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ABSTRACT

This study examines whether Spanish-English bilingual children's phonological awareness (PA) performance reflects specific contrasts between English and Spanish by focusing on children's segmentation of vowels treated as single units in English but as two units in Spanish (/eI/ and /aI/). The role of oral language proficiency, specifically vocabulary, in the phonological awareness of bilingual children is also explored. Bilingual kindergartners and first graders in English or Spanish literacy instruction and a comparison group of monolingual English-speaking peers were administered tests of expressive vocabulary in English and Spanish and a phonemic segmentation task in English. Bilingual children, particularly those with higher Spanish language proficiencies, tended to hypersegment long diphthongized vowels. English language proficiency predicted correct performance on English phonemic segmentation more powerfully for children with low Spanish language proficiency and for children in English literacy instruction. For Spanish-instructed children, Spanish language proficiency predicted English phonemic segmentation, suggesting cross-language transfer. (Contains 32 references.) (Author/SM)

Cross-Language Interference in the Phonological Awareness of Spanish-English Bilingual Children

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Abstract

This study examines whether Spanish-English bilingual children's phonological awareness (PA) performance reflects specific contrasts between English and Spanish, by focusing on children's segmentation of vowels treated as single units in English but two units in Spanish (/eI/ and /aI/). The role of oral language proficiency, specifically vocabulary, in the phonological awareness of bilingual children is also explored. Bilingual kindergartners and first graders in English or Spanish literacy instruction and a comparison group of monolingual English-speaking peers (N=102) were administered tests of expressive vocabulary in English and Spanish and a phonemic segmentation task in English. Bilingual children, particularly those with higher Spanish language proficiencies, tended to hypersegment long diphthongized vowels. English language proficiency predicted correct performance on English phonemic segmentation more powerfully for children with low Spanish language proficiency and for children in English literacy instruction. For Spanish-instructed children, Spanish language proficiency predicted English phonemic segmentation, suggesting cross-language transfer.

Cross-Language Interference in the Phonological Awareness of Spanish-English Bilingual Children

Learning to read presents a number of challenges to all children, such as mastering the alphabetic principle and learning to manipulate the sounds of oral language, an ability referred to as phonological awareness (PA). Little is known about how experience with two languages prior to the initiation of formal reading instruction affects the nature of these challenges for bilingual children. A better understanding of these processes can help us better address the needs of bilingual children, who are at greater risk for reading difficulties than their English-speaking peers (Snow, Burns, & Griffin, 1998). Two major claims in the literature are that there is cross-language transfer in the PA of bilingual children (e.g., Durgonoglu, Nagy, & Hancin-Bhatt, 1993), and that oral language plays a role in the development of PA (e.g., Goswami, 2000).

Phonological Awareness

PA, the understanding young children develop of the sounds in oral language, has been identified as a powerful correlate of success in reading, but this work has been done almost exclusively with monolingual English speakers (for a review, see Blachman, 2000). Intervention studies have also shown that heightening monolingual English speakers' PA has a positive impact on reading ability (for a meta-analysis, see Ehri, Nunes, Willows, Schuster, Yaghoub-Zadeh, & Shanahan, 2001). In addition, correlational and longitudinal studies have demonstrated a positive relationship between PA and reading in monolingual Spanish speakers (Bravo, Villalón, & Orellana, 2001; González, 1996; Jiménez, 1996; Defior, 1996). PA interventions with monolingual Spanish speakers have also proven successful in improving their reading (Defior, 1996; Domínguez, 1996; Defior & Tudela, 1994; Domínguez, 1994).

A few research studies have found a similar relationship between phonological awareness in the first and/or second language and reading in Spanish-English bilingual children (Quiroga, Lemos-Britton, Mostafapour, Abbott, & Berninger, 2002; Carlisle, Beeman, Davis, & Spharim, 1999; Cisero & Royer, 1995; Durgonoglu, Nagy, & Hancin-Bhatt, 1993). What remains unclear, however, is whether PA is language-specific – i.e., whether the relation between PA and reading requires PA in the language of literacy instruction – or whether PA is a capacity/understanding that is "language-general," or that perhaps can be transferred easily from L1 to L2. In other words, is PA an abstract cognitive ability that can facilitate language processing across a variety of languages or is it restricted to the languages in which people are highly proficient orally or to the language of formal literacy instruction?

Oral language proficiency

The role of oral language proficiency in the phonological awareness and reading of bilingual children also remains unclear. There is a long-standing recognition that lexical development influences reading comprehension (Nagy & Scott, 2000). There is a growing consensus that lexical development plays an important role in monolingual children's phonological awareness in alphabetic languages (e.g., Silvén, Niemi, & Voeten, 2002; Goswami, 2000; Metsala, 1999; Wagner et al., 1999). In fact, children with less precise phonological representations of speech tend to poorer readers (Booth, Perfetti, & MacWhinney, 1991). This suggests a relationship between lexical development and reading that is mediated by phonological awareness.

Cross-language transfer

The positive relationship between L1 PA and L2 PA in bilingual children appears to be replicated across studies, but it remains unclear whether PA is mediated by oral proficiency in the L1 or the L2. Durgonoglu et al. (1993) found cross-language transfer between L1 PA and L2 reading and no relationship between oral proficiency and PA or reading in a study of 27 Spanish-dominant, bilingual first graders receiving Spanish literacy instruction. Quiroga et al. (2002) also found cross-language transfer between L1 PA and L2 reading but found that L2 oral proficiency, not L1 oral proficiency, predicted L1 and L2 reading in a study of 30 Spanish-speaking first grade children in English literacy instruction. Cisero and Royer (1995) found cross-language transfer between L1 PA and L2 PA in one of three PA tasks in a study of 40 Spanish- and English-speaking first graders who were receiving literacy instruction in both English and Spanish. Therefore, cross-language transfer in phonological awareness appears to occur in bilingual children receiving English, Spanish, and bilingual literacy instruction, although the relationship of L1 and L2 oral proficiency to PA or reading is unclear.

