

The Role of Language Experience in Nonword Repetition Tasks in Young Bilingual Spanish-English Speaking Children

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1. Introduction

Phonological memory, or verbal short term working memory, is proposed to be a component of the language learning mechanism used in language acquisition (see Gathercole, 2006). Children with stronger phonological memory abilities are better at learning language than children with weaker phonological memory abilities. Phonological memory predicts language growth, and as a result it has been proposed as a clinical marker of language impairment (Coady & Evans, 2008). One proposed benefit of using phonological memory to identify children at risk of language impairment is that it is argued to be largely free of language experience (cf. Estes, Evans, & Else-Quest, 2004).

However, studies of the role of language experience in nonword repetition tasks in bilingual children yield mixed findings. It is well accepted that phonological memory reflects children's phonological representations (Gathercole, 2006). Some research indicates that phonological memory may also be affected by language input or language knowledge (e.g., MacDonald & Christiansen, 2002). For example, several studies have found that children are better at repeating nonwords that contain sounds that occur frequently in their language than nonwords containing sounds that occur infrequently (Coady & Aslin, 2004; Edwards, Beckman, & Munson, 2004; Munson, Edwards, & Beckman, 2005). If phonological memory is based on language knowledge that results from language experience, then bilingual children might have different levels of phonological memory skill in each of their two languages, based on the amount of experience with each language, or their knowledge of each language. On average, bilingual children know fewer words in a given language than monolingual children who speak the same language (Hoff et al., 2012). If phonological memory abilities are language-specific, we might expect bilingual children to perform more poorly on phonological memory tasks than monolingual children in the same language because they have less experience with the language. In a group of young second language learners, Messer,

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Leseman, Boom, and Mayo (2010) found that children who were more familiar with the language being tested more accurately repeated high-probability sound sequences, confirming that language knowledge influences phonological memory ability.

In studies of sequential bilingual children, several researchers have found that language knowledge and experience are related to nonword repetition ability (Armon-Lotem & Chiat, 2006; Gibson et al. 2015; Summers, Bohman, Gillam, Peña, & Bedore, 2010). Studies of simultaneous bilingual children have also found relations between input NWR ability and language abilities (Parra, Hoff & Core, 2011), but a few studies looking only at input measures found no effect of language experience measured by quantity of input on NWR performance (Brandeker & Thordardottir, 2015; Thordardottir & Brandeker, 2013).

The present study differs from previous research in several respects. We use wordlike stimuli in English and Spanish to assess phonological memory in both languages of young bilingual children. We test children at 30 months, we use measures of quantity of input and vocabulary size to reflect bilingual children's language experience, and we compare bilingual children to a group of age-matched monolingual English-speaking peers.

This study aims to examine the role of language experience – measured by relative amount of input and expressive vocabulary size in each language – on phonological memory tasks in young bilingual first language learners of English and Spanish. If input plays a role in development of phonological memory, we expect to see a relation between the relative amount of input children hear at 30 months and their NWR abilities in the same language. Because bilingual and monolingual children differ in their experience with English (monolingual children have larger vocabularies than bilingual children), we anticipate that monolingual children may be better at producing English-like nonwords than bilingual children. Given previous reports of relations between phonological memory and language abilities, we expect to see these relations within, but not across languages (i.e., English vocabulary and English-like NWR related). Finally, it is possible that bilingual children are better at the NWR task in one of their languages, corresponding to their language abilities in that language.

2. Methods

2.1. Participants

One hundred and five 30-month-old bilingual Spanish-English speaking children (59 males; mean age = 30.5 months; range = 29.48 - 34.63), and thirty monolingual age-matched controls (15 males; mean age = 30.56 months; range = 29.87 - 31.17), participated in this study. Parents reported that children were full term at birth, passed a newborn hearing screening, and had no other health or developmental concerns. The study was conducted in South Florida in accordance with the Institutional Review Board at Florida Atlantic University. Children were considered bilingual because they were exposed to English and

Spanish from birth, and they produced words in both languages at the time of testing. These children had at least one parent who was a native Spanish speaker from a Latin American country.

2.2. Measures

Parents completed an extensive interview about the children's home language environment. We used this to estimate the participants' relative exposure to English (and inversely, Spanish) in the home at the time of testing, expressed as a percentage of relative input. Expressive vocabulary was assessed using the MacArthur-Bates Communicative Development Inventory (CDI; Fenson et al., 1993) and its Spanish adaptation, the *Inventario del Desarrollo de Habilidades Comunicativas: Palabras y Enunciados* (IDHC; Jackson-Maldonado et al., 2003). Parents completed these inventories to report the words that they remembered their children producing. Raw scores from these vocabulary measures were used in our analyses.

To measure phonological memory, children completed two tasks of nonword repetition consisting of 12 English-like and 12 Spanish-like nonwords in a toy-naming activity. We created the nonword stimuli to reflect phonotactic and prosodic properties of each language by matching nonword stimuli to 12 words from the CDI and the IDHC by manipulating syllables and subsyllabic units of onsets and rhymes. The stimuli for each language included four 2-syllable stimuli, four 3-syllable stimuli, and four 4-syllable stimuli. We audio- and vide-recorded children's productions of nonwords, then phonetically transcribed each item in Phon using a consensus method by two independent listeners trained in Spanish and English phonetics. The outcome measure used in our analyses was Percent Consonants Correct (PCC; Shriberg et al., 1997).

3. Results

Table 1. – Descriptive statistics for percent exposure to English, English and Spanish vocabulary scores, and percent consonants correct for English-like and Spanish-like nonword stimuli.

