Crossover of Phonological Processing Skills

A Study of Spanish-Speaking Students in Two Instructional Settings

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ABSTRACT

This study investigated three questions: Do phonological processes show cross-linguistic transfer? How does the language of instruction influence the relationship between phonological processes and decoding? Does performance on Spanish and English phonological processing tasks similarly predict English decoding for the same English learners (ELs)? We studied first-grade ELs who had been enrolled for 2 years in two programs that differed by language of instruction (English only and bilingual). Phonological processing skills were examined following a theory of core phonological processing deficits that postulates that three related constructs—phonological awareness, phonological coding, and phonological recoding—are the major components of phonological processing. The results indicate that (a) phonological processes do exhibit cross-linguistic transfer in young ELs; (b) phonological awareness might best be conceptualized as comprising two developmentally overlapping components; (c) language of instruction influences English and Spanish word reading and Spanish pseudoword decoding, but not English pseudoword decoding; and (d) phonological awareness is the only theoretical phonological processing construct significantly related to all English and Spanish reading tasks.

THERE IS GROWING CONSENSUS ABOUT THOSE ELEments of reading acquisition for young children that are most fundamental and susceptible to instructional intervention (Committee on the Prevention of Reading Difficulties in Young Children, 1998; National Reading Panel, 2000). However, significant questions remain about the growing number of young students who may not become proficient in reading English because English is their second language (L2; Hakuta & Garcia, 1989; Rumberger, 2000).

The primary purpose of this study is to frame some of the basic questions about the reading difficulties of English learners (ELs) in terms that relate to cognitive mechanisms that serve as the substrate for learning to read in English. We are particularly interested in what kinds of cognitive resources related to first language (L1) competencies are available for ELs via cross-linguistic transfer as they learn to read English. In selecting this approach, we do not believe that we are reducing a significant educational and social problem to a few cognitive constructs, nor are we denying the overarching and long-term importance of specific and larger instructional events and social conditions that influence and give meaning to long-term outcomes.

However, we do believe that form should follow function. Therefore, how young students function cognitively as they learn to read English ought not only to inform us but also to dictate to a large extent the forms of instruction and the programmatic arrangements that we mandate. Unfortunately, although there is considerable empirical literature on the cognitive aspects of L2 learning, there appears to be a significant dearth of literature on very young children who must learn to read in an L2. Fortunately, there is now a significant body of literature on individual cognitive differences between young monolingual readers that may inform us in pursuing better understanding of young ELs.

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Two theoretical considerations

We are informed by and attempt to bridge between two theoretical positions on L2 reading acquisition by young students. One is a "macro" theory of global language ability in the cultural and social context of its acquisition and use. The other is a "micro" theory of universal cognitive mechanisms underlying reading acquisition. We reason that broad language competencies emerge, in part, on a substrate of far simpler language-processing mechanisms and that individual differences in the development or functioning of these mechanisms may interact with broad environmental factors, including school instruction, to either increase or decrease the risk of failure to become academically proficient in English reading (e.g., see Hakuta, Butler, & Witt, 2000, & Rossell, 2000, for a discussion of time-to-proficiency issues).

The first theory to frame our work, a theory of *common underlying proficiencies* (CUP), states that a common underlying knowledge about language lies beneath the surface of bilingual or multilingual performance (Cummins, 1996). In other words, knowledge about reading in L1 is an available resource for assisting in L2 reading acquisition.

The second is a theory of *core phonological deficits* that represent a convergence of several lines of investigation showing that students with reading difficulties, particularly in word reading, have deficits in phonological processes (Liberman & Shankweiler, 1985; Morris et al., 1998; Shankweiler & Crain, 1986; Stanovich, 1988; Wagner & Torgesen, 1987; Wagner, Torgesen, & Rashotte, 1994).

This present research proceeds from a specific theory in which phonological processing is composed of three independent but highly related components: phonological awareness, phonological coding, and phonological recoding (Wagner & Torgesen, 1987). *Phonological awareness* refers to one's awareness of and access to the sound structure of oral language (Wagner, 1988). *Phonological coding* refers to coding of sound-based information in working memory. *Phonological recoding* refers to the ability to retrieve phonological information from long-term memory at a rapid pace.