Cross-language interference

As these findings suggest, the study of transfer from L1 to L2 PA and reading is generally assumed to be positive. No study has looked at how the misapplication of knowledge from L1 PA may affect L2 PA or reading.

Misapplication of L1 PA into L2 PA may occur because the L1 categorical perception of phonemes may influence the perception of L2 categories and thereby affect L2 production. Many researchers in second language acquisition argue that certain speech production errors arise from an incorrect perceptual representation of L2 phonemes based on L1 phoneme categories (Flege, 1999, p. 108).

Research on early bilinguals indicates that L2 phonological production is influenced by L1 phonology (Vernon-Feagans, Scheffner Hammer, Miccio, & Manlove, 2002). Referred to as negative transfer or interference, these errors do not reflect language delay but rather are a normal misapplication of L1 phonology by developing bilinguals, in which their L2 perception and production is affected by their L1 (Gass, 1996). Data from L2 spelling also show systematic errors that can be related to the phonological as well as the orthographic systems of L1, suggesting that L1 phonology has an impact on L2 perception and production (Fashola, Mayer, Drum, & Kang, 1996).

Systematic errors of interference can be "explained" by comparing and contrasting the two languages of bilinguals, through what is called contrastive analysis. Through a careful analysis of the differences between languages, L2 learners' production errors could supposedly be predicted and explained. While contrastive analysis was not able to predict all L2 errors accurately, research in second language acquisition has found that undoubtedly there is an influence of the L1 on the L2 and that contrastive analysis serves to help explain many L2 errors (Major, 2001).

There is a range of contrasts between English and Spanish that cause evident interference in production, resulting in accented speech. In the specific case of negative transfer between L1 PA and L2 PA, however, specific examples of interference are exhibited in tasks that require the conscious manipulation of phonemes and may not be as salient in the everyday use of speech. For example, in the case of Spanish and English, there are vowels that consist of two sounds contained in the same syllable, termed diphthongs, that could be hypothesized to be prime targets for interference in PA for Spanish-English bilinguals in English. One such diphthong is /aI/. English speakers perceive a diphthong like /aI/, "I", to be one phoneme. In contrast, Spanish speakers perceive the same diphthong /aI/ to be two phonemes, /a/-/I/, as in the "ai" of the word *aire*.

While /aI/ is invariably a diphthong in English or in Spanish, a second vowel combination, /eI/, can be categorized either as a diphthong or a tense vowel in English. Regardless of the vowel's categorization in English, it is heard as one phoneme by English speakers, as in the "a" of "lady" but as two sounds by Spanish speakers, as in the "ey" of "ley."

Given that young readers' spellings are closely related to their phonological analyses (Templeton & Bear, 1992; Read, 1975), it seems likely that L2 learners' PA performance, like their spelling performance, would similarly reflect specific contrasts between L1 and L2. Up to now, no one has tested this possibility. If this does occur, it would imply that, in the absence of the language-appropriate phonological category, phonological analysis will lead to an erroneous conclusion. Therefore, relevant knowledge from L1 PA may be transferred to L2 phonological analysis of the phonological structure of the word, with either positive or negative effects, depending on the phonemes being segmented. This study seeks to assess whether bilingual children's English phonemic segmentation reflects contrasts between L1 and L2, specifically in the case of the two diphthongs previously described, as compared to other vowels where English and Spanish are more similar.

Phonemic segmentation, a later-developing PA skill, is one of the most highly predictive of reading skills, particularly for bilingual children (Denton, Hasbrouck, Weaver, & Riccio, 2000). Segmentation is the ability to take a word and break it into its constituent parts, that is, to sound out the number of phonemes or sounds in a word (phonemes and sounds will be used interchangeably from now on). For example, a child says each sound in the word "fine," i.e., /f/-/aI/-/n/.

In the case of the two diphthongs previously described, if Spanish-speaking children are more likely to analyze the vowels as two successive phonemes, then their responses can clearly be distinguished from a child segmenting according to English phonology. In a word, then, with one of these target diphthongized vowels, monolingual children, relying on the English phonological system that distinguishes 14 vowels, will typically sound out three phonemes, for the word "fine"; they produce one phoneme for the vowel sound. Spanish-speaking children, relying on the Spanish phonological system with its five vowels, might more likely segment the /aI/, sounding out four phonemes, /f/-/a/-/I/-/n/. They therefore make an error by standards of English phonology, even though they are segmenting correctly according to Spanish phonology.

The goal of this study was to develop and administer a task explicitly designed to reveal whether bilingual children treat diphthongized and non-diphthongized vowels on phoneme segmentation items differently. One method of determining whether bilinguals hypersegment is comparing bilingual children's phonemic segmentation errors with monolingual children's errors. More specifically, can their errors overall be classified as developmental (i.e., similar to monolinguals') or L1-influenced? If some errors are L1-influenced, bilingual children's errors should be different from monolingual children's, at least on specific items containing the diphthongs described. If some interference occurs, which bilingual children exhibit it? Are they those who have received formal literacy instruction in Spanish? Are they children with higher levels of Spanish proficiency?