Measure	Monolinguals (n=30)	Bilinguals (n=105)	<i>t</i> -test
% English Exposure	99.30 (2.05)	47.22 (23.93)	$F(1,133) = 141.03$, $p = .000$
CDI raw score	519.33 (146.46)	296.69 (185.44)	$F(1,133) = 36.64$, $p = .000$
IDHC raw score	n/a	205.84 (149.06)	n/a
English-like PCC	0.51 (0.32)	0.47 (0.27)	$t(133) = .705$, $p = .482$
Spanish-like PCC	n/a	0.45 (0.25)	n/a

3.1. Descriptive Statistics

Monolingual children were exposed to more English than bilingual children, and they had larger English vocabularies than bilingual children.

3.2. Analyses

Correlation analysis showed that nonword repetition for English-like and Spanish-like nonword stimuli was not related to relative exposure to English (or inversely, Spanish) in the home at 30 months. (Bilinguals: $r = .17$, $p = .08$ for English-like stimuli, $r = -.05$, $p = .63$ for Spanish-like stimuli; monolinguals: $r = -.28$, $p = .14$).

We used an independent samples *t*-test to ask whether monolingual and bilingual children differed in their production of English-like nonwords. The two groups did not differ in their production of English-like nonwords ($t = .70$, $p = .48$).

Correlation analysis showed that the nonword repetition tasks were related to expressive vocabulary, but the relationship was not symmetrical across languages. English (but not Spanish) vocabulary was related to English-like nonword repetition ($r = .43$, $p = .000$, $r = .16$, $p = .10$, respectively). Spanish-like nonword repetition was related to both English ($r = .28$, $p = .004$) and Spanish vocabulary size ($r = .27$, $p = .005$). There was no relation between vocabulary size and nonword repetition in English for monolingual participants ($r = .15$, $p = .42$).

We used a paired samples *t*-test to determine whether bilingual children produced nonwords more accurately in one language than the other. There was no difference in accuracy of production of English-like or Spanish-like nonwords for bilingual children acquiring both languages ($t = .66$, $p = .508$), and the two tasks were strongly and significantly correlated ($r = .56$, $p = .000$).

4. Discussion

This study explored the role of language input and experience in phonological memory skills of young bilingual children. We did this by measuring the relations between relative amount of input in each language and nonword repetition tasks, and between nonword repetition tasks and vocabulary size in each language. We compared monolingual and bilingual children's performance on repetition of English-like nonwords, and we compared the performance on English-like and Spanish-like tasks in bilingual children.

The first aim was to determine whether nonword repetition scores were related to relative exposure to each language at 30 months for bilingual. Unlike in previous studies, we found no relations between input and NWR scores for bilingual children or monolingual children in this study. This suggests that quantity of input alone does not affect phonological memory in young children,

and supports findings reported by Thordardottir and colleagues who also found no relation between input and nonword repetition. We hypothesized that children who heard more English might perform better on the English-like NWR task than children who heard less English, following Parra, Hoff and Core (2012). However, children in the study by Parra and colleagues were younger than children in the present study (22 v. 30 months), and perhaps during an earlier period of development the effects of exposure on phonological memory are more observable. Our measures of input and NWR were obtained concurrently, but perhaps a measure of cumulative input would show relations to nonword repetition ability.

The second aim was to compare monolingual and bilingual children on the English-like nonword repetition task. Even though the monolingual group had greater exposure to English and larger expressive vocabularies in English than the bilingual children, on average, the two groups did not differ in accuracy of production of English-like nonwords. This does not mean that there was no influence of language ability on task performance by bilingual children. In post-hoc analyses of our data we found that the bilingual children in this study who scored in the lowest quartile on the CDI ($n = 25$) appeared to have lower scores on the English-like NWR task than the monolingual English-speaking children, but the difference between groups fell short of statistical significance ($t = -1.96$, $p = .06$). However, with a larger sample of children, it is possible that these differences would emerge as statistically significant.

Our third aim was to investigate the nature of the between phonological memory and vocabulary in bilingual children. As expected, we found significant relations between English-like nonwords and English vocabulary size for bilingual children. However, Spanish-like nonword accuracy was related to both English and Spanish vocabulary size, while English-like nonword accuracy was related only to English vocabulary size. Parra, Hoff and Core (2012) previously found within-language relations between phonological memory and grammar, but no relations across languages. Our findings support that there is a language-specific component of phonological memory, measured by nonword repetition tasks. The language-specific component may be due to the wordlike nature of our stimuli, which may be more closely related to children's lexical knowledge than less wordlike stimuli.

Finally, we examined relations between language experience and phonological memory in bilingual children. In order to investigate this relationship, we compared production accuracy of English-like and Spanish-like nonwords in 105 bilingual children. Bilingual children did not produce stimuli in one language more accurately than in the other. Further, the two tasks were strongly related ($r = .60$, $p = .000$), suggesting that the ability to repeat sequences of phonemes depends on a shared underlying ability or knowledge. Another possible reason children may have similar abilities in both languages is that phonological abilities may be shared across languages, with greater transfer of information than in other domains of language.

5. Conclusion

Our findings support previous claims that phonological memory is relatively free of language experience for word-like nonword repetition tasks in both languages spoken by young simultaneous bilingual children. This holds whether we use measures of quantity of input to characterize experience, or whether we use vocabulary measures to describe children's language experience. As such, our findings support clinical use of nonword repetition tasks as a measure of phonological memory abilities in young simultaneous bilingual children. Our findings also support a language-specific component to phonological memory. Future investigations should focus on whether the relations found in this study are bidirectional, with early phonological memory skills supporting later language skills, and stronger language skills resulting in better phonological memory skills. Another area for future exploration is the nature of phonological abilities in bilingual children and the degree to which these abilities are able to transfer between languages.

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