It is reasonable to suppose that Cummins' (1996) bilingual theory of common underlying proficiency implies core cognitive and linguistic mechanisms that may also account for individual differences in young children's ability to learn to read words in a second language. Specifically, *cross-linguistic transfer* is conceptualized as the access and use of linguistic resources in L1 by students while learning other languages. Research on monolingual students in several languages provides considerable evidence that specific phonological skills improve students' chances of becoming strong readers, and, conversely, lack of these skills predicts later reading difficulties (Liberman & Shankweiler, 1985; Wagner, 1988). It is logical, therefore, that the ability to process phonological information is part of the common underlying proficiency posited by Cummins (Cisero & Royer, 1995; Durgunoglu, Nagy, & Hancin-Bhatt, 1993; Gerber, English, & Leafstedt, 2000; Gerber, English, & Leafstedt, 2002). The present study extends the existing research literature by examining relative influences of native language, language of instruction, and individual differences in phonological processes as these relate to early acquisition of word reading.

Crossover Of Phonological Processing Skills

Relatively little research has been conducted thus far on the cross-language transfer of phonological processes in early reading. Most of this research has focused primarily on one component of phonological processing: phonological awareness. Examination of the cross-linguistic transfer of phonological awareness skills has focused primarily on correlations among phonological measures in Spanish and English (August, Calderón, & Carlo, 2000; Cisero & Royer, 1995; Durgunoglu et al. 1993) and through examination of outcomes in English for bilingual students (Muter & Diethelm, 2001). Thus far, research findings have consistently revealed evidence of cross-linguistic transfer. Across comparable English and Spanish phonological awareness tasks, correlations have been high to moderate and statistically significant. These data can be used to argue that the measures are tapping the same underlying construct rather than a specific English or Spanish skill (Cisero & Royer, 1995). Preliminary factor analysis of comparable Spanish and English phonological awareness tasks administered to a large sample of Spanish-speaking kindergartners has suggested underlying constructs that are not specific to a particular language (Gerber, English, & Leafstedt, 2000). Additional research has shown that correlational relationships among English and Spanish phonological awareness tasks remain stable over time (Cisero & Royer, 1995). Some preliminary research also exists showing that phonological awareness tasks in *Spanish* predict *English* word decoding (Durgunoglu et al., 1993)—findings identical to those reported in the monolingual research. Finally, comparing English-only and bilingual students, Muter and Diethelm (2001) found no group differences in performance on the same phonological awareness tasks. Students performed equally well despite differences in native language and level of English proficiency.

In summary, phonological processing is a set of cognitive skills needed to process sounds. Phonological processes can be divided into three components: phonological awareness, phonological recoding, and phonological coding. Initial evidence from the literature points to phonological awareness as a cognitive skill that has cross-linguistic transfer abilities. At this time, there is limited evidence that phonological recoding or phonological coding have the same ability. If the cross-linguistic transfer of phonological awareness is replicated, the implications for phonological awareness training and risk identification for students acquiring reading skills in their second language will need to be considered.

METHOD

Participants

The students participating in this study were selected from a sample of 381 students participating in a larger study, *La Patera* (Gerber, English, & Leafstedt, 2002). The students in the present study were selected because of the instructional contrasts and demographic similarities of the schools they attended. Ninety Spanish-speaking students participated in this study. All of the students were Latino. All students were mandatory bilinguals, meaning they were required by school policy to learn English in school but spoke Spanish at home; 47% of the students were girls, 53% were boys. Average age of the students was 6.5 years. For the 53 families who completed a family survey, there were no statistically significant differences between the English-only school and the bilingual school in families' reported income, $F(1, 53) = .160$, $p = .69$, or parent education levels, $F(1, 51) = 1.65$, $p = .20$. The average reported income for both schools was $19,000. The average parent education level for both schools was ninth grade.

Research Sites

Data were gathered in seven first-grade classrooms at two elementary schools in two different public school districts in Southern California. The selected schools in each district provided distinct programs but similar demographics. School 1 provided a program of English-only (EO) instruction, whereas School 2 provided a bilingual instruction program. Students at the bilingual site received Spanish instruction for 70% of their day through third grade, at which time they transitioned to English instruction. The EO site offered English instruction exclusively. Students were not placed following any school assessment of language ability or reading skills. All students at the bilingual site were asked to sign a waiver, as required by the state of California, for participation in bilingual education. Of the five teachers in the EO school, two spoke Spanish. All of the English-only classes had extra instructional support from a bilingual instructional assistant for an average of 2 hours per day. Teaching experience ranged from 3 to 27 years, with an average of 9½ years. Despite their distinctly different programs, the demographic profiles for each school were very similar. Both schools were primarily composed of Latino students (EO, 94.3%; bilingual, 97.4%), and the majority of students received free and reduced lunch (EO, 97.4%; bilingual, 90.7%). Both schools qualified for Title 1 services and received the lowest state academic performance ranking of 1. The bilingual site had slightly more Spanish-speaking students (EO, 59%; bilingual, 74.6%)

