Bilingually Developing 2-Year-Olds." Journal of Experimental Child Psychology 108 (1): 113–25. doi:10.1016/j.jecp.2010.07.011. [PubMed: 20828710]

Roberts Julie, Rescorla Leslie, Giroux Jennifer, and Stevens Lisa. 1998. "Phonological Skills of Children with Specific Expressive Language Impairment (SLI-E)." Journal of Speech, Language, and Hearing Research Language and Hearing Research 41 (2): 374. doi:10.1044/jslhr.4102.374.

Ruiz-Felter Roxanna, Cooperson Solaman J., Bedore Lisa M., and Peña Elizabeth D.. 2016. "Influence of Current Input–Output and Age of First Exposure on Phonological Acquisition in Early Bilingual Spanish–English-Speaking Kindergarteners." International Journal of Language and Communication Disorders 51 (4): 368–83. doi:10.1111/1460-6984.12214. [PubMed: 26952160]

Sander Eric K. 1972. "When Are Speech Sounds Learned?" Journal of Speech and Hearing Disorders 37 (1): 55. doi:10.1044/jshd.3701.55.

Semel Eleanor, Wiig Elisabeth H., and Secord Wayne A.. 2006. Clinical Evaluation of Language Fundamentals – Fourth Edition. San Antonio, TX: NCS Pearson, Inc.

Serratrice Ludovica, Sorace Antonella, Filiaci Francesca, and Baldo Michela. 2009. “Bilingual Children’s Sensitivity to Specificity and Genericity: Evidence from Metalinguistic Awareness.” Bilingualism 12 (2): 239–57. doi:10.1017/S1366728909004027.

Sundara Megha, and Polka Linda. 2008. “Discrimination of Coronal Stops by Bilingual Adults: The Timing and Nature of Language Interaction.” Cognition 106 (1): 234–58. doi:10.1016/j.cognition.2007.01.011. [PubMed: 17379203]

Sundara Megha, Polka Linda, and Baum Shari. 2006. “Production of Coronal Stops by Simultaneous Bilingual Adults.” Bilingualism: Language and Cognition 9 (1): 97–114. doi:10.1017/S1366728905002403.

Tamburelli Marco, Sanoudaki Eirini, Jones Gary, and Sowinska Michelle. 2015.“Acceleration in the Bilingual Acquisition of Phonological Structure: Evidence from Polish–English Bilingual Children.” Bilingualism: Language and Cognition 18 (5): 1–13. doi:10.1017/S1366728914000716.

Torgesen Joseph K., Wagner Richard K., and Rashotte Carole A.. 2012. Test of Word Reading Efficiency – Second Edition. Austin, TX: Pro-Ed, Inc.

Vitevitch Michael S., and Luce Paul A.. 2004. “A Web-Based Interface to Calculate Phonotactic Probability for Words and Nonwords in English.” Behavior Research Methods, Instruments, & Computers 36 (3): 481–87. doi:10.3758/BF03195594.

Werker Janet. 2012. “Perceptual Foundations of Bilingual Acquisition in Infancy.” Annals of the New York Academy of Sciences 1251 (March): 50–61. doi:10.1111/j.1749-6632.2012.06484.x. [PubMed: 22694186]

Werker Janet F., and Hensch Takao K.. 2015. “Critical Periods in Speech Perception: New Directions.” Annual Review of Psychology 66 (1): 173–96. doi:10.1146/annurev-psych-010814-015104.

Whitley M. Stanley. 2002. Spanish/English Contrasts: A Course in Spanish Linguistics. 2nd ed. Washington, D.C.: Georgetown University Press.

Williams Kathleen T. 2007. Expressive Vocabulary Test – Second Edition. Minneapolis, MN: NCS Pearson, Inc.

Windsor Jennifer, Kohnert Kathryn, Lobitz Kelann F., and Pham Giang T.. 2010. “Cross-Language Nonword Repetition by Bilingual and Monolingual Children.” American Journal of Speech-Language Pathology 19: 298–310. doi:10.1044/1058-0360(2010/09-0064). [PubMed: 20601622]

Woodcock Richard W. 2011. Woodcock Reading Mastery Tests – Third Edition. Bloomington, MN: NCS Pearson, Inc.

Yavas Mehmet S., and Core Cynthia W.. 2001. “Phonemic Awareness of Coda Consonants and Sonority in Bilingual Children.” Clinical Linguistics & Phonetics 15 (1–2): 35–39. doi:10.3109/02699200109167627. [PubMed: 21269095]

Zhou Huixia, Chen Baoguo, Yang Meiying, and Dunlap Susan. 2010. “Language Nonselective Access to Phonological Representations: Evidence from Chinese-English Bilinguals.” Quarterly Journal of Experimental Psychology 63 (10): 2051–66. doi:10.1080/17470211003718705.