This study also sought to understand whether the children's English phonemic segmentation could be further understood by examining the potential role of native and second language proficiency in phonological awareness, in this case specifically phonemic segmentation. Since expressive vocabulary is highly predictive of children's reading ability In monolingual children (Snow et al., 1993), language proficiency was assessed through expressive vocabulary in this study.

Research Questions

This study sought to answer the following research questions.

1. Can negative transfer from Spanish be found in the English phonemic segmentation of children who
   a. have received literacy instruction in Spanish, versus those who have received literacy instruction in English?
   b. have higher vs. lower levels of Spanish language proficiency?
2. Do English and Spanish oral language proficiency contribute to English phonological awareness in bilingual children?

Method

Subjects

The study was conducted in a public, low-SES school in the Boston metropolitan area. The subjects of the study were 102 children, consisting of three groups: 45 bilingual children receiving Spanish language instruction, 35 bilingual children receiving English language instruction, and 22 monolingual children receiving English language instruction. Further details about the sample can be found in Table 1.

Tasks

Vocabulary. The bilingual children's oral language proficiencies were assessed using the Spanish and English Picture Vocabulary subtests from the Woodcock Language Proficiency Battery (Woodcock, 1991). The monolingual children were tested only in English.

Phonemic Segmentation. A phonemic segmentation task was developed, with 20 target and 20 control items. The task was based on the hypothesis that the bilingual children would be more likely to insert a phoneme in the 20 target pseudowords that contained the target diphthongs /aI/ and /eI/ but not more likely to insert a phoneme in the 20 control pseudowords that contained control vowels. There were three practice items with non-target vowels, consisting of two, four, and three phonemes, respectively. Each item was a three-phoneme sequence, composed of a consonant, vowel, and final consonant. The varying number of phonemes in the practice items was designed to provide the anticipated range of potential responses children might give. To control as much as possible for lexical knowledge and reading ability, the stimuli were pseudowords, created by changing the initial consonants of real English words. The initial consonants were substituted with consonants in the same category, e.g., the word "made" became the pseudoword "nade" by replacing the initial nasal with another nasal. The control stimuli were identical to the target stimuli but they contained a non-target vowel, e.g., "nad" was a control item for "nade."

Since this task focuses on two target vowel sounds, the final consonants were varied systematically because they affect vowel length; half of the consonants were voiced and half were unvoiced, defined as whether the vocal cords vibrate or not when the consonant is pronounced. The target and control real words and their corresponding pseudowords can be found in the Appendix.

Procedure

The children were tested individually by trained research assistants (RAs). For bilingual children, one session included half of the phonemic segmentation items and the Woodcock English Picture Vocabulary Subtest; the other session included the other half of the phonemic segmentation items and the Spanish Woodcock Picture Vocabulary Subtest. For monolingual children, one session included one half of the phonemic segmentation task and the English Woodcock Picture Vocabulary Subtest; the other session consisted of the second half of the phonemic segmentation task. The children's responses were audio-taped.

The children were presented with 10 pennies that they used as "counters." The children listened to the RA say a pseudoword stimulus, repeated the word to ensure they had heard it correctly, and then segmented the word orally, pushing forward a counter for each phoneme. The children did three practice items with feedback. For the first example, the RA would say the pseudoword [ree], the child would first repeat the pseudoword *ree*, then the child would say r-ee and push a penny for each sound. Each child received one of two parallel versions of the test; the items were presented in a different order in each version to control for fatigue effects.

Results

Scoring

Phonemic Segmentation. In the phonemic segmentation task, it was important to determine whether the use of counters accurately reflected the child's oral segmentation. In order to check on the accuracy of using the number of counters a child pushed forward as a proxy for the number of sounds they emitted when they were segmenting orally, a comparison was made between the scoring based on number of counters against a scoring of the audiotapes of children's segmentation. A sample of 20% of the children's audiotapes were chosen, and the Cohen's Kappa for these responses was 0.69, with 86% agreement. The level of agreement was substantial; therefore the number of counters the children pushed forward was used as a proxy for their oral segmentation.

The items for the phonemic segmentation task were scored in two ways. To answer the research question regarding negative transfer, the number of counters a child pushed forward on each item was used. A difference score was obtained by subtracting the number of phonemes a child counted on a control item from the number of phonemes a child counted on a target item. Therefore, this score quantified the number of times there was negative interference from Spanish, i.e., a segmentation reflecting a two-sound Spanish diphthong instead of a one-sound long English vowel. For the second research question regarding the role of oral language proficiency in English phonemic segmentation, the items were scored as correct or incorrect, based on the number of counters the child pushed forward. Therefore, since all of the items were consonant/vowel/consonant (CVC), all responses of three phonemes were scored as correct and all other responses were scored as incorrect.

Analyses were designed to test whether children receiving Spanish versus English instruction were more likely to hypersegment, and also whether performance of the bilingual children was related to their level of Spanish proficiency. Finally, analyses were designed to test whether English and Spanish language proficiency had an impact on English phonemic segmentation in bilingual children. An alpha level of .10 was used for all analyses.

Item Analysis: Reliability and Item Discrimination

Two outcomes were used in the analysis. One was a difference score subtracting the number of phonemes segmented on the control items from those given on the target items. The reliability of the difference score was .64. The other outcome was the overall phonemic segmentation task score. Cronbach's alpha for all of the children on the dichotomously-scored items was .98.