Constructs and Measures

Phonological Awareness. Four subtests were used to measure the construct of phonological awareness; each subtest consisted of an English version and a Spanish version. For this study, the tasks were chosen to measure the multiple dimensions of phonological awareness. Two 20-item tasks developed by Project La Patera measured onset and rime, respectively. In the rime task, assessors presented students with three pictures, asking them to identify which of two pictures rhymed with the stimulus picture. The onset task followed the same procedures but asked students which of two pictures began with the same sound as the stimulus picture.

Two additional 20-item tasks, segmentation and blending, were used to measure skills theorized to be later developing skills. Project La Patera developed both English and Spanish segmentation tasks and Spanish blending (Jiménez, Leafstedt, & Gerber, 2002). The English blending task was taken from the *Comprehensive Test of Phonological Processing* (CTOPP; Wagner, Torgesen, & Rashotte, 1999). The segmentation task required students to separate and say a word in individual phonemes, progressing from 2-phoneme to 4-phoneme words. The blending task required students to say a series of individual sounds together to make a word. In both the Spanish and the English version of the subtest, students heard a word that was broken into syllables or phonemes on a tape recorder; the students were then required to blend the sounds they heard to say a word.

Phonological Coding. An 18-item nonword repetition subtest with Spanish and English versions was used to measure phonological coding. The English version of the nonword repetition task came from the CTOPP (Wagner et al., 1999). The Spanish version was developed by Project La Patera (Jiménez et al., 2002). In each version of this subtest, items consist of nonwords that can be pronounced as English or Spanish words, respectively. After hearing each nonword on a tape recorder, students were required to repeat it.

Phonological Recoding. Rapid object naming (RON) was used to measure phonological recoding. This subtest measured the speed with which students named a series of objects. The tasks were administered in both English and Spanish. The English version came from and followed procedures in the CTOPP. Following Swanson, Saez, Gerber, and Leafstedt (2004), we used a direct translation to Spanish of the English subtest. Each task was conducted twice, and the final score was the average.

Decoding. Measures of real-word reading and pseudoword decoding were used as dependent measures. Pseudoword decoding was included to ensure a measurement of the students' decoding ability that would be less influenced by vocabulary than would their performance on a real-word reading task. The English tasks are the *Woodcock-Johnson–III* (2000) Letter–Word Identification (WI) subtest and the Word Attack (WA) subtest. The Spanish version of these subtests was from the *Woodcock-Munoz Bateria–R* (1996).

Vocabulary Knowledge. The construct of vocabulary knowledge was measured with the *Peabody Picture Vocabulary Test, Third Edition* (PPVT3; Dunn & Dunn, 1997).

Procedure

A team of trained assessors assisted in performing assessments as part of the larger research project. Assessors were undergraduate and graduate students who were fluently bilingual and were both trained and monitored by the researchers. All assessments were conducted on the respective school sites. Each student was assessed during three 20-min sessions conducted over a long month. Order of subtest and language of subtest were randomized for all phonological assessments. Each assessor first determined the student's dominant language. If the dominant language was unclear, assessors gave directions in both English and Spanish.

Design

In this study, a quasi-experimental group contrast design was employed with elementary school students from intact classrooms. Classrooms varied in the language of instruction (English and Spanish), and we varied the language of testing (English and Spanish) for each student. This design allows for the detection of differences in performance due to interactions of language of testing with the language of instruction. Students' performances on each task should be similar, regardless of the language of instruction or testing, if the tasks tap core individual differences in phonological abilities.

