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EDUCATIONAL PSYCHOLOGY & COUNSELLING | RESEARCH ARTICLE

"One glove does not fit all" in bilingual reading acquisition: Using the age of first bilingual language exposure to understand optimal contexts for reading success

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Abstract: In teaching reading, educators strive to find the balance between a code-emphasis approach and a meaning-oriented literacy approach. However, little is known about how different approaches to literacy can benefit bilingual children's early reading acquisition. To investigate the novel hypothesis that children's age of first bilingual exposure can interact with different approaches to literacy, we tested 56 Spanish-English bilingual children (ages 7–9), with birth exposure to Spanish and either early (before age 3) or late (3–4) age of first bilingual exposure to English. The children attended reading programs identified with either phonics or whole language emphasis. Consistent with our hypothesis, differential outcomes were linked to different ages of first bilingual exposure. Early bilingual exposure to English was associated with more advanced reading abilities under whole language emphasis, while later (ages 3–4) exposure was associated with better decoding and reading abilities under phonics emphasis. The findings show that knowing the age

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Our projects investigate how bilingual children can successfully achieve dual language and reading mastery, and how bilingualism impacts the brain. Previously, we have found that early and simultaneous bilingual instruction is better than either delayed bilingual or monolingual instruction. Here, we show that knowing the age of first bilingual exposure can help guide educator's choice in building better reading instruction for bilingual students.

PUBLIC INTEREST STATEMENT

Literacy instructors face the challenge of offering children the "right" balance between targeted reading instruction in the orthographic and sound correspondence rules of language and exposure to whole words and their meanings. In the US, these approaches are termed "phonics" and "whole-language," respectively. Ideally, what is the right balance? We tested bilingual Spanish-English children (grades 2–3, $N = 56$) with different ages of first bilingual exposure to English (before/after age 3) to explore the hypothesis that knowing the age of first bilingual language exposure can guide the right balance in reading instruction for bilinguals. Key findings: children with different ages of bilingual exposure are in different phases of language acquisition. Children focused on mastering words and sounds benefit from phonics; children focused on mastering complex meanings and sentence rules benefit from whole-language. Thus, knowing the age of first bilingual exposure can help guide reading instruction for bilingual learners.

of a child's first bilingual language exposure, as it corresponds to different periods in child development, may contribute to an educator's design of reading instruction that best accommodates young bilingual learners.

Subjects: Behavioral Sciences; Development Studies; Education; Educational Psychology and Bilingualism / ESL

Keywords: children; bilingualism; reading acquisition; reading instruction

1. Introduction

One of the persistent puzzles in reading acquisition is the question of how language experience and reading instruction interact to support a child's reading acquisition. Language acquisition research suggests that *different types of language exposure* (e.g. bilingual versus monolingual) may have a profound and lifelong impact on children's language and cognitive processes (Kroll & Bialystok, 2013), reading acquisition (Kovelman, Baker, & Petitto, 2008a), and language organization in the brain (Kovelman, Baker, & Petitto, 2008b; Petitto et al., 2012). In parallel, reading acquisition research has shown that *different types of reading approaches* may have different outcomes on children's learning to read (e.g. Berens, Kovelman, & Petitto, 2013; Dickinson & Neuman, 2007), as well as their neural adaptation and reorganization of the brain's networks that support fluent reading processes (Jasinska & Petitto, 2013; Kovelman et al., 2008b). How then might the age of bilingual language acquisition interact with different types of reading approaches?

1.1. Age of bilingual exposure and language acquisition

Reading is a complex process involving multiple levels of language processing (phonological, morphological, semantic, syntactic, etc.; Pugh & McCardle, 2009). There is a general understanding that both phonological competence and phonological awareness constitute the foundation of reading acquisition (Kovelman et al., 2012b; Kovelman, Christodoulou, & Gabrieli, 2012a; Pugh & McCardle, 2009). Infant studies have shown that phonological development begins within the first moments of birth (Baker, Golinkoff, & Petitto, 2006; Petitto, 2005, 2009), though it takes a child several years to achieve full mastery of the language sound system (Gervain & Mehler, 2010). Bilingual infants with extensive and systematic exposure to two languages from birth learn the sounds in each of their two languages on roughly the same timescale as their monolingual counterparts (Petitto et al., 2001, 2012). Moreover, those with early bilingualism (~ before the age of 3) have been found to possess better phonological sensitivity (Petitto et al., 2012) and better phonological awareness than their monolingual peers (Kovelman et al., 2008a).