Item Analysis: Rasch Analysis

Rasch analysis was chosen as an exploratory tool to do an in-depth comparison of the number of phonemes segmented orally by the three groups: monolinguals, bilinguals in English language instruction, and bilinguals in Spanish language instruction. Item difficulty estimates from Rasch analyses can be compared across groups, facilitating direct comparisons between the number of phonemes children sounded out on target and control items (Bond & Fox, 2001; Hambleton, Swaminatham, & Rogers, 1991). Figure 1 represents monolingual children; Figure 2 represents bilingual children in English language instruction; and Figure 3 represent bilinguals in Spanish language instruction. The X's on the left-hand side represent the children who took the test; those who are lower down on the diagram are those less likely to add phonemes to their responses on the phonemic segmentation task. Those who are higher up were more likely to insert sounds.

A comparison of the three figures indicates that bilingual children in Spanish language instruction were the most likely to insert phonemes in the target items. The target items, which are in bold, are clearly more likely to be toward the bottom of the variable map than the control items for the bilingual children in Spanish language instruction, as compared to the monolingual children, meaning that the bilingual children in Spanish language instruction were more likely to insert a phoneme with the target items than the control items. These results are exploratory, however, because the subgroup sample sizes are small.

Descriptive Statistics

The descriptive statistics in Table 1 provide insight into the differences among monolinguals and bilinguals in Spanish and English literacy instruction in this sample. The monolinguals had the highest mean standardized score on the English Woodcock Picture Vocabulary, the bilinguals in English language instruction had a slightly lower mean score, and the bilinguals in Spanish language instruction had a substantially lower mean score. The bilinguals in Spanish language instruction had a large range – 0 to 95 – in their English scores. The opposite occurred in the standardized scores on the Spanish Woodcock Picture Vocabulary: bilingual children in Spanish language instruction had a higher mean score than bilingual children in English language instruction. The bilingual children in English language instruction had a range of 1 to 97, similar to that of the Spanish-instructed bilinguals in the English version of the same subtest. The low mean scores on the English and Spanish tests of expressive vocabulary, respectively, suggest that these two groups of bilingual children come from different populations, even in comparison to the monolingual children. The bilingual children in English literacy instruction appeared to be English-dominant, on average, whereas bilingual children in Spanish language instruction appeared to be Spanish-dominant, on average. The negative relationship between English and Spanish language proficiency is demonstrated in the negative correlation between the corresponding Woodcock tests ($r = -.35$, $p=.002$). It should be noted that these data are not longitudinal, therefore it is unknown how the proficiencies in each language, and the relationship between them, change over time.

On the overall task of phonemic segmentation in English, the monolinguals as a group answered significantly more items correctly on the phonemic segmentation task when compared to the bilinguals in English and Spanish language instruction. It is interesting to note that the difference scores between the target and control items – the measure of negative interference – is similar for both monolinguals and bilinguals in English language instruction. The bilinguals in Spanish language instruction scored, on average, two points higher on the negative interference score and had a larger standard deviation; the range of their scores reached 19, indicating more variation and greater interference as a group.

The errors on the phonemic segmentation task of the children in the sample were analyzed to explore how the subgroups differed (Table 2). The majority of errors were hyposegmentations across all groups on target and control items alike. Hyposegmentation is the more primitive error, reflecting a developmentally prior strategy for performance on a phonemic segmentation task. The bilinguals in Spanish language instruction appeared to be developmentally at a different level in their phonemic segmentation; their percentage of items correct was only 56%, while the other two subgroups were performing at a rate of over 79% correct. All three groups were more likely to hypersegment on target than control items. Bilinguals in Spanish language instruction were the most likely to make errors and to make the developmental error of hyposegmentation overall. They were much more likely to hypersegment on target than control items, however.

Multiple Regression Analyses: Answering the Research Questions

Multiple regression analyses were conducted to answer each of the research questions guiding this study. For each question, the major question variable was entered in the regression after forming a baseline control model. The control models used in all of the analyses included age and gender; when other variables were included in the analyses as control variables, they are mentioned in the description of the specific analysis. Interactions between the question variable and each control variable were also included.

Does language of instruction have an impact on negative transfer? The first set of multiple regression models was designed to test if language of instruction had an impact on negative transfer. The baseline model used included age and English oral language proficiency as control variables. Language of instruction was found to interact with age (see Table 3). Overall, the model explained 17% of the variation in interference scores. The fitted model can be seen in Figure 4. Age was set to its mean for each group, Spanish- and English-instructed children. Figure 4 shows that the Spanish-instructed children, in comparison to English-instructed children with the same level of English proficiency, were more likely to insert a phoneme on the target items than the control items. Higher scores on the English Woodcock Picture Vocabulary Subtest were associated with slightly higher interference scores. Therefore, controlling for age and English oral proficiency, Spanish-instructed children were more likely than English-instructed children to exhibit interference.

Does Spanish language proficiency have an impact on negative transfer? The second set of regression analyses examines the role of Spanish language proficiency in interference. Only bilingual children with Spanish oral proficiency scores were studied. Once the question variable of Spanish language proficiency was added, the only control variable that maintained significance in the model was age. Higher Spanish language proficiencies are associated with higher levels of interference (Table 4). Overall, this model explained 18% of the variance in the interference scores.

Do both English and Spanish language proficiency have an impact on overall English phonemic segmentation? The final set of regression analyses found that English language proficiency does explain some variation in bilingual children's English phonemic segmentation; the amount of variation explained by English language proficiency depends on the child's Spanish language proficiency, and vice versa (see Figure 5, which shows the relationship between English and Spanish language proficiency without controlling for language of instruction). This is reflected by the fact that there is a significant interaction between English and Spanish proficiency in the final regression model (see Table 5). The interaction is evident even when language of instruction is controlled for. The final model for the total score on the phonemic segmentation items explains 18% of the variation.