Results

Descriptive Statistics

The descriptive statistics are provided in Table 1. Significant differences were found between the EO instruction group and the bilingual instruction group on four phonological processing tasks: English segmentation ($p = .030$), English blending ($p = .014$), Spanish blending ($p = .001$), and Spanish RON ($p = .000$). Significant differences were also found between language-of-instruction groups on all of the decoding tasks:

TABLE 1. Descriptive Statistics for All Students, English-Only Instruction, and Bilingual Instruction Groups

	All students			English-only instruction			Bilingual instruction			
Measure	*n*	*M*	*SD*	*n*	*M*	*SD*	*n*	*M*	*SD*	*p*
Spanish rime	89	17.68	2.74	56	17.44	2.82	33	18.09	2.60	.287
English rime	89	16.38	3.08	56	16.63	3.05	33	15.79	3.10	.323
Spanish onset	89	14.38	3.09	56	14.05	2.88	33	15.24	3.32	.200
English onset	89	15.54	3.19	56	15.70	3.17	33	14.97	3.22	.537
English segmentation	89	12.08	5.14	56	12.98	4.40	33	10.55	5.96	.030
Spanish segmentation	89	12.48	5.34	56	12.34	4.32	33	12.73	6.80	.743
English blending	89	7.86	3.13	56	8.49	2.94	33	6.82	3.20	.014
Spanish blending	89	9.72	3.66	56	8.73	3.07	33	11.40	4.00	.001
Spanish nonword repetition	89	12.07	2.80	56	11.91	2.72	33	12.40	2.94	.493
English nonword repetition	89	9.51	2.94	56	9.88	2.79	33	8.88	3.12	.123
Spanish RON	76	77.32	37.02	43	96.18	38.69	33	52.74	12.13	.000
English RON	76	64.30	26.86	54	67.57	30.02	22	56.27	14.43	.096
English real-word decoding	89	21.79	8.43	56	25.34	5.38	33	15.76	9.27	.000
English pseudoword decoding	89	9.06	5.27	56	10.27	5.18	33	7.33	4.97	.004
Spanish real-word decoding	84	19.62	14.87	51	11.37	8.49	33	32.36	13.60	.000
Spanish pseudoword decoding	84	9.61	8.32	51	6.25	5.96	33	14.79	8.87	.000
English vocabulary	83	8.57	7.26	50	11.52	7.68	33	4.10	3.27	.000

Note. *p* values represent a comparison between english and bilingual instruction. RON = rapid object naming.

English real word (p = .004), English pseudoword (p = .004), Spanish real word (p = .000), and Spanish pseudoword (p = .00); and English vocabulary (p = .000)

The correlations between phonological processing tasks are presented in Table 2. The correlations show a consistent pattern across languages. Both Spanish and English versions of each subtest are significantly correlated (r = .582–.748), except blending (r = .199). Furthermore, rime, onset, and segmentation are significantly correlated with each other, both within and across languages, with the exception of the correlation between Spanish rime and English segmentation. Blending did not correlate across languages. Moreover, blending in both languages correlated with segmentation in both languages. Spanish blending also correlated with Spanish onset. The Spanish and English versions of nonword repetition were significantly correlated across languages. Spanish nonword repetition was also significantly correlated with English segmentation, Spanish segmentation and Spanish blending English nonword repetition was significantly correlated with English segmentation and English blending. RON was also significantly correlated across Spanish and English versions. Spanish RON negatively correlated with Spanish blending. RON did not significantly correlate with any other measures.

Relationship Between Phonological Processes Across English and Spanish

The phonological processing measures were composed of six subtests: rime, onset, segmentation, blending, nonword repetition, and RON. Each subtest consisted of a Spanish and an English version. A principal components analysis examined whether measures hypothesized to tap three theoretical components of phonological processing (phonological awareness, phonological coding, and phonological recoding) factored similarly across languages. Four orthogonal factors were extracted, each composed of parallel English and Spanish measures.

From a developmental perspective, rime and onset emerge earlier than segmentation and bending. Therefore, the first factor, *early phonological awareness,* is composed of rime and onset in both languages (r = .692–.828). The second factor, *late phonological awareness,* consisted of segmentation and blending in both languages (r = .613–.797). The third factor, *phonological coding*, consisted of nonword repetition in both languages (r = .713–.728). The last factor, *phonological recoding*, was composed of RON in both languages (r = .697–.784).

Predictive Relationship Between Phonological Processes and Decoding

Does the language of instruction influence the relationship between phonological processes and decoding? Do the three phonological processing components all affect students' reading ability in their first language and their second language?