Yet, research has also found that children who receive exposure to their new language between the ages of 3–4 are behind their monolingual peers in phonological awareness and reading ability (Berens et al., 2013; Jasinska & Petitto, 2013; Kovelman et al., 2008a). This finding has been supported by adult bilingual research, which suggests that adult bilinguals who learned their new language after age 3 show a decline in the ultimate levels of phonological and morphosyntactic competence (Kovelman, et al., 2008b), and show a non-native pattern of language processing in the brain (after age 3: Jasinska & Petitto, 2013; Kovelman et al., 2008b). Thus, children with new language exposure between the ages of 3–4 might be in a developmentally "vulnerable" zone for ultimate language and, potentially, reading and literacy attainment. Nevertheless, preschool years are characterized by rapidly advancing learning abilities and great neurological change—change that can be influenced by educational factors (Diamond, 2011). This positive impact is especially critical for the development of young children from immigrant and, oftentimes, low socioeconomic status (SES) communities (Hackman & Farah, 2009). What approaches to reading would be better suited for children in the developmental "risk" zone, such that they may still achieve their ultimate learning potential?

1.2. Age of bilingual exposure and reading acquisition

Although the "reading wars" phenomenon is more specific to the United States, educational practitioners across the globe are concerned with the issue of achieving balance between targeting instruction in the rules of language-to-orthography mapping and encouraging richer literacy-based

text explorations. Such discussions can be found in publications by Burnham, Luksaneeyanawin, Kantamphan, and Reid (2013), Chou, Wang, and Ching (2012), Connor et al. (2011), and Seidenberg (2013).

Briefly, the whole-language approach is accomplished through immersion in print-rich and language-rich environments (Reutzel & Cooter, 2013). Using this approach, children are asked to identify (or read) a word based on pictures, the meaning of the text, or the first letter of the word. Here, little overt direct guidance is given to the child regarding the complex rules of sound-to-letter correspondence in the given language. Reading books of interest are assumed to lead to fluent reading and text comprehension, and again, less attention is given to overt instruction in the rules of sound-to-letter correspondences.

In the phonics approach, young children learn the rules about the way words are written and spelled and are explicitly taught spelling–sound relationships. Using the phonics approach, children apply this knowledge in "sounding-out" each word they encounter, with the assumption that comprehension will follow. While research has shown that both methods are effective, introduction to phonics in early grades frequently yields better outcomes for "at risk" populations, including children with low levels of school readiness and/or low socioeconomic status (e.g. McGee, 2004), or children at risk for dyslexia (Juel & Minden-Cupp, 2000). Although the "reading wars" phenomenon is specific to the US, education researchers in other countries and cultures often consider similar dilemmas of choosing the ideal balance between targeted instructions in the rules of language-to-orthography mapping versus richer exploration of text, and therefore, such discussions have been found across multiple types of reading acquisition phenomena: monolingual, bilingual, and second-language reading instruction (Burnham et al., 2013; Chou et al., 2012).

Researchers commonly advocate a "balanced" approach that might combine the best of two worlds, but what is that balance (Connor et al., 2011; Seidenberg, 2013), especially for young bilingual learners? Particularly, at the theoretical level, a bilingual child could be considered an "*at risk learner*" or "*disadvantaged*" young reader because they must decide how their two languages relate to two distinct orthographic systems (This is in contrast to the young monolingual child, who only needs to resolve this dilemma for one language.). Phonics instruction has previously been shown as critical for children at risk for reading impairments and dyslexia; might it then also be best for a bilingual learner?

Alternatively, a bilingual child might be an *advantaged learner* because knowing how to adjudicate between two languages at an early age might better prepare the child for the challenges of transferring from two languages in speech to reading in two languages (Kovelman, et al., 2008a). Thus, a bilingual learner might be well prepared for an arguably more challenging whole-language method, which requires the child to independently and intuitively arrive at some of the rules of literacy.

Importantly, children with different ages of bilingual exposure might be at different levels of dual language acquisition, with some children potentially needing more focus on the basics of how sounds, words, and their combinatorial rules come together in their two languages (*phonics*), while others are ready to analyze a more complex and enriched linguistic context (*whole-language*). Thus, the type of reading approach that is best for any given bilingual child may interact with the child's age of first bilingual language exposure.