This relationship can be seen in Figures 6 and 7. The white line in both graphs represents English-instructed bilingual children; the black line represents Spanish-instructed bilingual children. Figure 6 shows the effect of English language proficiency, controlling for Spanish language proficiency, which was set to the mean for each instructional group. For the English-instructed children, the relationship is as would be expected: setting Spanish language proficiency at its mean for the group, there is a positive relationship between English language proficiency and English phonemic segmentation. For the Spanish-instructed group, there appears to be a slightly negative relationship between English language proficiency and English phonemic segmentation. Regardless of English language proficiency, the English-instructed children are predicted on average to have higher phonemic segmentation scores.

Figure 7 shows the effect of Spanish language proficiency, controlling for English language proficiency, which was set to the mean for each instructional group. For Spanish-instructed children, the relationship is positive: higher Spanish language proficiency is associated with higher English phonemic segmentation scores. This would suggest that there is cross-language transfer in phonological awareness. For the English-instructed children, Spanish language proficiency appears to have a slightly negative relationship with English phonemic segmentation. Again, however, regardless of Spanish language proficiency, the English-instructed children are predicted on average to have higher phonemic segmentation scores.

Essentially, then, the role of English vocabulary is clearly related to the role of Spanish vocabulary and the language of instruction in predicting performance on English phonemic segmentation. For children in English instruction, essentially children who are English-dominant, phonemic segmentation varies as a positive function of their English vocabulary, similar to a monolingual child's. In other words, the better their English expressive vocabulary, the better their performance on English phonemic segmentation. For children in Spanish language instruction, performance on phonemic segmentation is not related to their English vocabulary, but is predicted by their Spanish vocabulary. At higher levels of Spanish vocabulary, it appears that positive transfer of L1 skills may allow the children to do fairly well on the task. Overall, however, the English-instructed children did better on phonemic segmentation.

Discussion

Strikingly, phonological interference was found in this particular contrast between English and Spanish, specifically in those children who had higher Spanish language proficiencies and those who were in Spanish language instruction. The effect of Spanish literacy instruction no longer achieved significance when analyzed in conjunction with

Spanish language proficiency. Thus, the phenomenon of negative transfer in phonemic segmentation has been confirmed in this subpopulation, an important finding with both theoretical and practical implications.

The existence of negative interference, as demonstrated in the case of two contrastive vowel sounds in English and Spanish, indicates that phonological awareness (PA) is a cross-language capability for bilingual children, but only in certain circumstances. Apparently children who have little knowledge of L2 are more likely to use their knowledge of L1 in an L2 phonemic segmentation task. Those with more knowledge of the L2 would appear to use that knowledge rather than L1 knowledge in L2 phonemic segmentation. Theoretically, these results support Bialystok and Bouchard's (1985) assertion that metalinguistic skills (such as PA) require both analysis of knowledge and control over cognitive processing. Essentially, children in this study who had little L2 knowledge lacked the ability to analyze the contrasts between English and Spanish in order to avoid mistakes in English phonemic segmentation. Furthermore, children who had received L2 instruction were much more likely to have been explicitly taught to control their processing in the L2, thereby improving their overall performance in L2.

These results have practical implications. Educators may misinterpret the errors of children who are exhibiting negative transfer across languages. For example, many school districts are using phonemic segmentation tests like the Yopp-Singer Test (Yopp, 1995). Of the 22 3-phoneme items on the Yopp-Singer, 6, or 27%, of the test might be subject to such hypersegmentation by bilingual children because they include the diphthongs examined in this study. Language-delayed children must be distinguished from those relying on Spanish phonology, if we are to make appropriate instructional decisions. A deficit in phonological awareness should be distinguished from a lack of knowledge of English phonology.

The second finding of this study is that the role of bilingual children's English language proficiency in their English phonemic segmentation depends on their Spanish language proficiency, and vice versa. Language of instruction also has an impact on English phonemic segmentation. In the language of instruction there is a positive relationship between language proficiency and phonemic segmentation; in the other language, there is a slightly negative relationship. This finding has methodological and theoretical implications.

Methodologically, the two findings of an interaction between languages and an effect of language of instruction indicate that studying bilingual children requires a carefully selected battery of assessments. In order to more fully understand the capacities of bilingual children, they should be assessed in both their languages, particularly if their dominant language is not the language of the study in which they are participating. Children who have high L1 proficiencies do well on phonemic segmentation, almost regardless of their L2 proficiency. Children who have low L1 proficiencies, however, are predicted not to do well on phonemic segmentation unless they have high L2 proficiencies. In addition, controlling for language of instruction and testing for interactions between languages should be a part of study design, wherever possible.

Theoretically, this finding would indicate that bilingual children who have been instructed in English literacy are similar to monolingual English speakers: their English vocabulary predicts their English PA. On the other hand, bilingual children in Spanish literacy instruction are different from children in English literacy instruction: their Spanish vocabulary better predicts their English PA. It would be interesting to replicate this study and/or to study the role of oral language proficiency in bilingual children before they receive formal literacy instruction.

Limitations

The major limitation of this study is the sample itself, a problem for any study of bilingual children. The sample may not be representative of Spanish-English bilinguals as a whole, which is difficult to know because there is not enough data on bilingual children's development of oral proficiency in both languages and phonological awareness in English to know what a representative sample would be. The study is also limited by the fact that the two subgroups of bilinguals, i.e., those in English versus Spanish literacy instruction, were not matched on language dominance. This probably reflects the reality of many bilingual children, that they are dominant in the language of instruction for two reasons. The first reason is the process for deciding language of instruction for individual children; children who are Spanish-dominant or English-dominant will probably be placed by their parents, district, or school in the language of instruction of the dominant language. The second reason is that language of instruction probably increases the dominance of one language.