In response to these questions, a series of multiple regression analyses was performed to examine the relationship between phonological processing and decoding. Factor scores for each phonological component extracted in the previous analysis were used as independent variables. That is, factor

TABLE 2. Intercorrelations Between Phonological Process Tasks in English and Spanish

Subtest	1	2	3	4	5	6	7	8	9	10	11	12
1. Spanish rime	–	.615**	.388**	.544**	.178	.270*	.114	.144	.035	–.003	–.097	–.016
2. English rime		–	.491**	.511**	.258*	.225*	.143	.088	.182	.170	.041	–.199
3. Spanish onset			–	.582**	.315**	.354**	.185	.246*	.102	.165	–.175	–.106
4. English onset				–	.268*	.347**	.315**	.204	–.033	.064	–.083	–.064
5. English segmentation					–	.748**	.384**	.296**	.291**	.331**	.081	–.119
6. Spanish segmentation						–	.400**	.401**	.280**	.206	–.093	–.144
7. English blending							–	.199	.245*	.237*	.079	.043
8. Spanish blending								–	.126	–.127	–.267*	–.089
9. Spanish nonword repetition									–	.331**	.008	–.138
10. English nonword repetition										–	.107	.096
11. Spanish RON											–	.253*
12. English RON												–

Note. RON = rapid object naming.
*p < .05, 2-tailed. **p < .01, 2-tailed.

scores were calculated for early phonological awareness, late phonological awareness, phonological coding, and phonological recoding. The hypothesis stated that contextual variables influence performance. Therefore, two exogenous variables representing learning history and current exposure to instruction were included in the multiple regression analysis. Measures of English vocabulary (PPVT3), representing previous exposure to English, and language of instruction, representing current instruction, were entered as exogenous independent variables. Each regression analysis was conducted in two stages. PPVT3 and a dummy code for language of instruction were entered at Stage 1 to control for differences related to previous English vocabulary knowledge and classroom differences (i.e., language of instruction), respectively. The independent variables representing phonological processing differences were entered at a second stage using a stepwise method. The dependent variables were the two decoding measures, real-word and pseudoword decoding, in both English and Spanish. In the following sections, the results from the investigation of the effects of language of instruction on decoding and the relationship between phonological processes and decoding across the two languages are presented.

Effects of Previous Language Exposure and Language of Instruction

Does the language of instruction influence the relationship between phonological processes and decoding? As can be seen in Tables 3 and 4, PPVT3 was not a statistically significant predictor of decoding in either English or Spanish.

After accounting for PPVT3, the dummy code for language of instruction was entered and was reliably related to the three measures of decoding. As shown in Tables 3 and 4, the language of instruction was a significant predictor of Spanish real-word reading, $\beta = .806$, $t = 9.63$, $p = .00$, $\Delta R^2 = .41$, Spanish pseudoword decoding, $\beta = .27$, $t = 5.67$, $p = .00$, $\Delta R^2 = .23$, and English real-word reading, $\beta = -.421$, $t = -.421$, $p = .00$, $\Delta R^2 = .16$. However, language of instruction was *not* a significant predictor for English pseudoword decoding, $\beta = .08$, $t = -1.189$, $p = .26$, $\Delta R^2 = .02$.

Phonological Processing and Decoding

What is the cross-language relationship between phonological processes and decoding as represented by English and Spanish measures? After accounting for PPVT3 and language of instruction in the previous analysis, phonological processes still accounted for significant variance in Spanish and English decoding (see Tables 3 and 4). Specifically, measures of both early and late phonological awareness significantly predicted measures of decoding in both languages. Late phonological awareness was the strongest predictor for all measures of decoding. Late phonological awareness accounted for 18.7% of the explained variance in Spanish real-word reading, $\beta = .460$, $t = 6.30$, $p < .01$; 11.3% of the explained variance in Spanish pseudoword decoding, $\beta = .348$, $t = 3.65$, $p < .01$; 12.6% of the explained variance in English real-word reading, $\beta = .396$, $t = 4.11$, $p < .01$; and 15.1% of the explained variance in English pseudoword decoding, $\beta = .328$, $t = 2.88$, $p > .01$.