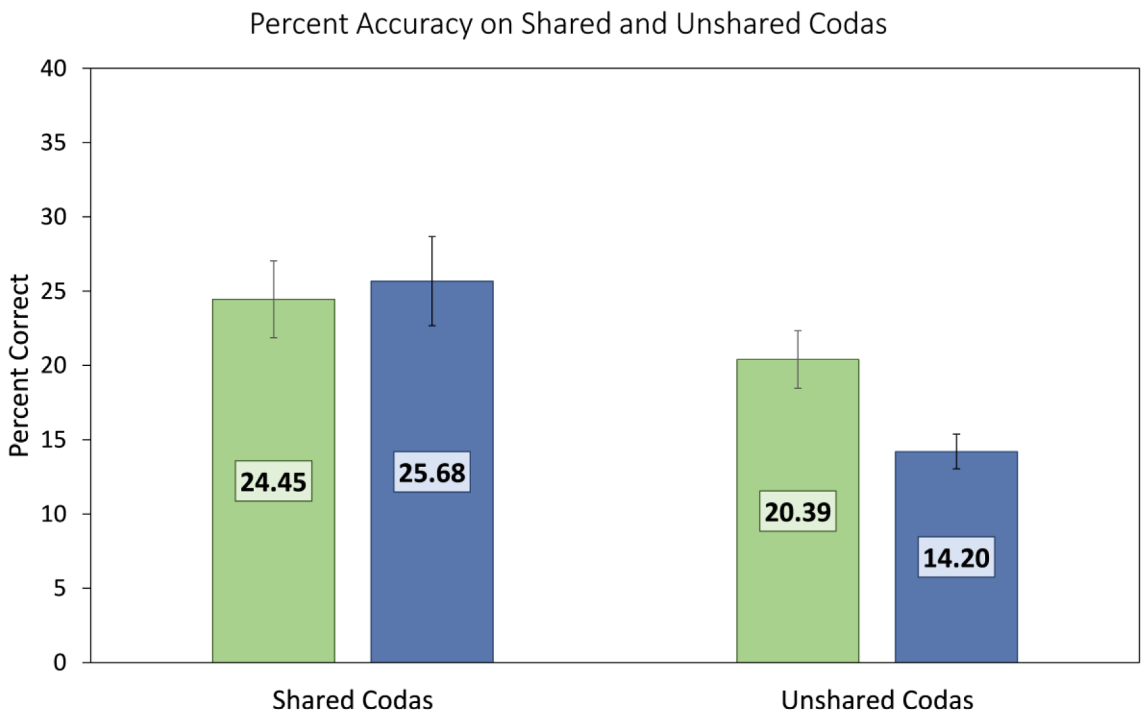

Figure 1.
Mean accuracy scores for monolingual and bilingual groups on shared and unshared codas. Error bars represent standard errors.

Table 1

Participant description information

	Monolingual (*n*=40)		Bilingual (*n*=40)[b]	
Measure	***M***	***SD***	***M***	***SD***
Age (years;months)	7;11	0;5	7;11	0;5
Mother's education (years)[a]	14.73	1.77	13.16[c]	2.73
GFTA-II percentile[a]	48.85	5.42	46.60	7.74
TOWRE-II	107.15	7.65	107.83	8.20
KABC-II	114.05	11.15	108.68	11.75
English CELF-IV[a]	106.15	8.27	94.00	9.40
Spanish CELF-IV	n/a	n/a	95.71[d]	13.22
Spanish CELF-IV FS	n/a	n/a	10.89[d]	2.56
WRMT-III[a]	109.38	11.47	102.40	8.83
EVT-II[a]	110.00	10.85	94.55	8.52
EOWPVT-IV	n/a	n/a	108.36[e]	13.49

Note. Values are standard scores, with the exception of scores reported for the Goldman-Fristoe Test of Articulation (GFTA-2) and the Spanish CELF-IV Formulated Sentences (FS) subtest. The normative mean for standard scores was 100 (*SD*= 15). Percentile scores are reported for the GFTA-2. Scaled scores are reported for the Spanish CELF-IV FS. The normative mean was 10 (*SD*=3). GFTA-II = Goldman Fristoe Test of Articulation, second edition (Goldman & Fristoe, 2000); TOWRE-II = Test of Word Reading Efficiency, second edition (Torgesen, Wagner, & Rashotte, 2012); KABC-II = Kaufman Assessment Battery for Children, second edition (Kaufman & Kaufman, 2004); English CELF-IV = English Clinical Evaluation of Language Fundamentals, fourth edition (Semel, Wiig, & Secord, 2003); Spanish CELF-IV = Spanish Clinical Evaluation of Language Fundamentals, fourth edition (Wiig, Semel, & Secord, 2006); Spanish CELF-IV FS = Formulated Sentences subtest of Spanish Clinical Evaluation of Language Fundamentals, fourth edition (Wiig, Semel, & Secord, 2006); WRMT-III = Woodcock Reading Mastery Test-Paragraph Comprehension (Woodcock, 2011); EVT-II = Expressive Vocabulary Test (Williams, 2007); Expressive One-Word Picture Vocabulary Test – Bilingual Edition (Martin & Brownell, 2010).

[a]Indicates group differences on a t-test with $p < .01$.

[b]Descriptive information for some measures were not available for all participants; differences in number of participants are indicated as needed.

[c]*n*=38 due to participant information on mother's level of education not reported.

[d]*n*=14 for the complete Spanish CELF-IV and *n*=38 for the Spanish CELF-IV FS subtest alone. Spanish CELF-IV information not available for some participants.

[e]*n*=39 due to participant scores on EOWPVT-IV unavailable.