The second possible limitation of this study is that the phonemic segmentation items all contained three phonemes and that the children realized this and simply counted three phonemes as a result, without actually doing the necessary analysis. To counter this possibility, children were provided with practice items that had two, three, and four phonemes. In addition, children had to say the segments orally, not simply count them, so they had to emit a corresponding sound for each counter. Finally, the children committed many errors, as described in the results, which suggests that the children had not realized this.

Conclusion

This study found that there is phonological interference from Spanish in the English phonemic segmentation of bilingual children, particularly those with higher Spanish language proficiencies. Language of instruction predicts interference but is no longer important once Spanish language proficiency is considered. The role of bilingual children's English language proficiency in their English phonemic segmentation depends on their Spanish language proficiency, and vice versa. In addition, the role of proficiency in each language also depends on the language of instruction. The language of instruction is the language in which there is a positive relationship between language proficiency and phonemic segmentation; in the language in which the child has not received instruction, there is a slightly negative relationship.

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Appendix: Items on the Phonemic Segmentation Task

Practice items: ip, shunny, tig

Target Items	Control Items
fide	fud
chibe	chob
hine	hean
shile	shull
bive	bove
kipe	kep
rike	ruck
yife	yiff
pithe	peethe
guice	goss
nade	nad
zein	zan
bame	bim
kail	kell
shays	shuss
yait	yeat
dake	deak
bape	bap
laith	leath
tase	tuss

Table 1. Descriptive statistics of sample*.

	Monolingual Children	Bilinguals in English Literacy Instruction	Bilinguals in Spanish Literacy Instruction
Grade			
Kindergarten	6	14	16
First grade	16	21	29
Gender			
Females	14	21	24
Males	8	14	21
		M (SD)	
Age	85.05 (8.69)	82.93 (6.92)	83.09 (7.63)
English Woodcock Picture Vocabulary**	91.64 (13.18)	80.14 (14.98)	56.42 (20.27)
Spanish Woodcock Picture Vocabulary***		42.12 (28.29)	79.42 (21.99)
Phonemic Segmentation (40)	35.05 (8.68)	31.71 (12.20)	22.40 (13.15)
Control Items (20)	17.55 (4.55)	15.97 (6.05)	11.04 (7.24)
Difference Score between Target and Control Items	1.18 (1.22)	1.03 (1.84)	3.11 (5.13)

*The mean scores were all significantly different at p<.03 except for age.
** Standardized scores for the Woodcock Picture Vocabulary Subtests were calculated using age-based norms.
*** Only 78 out of 80 bilingual children received scores for the Spanish Woodcock Picture Vocabulary. One child refused to take the test in Spanish, and the other child was repeatedly absent.

Figure 1: Rasch Analysis of Number of Phonemes Monolingual Children Counted*

```
ANALYZED: 22 PERSONS, 39 ITEMS
--------------------------------------------------------------------------------

       PERSONS           MAP OF ITEMS
         <frequ>|<less>
  2           T+  bive  hine  kail  kipe  tase  yife  zan
               |S
  1         X  +  dake  goss  ruck  shuss
            X  |  bape  bove  chibe  chob  guice  kell  laith  pithe  yeath  yiff
  0            +M
            X S|  bap   fud   hean  kep   nade  rike  shays  yaith  zein
 -1         X  +
            X  |S bim   deak  fide  leath  nad   peethe  shile  tuss
 -2       XXX  +
               |T
 -3 XXXXXXXX M+
            X  |  shull
 -4         X  +
               |
 -5        XX  +
              S|
 -6         X  +
               |
 -7            +
               |
 -8           T+
               |
 -9            +
               |
-10            +
               |
-11            +
               |
-12         X  +
          <rare>|<more>
```

Figure 2: Number of Phonemes Bilingual Children in English Language Instruction Counted*

```
ANALYZED: 35 PERSONS, 40 ITEMS
--------------------------------------------------------------------------------

       PERSONS           MAP OF ITEMS
             <frequ>|<less>
  5              X  +
                 X T|
  4                 +
                    |
  3                 +
                    |
  2             XX S+
             XXXXX  |T
  1              X  +  bim  yeat
                    |S bame bap bape dake fud hean kep kell leath nad nade shuss tuss yait yife yiff zan
  0 XXXXXXXXXXXX    +M deak goss  guice  hine  peethe  rike  ruck  shull  tase
               XXX M|S bove  chob  chibe  fide  kail  kipe  laith  pithe
 -1              X  +  bive  shays
                    |T
 -2             XX  +
                    |
 -3                 +  shile
                 X S|
 -4              X  +
                    |
 -5              X  +
                 X  |
 -6            XXX T+
              <rare>|<more>
```

Figure 3: Number of Phonemes Bilingual Children in Spanish Language Instruction Counted *

```
ANALYZED: 45 PERSONS, 40 ITEMS
--------------------------------------------------------------------------------

       PERSONS            MAP OF ITEMS
          <frequ>|<less>
    4          X  +
                  |
              XX  |
    3             +
                  |
               X  |
    2         XX S+
             XXX  |
       XXXXXXXXX  |
    1          X  +T bap
               X  |S bim   bove  deak  kail  kep   tuss  yiff
               X  |  chob  fud   hine  kell  leath  nad   shull  shuss  yeat
    0         XX  +M bame  goss  hean  kipe  nade  peethe  ruck  yait  zan
               X M|  laith  shays  tase
             XXX  |S bape  bive  chibe  dake  fide  guice  pithe  yife
   -1       XXXX  +T rike  zein
              XX  |
              XX  |  shile
   -2          X  +
                  |
               X S|
   -3         XX  +
                  |
               X  |
   -4             +
                  |
           XXXXX  |
   -5            T+
           <rare>|<more>
```

*Target items are in bold.