Early phonological awareness was the second significant predictor for all four decoding tasks. Early phonological awareness accounted for 4.2% of the explained variance in Spanish real-word reading, $\beta = .222$, $t = 2.87$, $p < .01$; 11.8% of the explained variance in Spanish pseudoword decoding, $\beta = .372$, $t = 3.71$, $p < .01$; 11.7% of the explained variance in English real-word reading, $\beta = .117$, $t = 3.63$, $p < .01$; and

TABLE 3. Summary of Multiple Regression Analysis for Variables Predicting Spanish Real-Word and Spanish Pseudoword Decoding Scores

Test/Variable	R^2	*df*	ΔR^2	β	ΔF	*t*
Spanish real-word decoding	.704	1,54				
PPVT				.064		.718
Language of instruction			.495	.806	27.49***	9.63***
Late PA			.187	.460	32.50***	6.30***
Early PA			.042	.222	8.25***	2.87*
Spanish pseudoword decoding	.504	1,53				
PPVT				–.037		–.319*
Language of instruction			.273	.620	10.49***	5.67**
Late PA			.113	.348	10.12***	3.65***
Early PA			.118	.372	12.78**	3.71***
PC			.044	.215	5.09*	2.25*

Note. PPVT = *Peabody Picture Vocabulary Test,* 3rd edition (Dunn & Dunn, 1997); PA = phonological awareness; PC = phonological coding.
*$p < .05$. ***$p < .001$.

TABLE 4. Summary of Multiple Regression Analysis for Variables Predicting English Real-Word and English Pseudoword Reading Scores

Test/Variable	R^2	*df*	ΔR^2	β	ΔF	*t*
English real-word decoding	.457	1,57				
PPVT				.003		.003
Language of instruction			.249	−.421	9.81***	−.421***
Late PA			.126	.396	11.70***	4.11***
Early PA			.117	.372	13.18***	3.63***
English pseudoword decoding	.241	1,57				
PPVT				.121		.887
Language of instruction			.078	−.153	3.56*	−1.189
Late PA			.151	.328	6.11***	2.881***
Early PA			.241	.339	7.84***	2.801***

Note. PPVT = *Peabody Picture Vocabulary Test,* 3rd edition (Dunn & Dunn, 1997); PA = phonological awareness; PC = phonological coding.
*$p < .05$. ***$p < .001$.

24.1% of the explained variance in English pseudoword decoding, β = .339, $t = 2.80$, $p < .01$. Phonological coding was only a significant predictor for Spanish pseudoword decoding, β = .215, $t = 2.25$, $p = .028$, accounting for less than 5% of the explained variance. Phonological recoding did not account for any variance in decoding in either language.

Because of the finding that phonological coding was a significant predictor of only one measure of decoding (Spanish pseudoword decoding) and that it accounted for less than 5% of the explained variance, the results were examined further. We examined the school groups separately to examine potential differences in how phonological coding influenced decoding. Specifically, a multiple regression analysis with Spanish pseudoword decoding as the dependent variable with the same independent variables as previously described was conducted. Phonological coding was not a significant predictor of Spanish pseudoword decoding within either language-of-instruction group.

Discussion

This study was designed to investigate the kinds of cognitive resources related to L1 competencies that are available to ELs cross-linguistically. The specific purpose of this study was to examine how individual differences in L1 cognitive processes influence the development of decoding skills in L2 for students who are not yet literate in L1. By focusing on phonological processes across languages and across instructional programs that differed in instructional language, this study was designed to determine if all components of phonological processing are cross-linguistic skills that relate to decoding across languages and if L2 reading instruction influences phonological processing.

Cross-Linguistic Transfer

The first question examined whether phonological processes exhibit cross-linguistic transfer. The concept of cross-linguistic transfer for phonological processes is based on the theory of CUP. The CUP theory states that skills learned in one language have components that cross over to later learned languages. The evidence from this study indicates that phonological processes are cross-linguistic processes. The fact that similar tasks in both languages were extracted in a principal components analysis can be interpreted to show that phonological awareness, phonological coding, and phonological recoding are common underlying proficiencies, indicating that measurement in L1 provides information regarding performance in L2.

The present analysis replicates and extends the existing evidence for cross-linguistic transfer of phonological awareness by looking at the direct relationship between phonological awareness in different languages (Cisero & Royer, 1995; Durgunoglu et al., 1993). This analysis provided insight into the developmental nature of phonological awareness. The results of the principal components analysis are interpreted as evidence for phonological awareness as a multidimensional construct composed of interrelated developmental components. Consistent with past research, measures of phonological awareness did not load together as a single component (Gerber et al., 2000, 2002; Muter, Hulme, Snowling, & Taylor, 1998; Wagner & Torgesen, 1993; Yopp, 1988). Rime and onset loaded together as a component, and segmentation and blending loaded together as another component. Furthermore, consistent with the literature, rime and onset were easier for students than segmentation and blending. Therefore, the rime and onset component was named early phonological awareness, whereas the segmentation and blending component was labeled late phonological awareness. The correla-

tions between performance on the tasks that compose early and late phonological awareness (rime, onset, segmentation, and blending) were significant, providing evidence for the interrelatedness of the constructs.