Table 2. Mean Numbers of Hypersegmentation Errors on Phonemic Segmentation Task*

	Monolinguals	Bilinguals in English Literacy Instruction	Bilinguals in Spanish Literacy Instruction
n	9	19	35
Target items			
M	2.22	2.11	1.97
SD	2.73	4.24	3.68
% of total errors	43%	28%	19%
Control items			
M	1.56	1.32	.77
SD	2.65	2.77	1.91
% of total errors	27%	18%	7%

*The mean number of target and control errors was significantly different across groups at the $p<.03$ level.

Table 3. Regression Analysis Summary of Language of Literacy Instruction's Prediction of Negative Transfer in English Phonemic Segmentation

PREDICTOR	Model 1: Baseline Model	Model 2: Language of Instruction	Model 3: Interaction Age and Language of Instruction
Intercept	-4.25	-9.83*	-2.69
Age	.08	.09~	.01
English Woodcock Picture Vocabulary Standard Score	-.005	.04~	.03~
Language of Instruction (0=English, 1=Spanish)		3.18**	-12.29~
Interaction between Age and Language of Instruction			.18*
R-square statistic	.03	.14	.17
Error df	99	98	97

~ p<.10 * p<.05 ** p<.01 *** p<.001

Table 4. Regression Analysis Summary of Spanish Language Proficiency's Prediction of Negative Transfer in English Phonemic Segmentation of Bilingual Children

PREDICTOR	Model 1: Baseline Model	Model 2: Language of Instruction	Model 3: Spanish Language Proficiency
Intercept	-9.01	-10.74~	-13.46*
Age	.14*	.14*	.15*
Language of Instruction (0=English, 1=Spanish)		2.19*	
Spanish Woodcock Picture Vocabulary Standard Score			.05**
R-square statistic	.05	.12	.18
Error df	76	75	75

~ p<.10 * p<.05 ** p<.01 *** p<.001

Figure 4. Predicted Negative Interference for Spanish- and English-Instructed Children

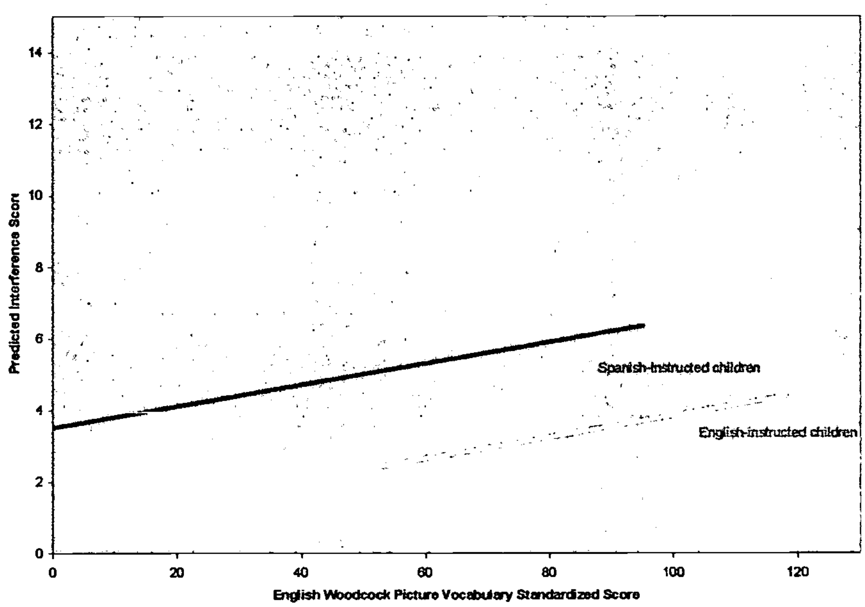
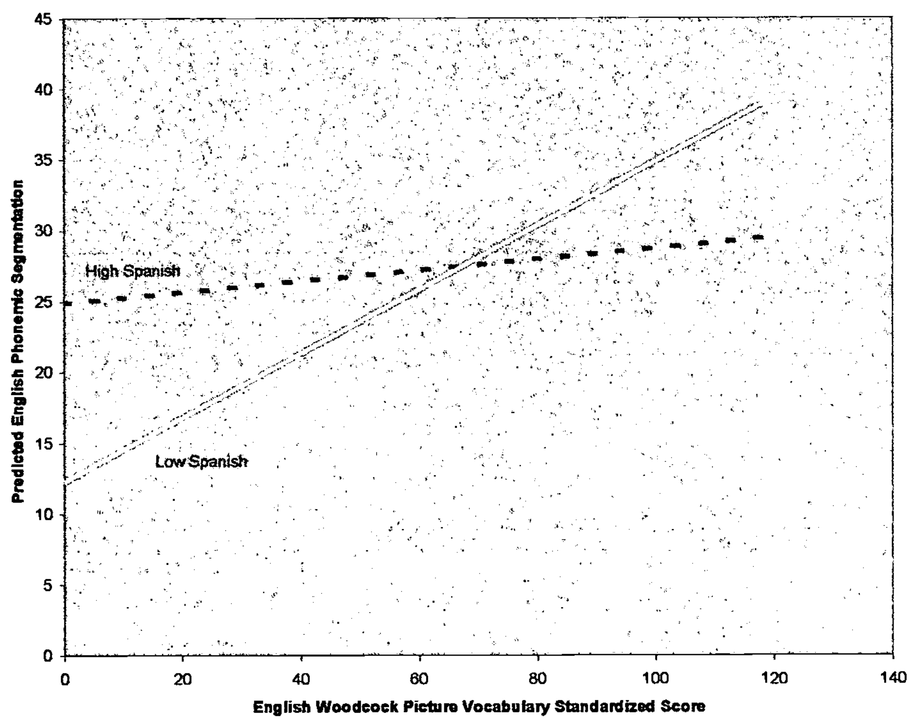