Developmental explanations of these findings explain the qualitative changes in the operations needed to do the tasks. These qualitative changes can result in increased overall accuracy and less variation in types of errors or speed of operation. That is, the operations do not change, but students become more reliable and efficient in their performance. Moreover, because there may be a series of information-processing operations at work to do these tasks, it may be that they are strengthened relative to one another in a specific order. This seems to be the case because in this and previous research, we have seen higher scores on rime than onset and onset than segmentation (Christensen, 1997).

Findings on the cross-linguistic transfer of phonological processing abilities other than phonological awareness were less clear. For example, it has proved difficult to tease apart the relative importance of L1 versus L2 on phonological recoding as measured by performance on a rapid naming task. These difficulties were especially acute because the students in our sample were not clearly bilingual. Because these students had not acquired the needed vocabulary to perform on a rapid naming task in L2 (and to some extent in L1), interpretations of the results are problematic.

Influence of Language of Instruction

At this time, no research has been conducted that examines how the language of instruction influences phonological development in preparation for early word reading. This study aimed to clarify if the language of instruction influenced the relationship between phonological processes and decoding. If the language in which a student is instructed influences phonological skill development, it is expected that the language of instruction would significantly influence decoding abilities in both English and Spanish. With the intent of learning how two different languages of instruction influence students' phonological decoding skills, we examined pseudoword decoding. Pseudoword decoding is a reliable measure of phonological decoding because the students are not able to depend on their vocabulary knowledge to read the word. The examination of pseudoword decoding and language of instruction suggests that the language in which a student is instructed has very little influence on the phonological aspects of learning to decode.

First, neither English nor bilingual instruction was a significant predictor for measures of English pseudoword decoding (WA). Therefore, we concluded that students instructed in English do not have a significant advantage in decoding English pseudowords as compared to their peers who are instructed bilingually. Although they do better in English real-word reading, Spanish-speaking students instructed in English do not appear to be developing phonological processes to help them decode pseudowords as rapidly as their bilingually instructed peers. Further evidence for this conclusion comes from the findings related to Spanish pseudoword decoding. Language of instruction was a significant predictor for Spanish pseudoword decoding. This indicates that when Spanish-speaking students are instructed bilingually, phonological processes influence their ability to decode Spanish pseudowords. This finding, along with the finding that bilingually instructed students performed significantly better than students instructed in English on measures of Spanish decoding, allows the conclusion that Spanish L1 reading instruction was more effective at developing phonological processes related to decoding for Spanish-speaking students.

Predictive Relationship of Phonological Processes and Decoding Across Languages

This study aimed to clarify if, when measured at the same time, all three of the phonological processing components (phonological awareness, phonological coding, and phonological recoding) are independently predictive of decoding for Spanish and English for mandatory bilinguals.

Phonological Awareness. The analysis indicated that of the three components of phonological processing, only phonological awareness influenced both Spanish and English decoding. Measures of early (onset/rime) and late (segmentation/blending) phonological awareness were significant predictors of all measures of reading (real word and pseudoword) in English and Spanish. This finding supports the hypothesis that phonological awareness is influential in the relationship between phonological processes and decoding. The present findings indicated that phonological coding and phonological recoding are not predictive of word decoding when simultaneously considering phonological awareness, the only exception being that phonological coding was predictive of Spanish pseudoword decoding.

Not only were measures of phonological awareness the only consistent predictor of word reading in both languages, but both components extracted in the principal components analysis (early and late phonological awareness) were significantly predictive of Spanish and English word reading. Elsewhere in the literature, the relationships between the individual components of phonological awareness and reading are less consistent. Some research has isolated segmentation (part of late phonological awareness) as the best predictor of word reading (Muter et al., 1998), whereas others claim that the multiple components of phonological awareness are the best indicators of word reading (Wagner & Torgesen, 1993). The present finding regarding the positive relationship between early and late phonological awareness and word reading extends the evidence that the multiple components rather than a single component of phonological awareness are predictive of decoding. We believe that the

contradiction in the literature regarding how the various components of phonological awareness relate to decoding may be due to the developmental nature of phonological awareness. Longitudinal investigations of phonological awareness in relation to decoding over time are beginning to show that early performance (rime and onset) is predictive of decoding in the early years. However, measures of rime and onset lose their predictive ability as students reach a ceiling in first grade (Gerber et al., 2002).

Phonological Coding. Although phonological awareness was the only consistent predictor of decoding across the two languages, measures of phonological coding significantly predicted Spanish pseudoword decoding. This finding contradicts the expectation that phonological coding would not account for variance in decoding once phonological awareness was taken into account. On the contrary, this finding supports claims that phonological coding independently predicts word decoding (Cormier & Dea, 1997; Gottardo, Stanovich, & Siegel, 1996). If phonological coding constitutes a fundamental phonological processing ability, it should either influence decoding in both languages or in neither language. To investigate this unexpected finding, we examined both language-of-instruction groups separately. When analyzed separately, the phonological coding effect disappears. This leads to the conclusion that the original finding is a statistical artifact.

Phonological Recoding. Unlike phonological awareness or phonological coding, phonological recoding did not account for any variance in decoding across any of the four word reading tasks. These findings are aligned with previous research reporting that explained variance in decoding is shared between phonological recoding and phonological awareness (Schatschneider, Carlson, Francis, Foorman, & Fletcher, 2002). Despite the relative strength of these findings, they must be interpreted carefully. The use of RON is a weakness in the study. RON was the only rapid naming task for which the mandatory bilingual students had the necessary vocabulary to complete the task. Unlike the other rapid naming tasks, RON is a relatively weak predictor of decoding (Semrud-Clikeman, Guy, Griffin, & Hynd, 2000).

In summary, the present study has provided three findings. First, phonological processes are common underlying proficiencies that exhibit cross-linguistic transfer. This implies that once a student has strong phonological processing abilities, they will be available regardless of the language that student is speaking. Second, this study provides evidence that phonological awareness is a developmental process composed of two unique but related constructs, early and late phonological awareness. Third, the examination of the language of instruction provided initial support for the development of phonological awareness in L1 prior to reading instruction in L2.

Limitations

One of the limitations of this study lies in the possible sampling bias associated with students chosen to participate in this study. The students were not randomly sampled from the general population; they were chosen for inclusion in the study due to their ongoing participation in existing programs within their schools. However, because all students who attended the school with the EO program received EO instruction and all students who attended the school with the bilingual program received bilingual instruction, the sampling bias was significantly reduced. Furthermore, parents were not given an option of programs if they wanted their child to stay at their neighborhood school, and the students were not placed in programs due to their language or reading ability. In an attempt to further reduce sampling bias, the two schools were selected for similar demographic variables. There may be implicit differences between communities that are not apparent in the reported demographics. For example, through informal conversations with teachers, one of the schools was revealed to be located in a high-crime neighborhood. These variables may also be confounds in the study.

In addition to program placement, there is a possible bias associated with classroom-level sampling; the classrooms selected were intact classrooms. Using intact classrooms represents possible instructional differences that may not be related to the language of instruction. Teachers' style of teaching may vary between the two schools and be a factor in the relationship between language of instruction, phonological processes, and decoding. For example, the amount of English and Spanish that students are exposed to during the school day could vary greatly. Within the classroom, it was observed through informal observations that two of the teachers in the EO program spoke Spanish with the students, whereas other teachers could not or chose not to speak Spanish with the children. Likewise, it is possible that the bilingual program teachers varied in the amount of English they used with the students throughout the year. However, this does not influence the fact that the goal of the bilingual program was to teach students to read in Spanish whereas the EO program goal was to teach students to read in English.

Educational Implications

These preliminary findings have implications for the on-going English-only versus bilingual education debate. At the very least, these results imply that no model of instruction can be expected to be universally optimal for any given EL. Teachers need to be aware of differences among ELs. These individual differences can be identified by simple assessments and taught regardless of the language of instruction to make a difference in the students' ability to learn to read. Those students failing to make progress in reading English words despite instruction in English might benefit from direct, intensive instruction in Spanish phonological skills. This study shows that English reading instruction for first-grade

Spanish-speaking students may not necessarily improve their phonological skills in English better than reading instruction in Spanish. Therefore, EO instruction provided to EL students should be reexamined to evaluate what is being instructed and how it is instructed. One step would be to open the door for research-based Spanish interventions. ■

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