Table 5. Regression Analysis Summary for English and Spanish Oral Language Proficiencies' Prediction of English Phonological Awareness in Bilingual Children

PREDICTOR	Model 1: English Woodcock	Model 2: Spanish Woodcock	Model 3: Interaction	Model 4: Final Model
Intercept	16.78**	-10.74~	.50	7.62
English Woodcock Picture Vocabulary Standard Score	.15*		.40*	.30~
Language of Instruction (0=English, 1=Spanish)				-8.47*
Interaction between Spanish and English Woodcock			-.004~	-.004~
Spanish Woodcock Picture Vocabulary Standard Score		-.09~	.27	.31~
R-square statistic	.05	.04	.12	.17
Error df	76	76	74	73

~ p<.10 * p<.05 ** p<.01 *** p<.001

Figure 5. Predicted Phonemic Segmentation of Bilingual Children According to English Language Proficiency*



* High and low Spanish proficiency were defined respectively as 75th and 25th percentile in this sample.

Figure 6. Predicted Phonemic Segmentation of Bilingual Children as a Function of English Language Proficiency

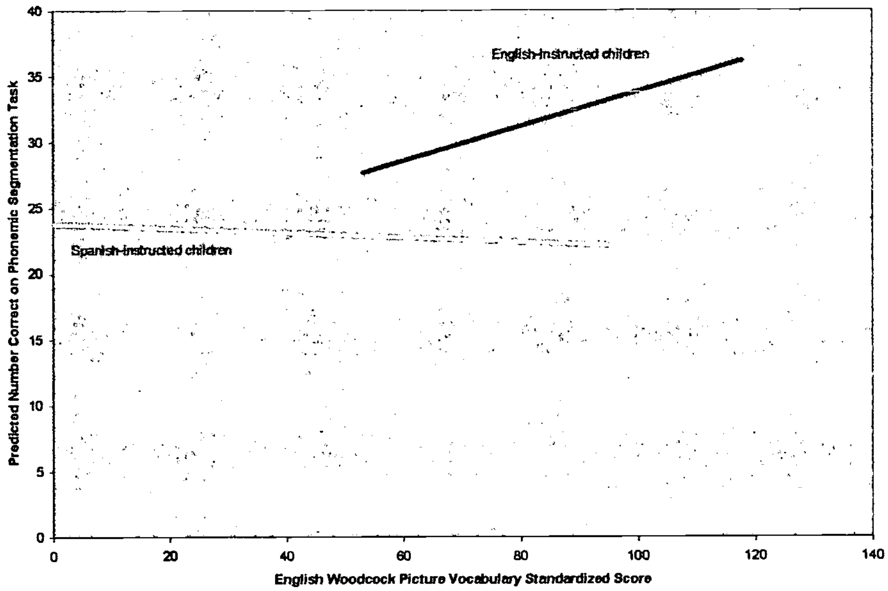
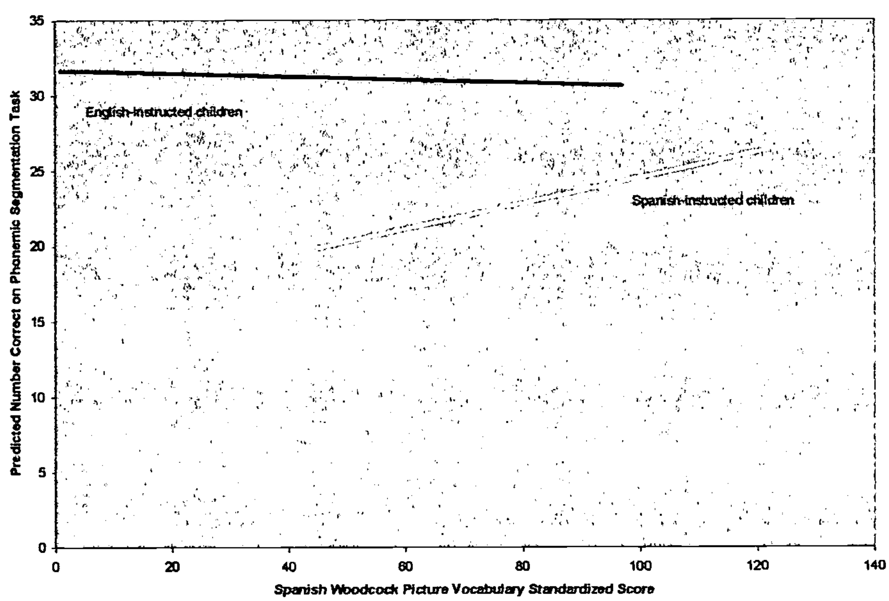


Figure 7. Predicted Phonemic Segmentation of Bilingual Children as a Function of Spanish Language Proficiency



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