1.3. Present study

In the present study, we explore how the *age of first bilingual language exposure* (exposure at ages 0–5) interacts with *the phonics* versus *whole-language approaches to learning to read*, with a unique focus on the degree to which each of these approaches may be *predictive* of the young bilingual child's concomitant reading success. We investigate young Spanish-English bilinguals (grades 2–3, ages 7–9) raised in the United States, who are native speakers of Spanish, and who were first exposed

to English either at ages 0–2 or 3–4 years. The children attended Spanish-English bilingual elementary schools, all of which held *constant* the bilingual language approach (specifically, 50% of instruction in each language starting in kindergarten), but which *differed* based on the approach to reading employed with their young bilingual pupils (phonics or whole-language). The study thus highlights the impact of the age of dual language experience on reading outcomes and success, and it hopes to shed new light on the learning mechanisms by which bilinguals achieve optimal reading mastery in each of their two languages.

2. Method

2.1. Participants

Spanish-English bilingual children in grades 2–3 and between the ages of 7–9 years (N = 56, 26 girls and 30 boys) participated in the study. All bilinguals were exposed to Spanish at birth, and to English either at ages 0–2 years (phonics n = 14; whole-language n = 9), or ages 3–4 years (phonics n = 17; whole-language n = 16). All bilinguals included in the study were attending their respective dual-language instruction schools beginning in kindergarten.

2.1.1. Bilingual instruction: Phonics reading instruction

The phonics type of instruction the bilingual school implemented was "Success for All" (SFA), a method of teaching elementary school children to read in both languages. The SFA program focuses on phonemic awareness, phonics comprehension, and vocabulary development beginning with phonetically controlled mini books for children ages 5–7 years old (Slavin, 1996). All participants from this school were receiving free or reduced lunch. *Whole-language reading instruction.* The whole-language type of instruction implemented in bilingual schools used the basal reading program in each language. Basal reading programs focus heavily on reading connected text. The stories were organized from least to most difficult reading levels. Eighty-nine percent of all participants from this school were receiving either free or reduced lunch. English and Spanish language instruction approaches were identical within each school.

2.1.2. Learning to read in each of the two bilingual schools

Both schools offered daily Spanish-English reading instruction starting with kindergarten (50/50 for each language). The bilingual school that used the phonics approach applied the same methods to reading materials in each of the children's two languages, as did the bilingual school that used the whole-language approach. Nevertheless, it should be noted that the comparatively more direct sound-to-letter correspondences in Spanish may inadvertently introduce a child to the principles of phonics, even in a whole-language, "basal reader" instructional approach.

2.1.3. Age of first bilingual language exposure and dual-language competence and proficiency

The parents of all the participants filled out a previously published language background and use questionnaire (LBU, see Holowka, Brosseau-Lapré, & Petitto, 2002; Penhune, Cismaru, Dorsaint-Pierre, Petitto, & Zatorre, 2003; Petitto, et al., 2000; and Shalinsky, Kovelman, Berens, & Petitto, 2009 for more details on this extensive bilingual language questionnaire). Parents answered questions about the age and the context (home, daycare, school) their child was exposed to each of his or her languages and at what age their child first learned to use and to read in those languages. The parents also answered if, and in what language(s), they read with their child. For reliability, experimenters also conducted structured and videotaped interviews with children about their language and reading experiences at home and at school.

Participants across the four groups were matched on their English expressive language proficiency competence using the language competence/expressive proficiency (LCEP) task (for data collection and scoring procedures see Kovelman et al., 2008a). Bilingual language proficiency may affect reading proficiency, and therefore, it was important to ensure that the children's expressive language proficiency in English and in Spanish was matched across the four groups (independent sample t-tests were non-significant for all within language/across group comparisons, $p > 0.05$).

It is important to note that the participant sample may appear relatively small. Yet, in contrast to large-sample studies that may include entire populations of 2nd and 3rd graders, our sample was very carefully chosen to maximally answer the study's specific questions. The study's sample was drawn from a larger data-set of about 300 bilingual students, who varied greatly in ages of acquisition and the order of language acquisition (Spanish at home, English at school, or vice versa. Additional findings for these children are now published; see Berens et al., 2013 and Kovelman et al., 2008a). We arrived at the final sample through careful consideration of the children's background variables, such that the children were maximally matched for all variables except for our independent variables of age of English exposure and type of reading instruction.

2.2. Reading competence tasks in English and in Spanish

2.2.1. Phonological awareness tasks

Children completed two phoneme elision and one phoneme segmentation tasks in English and in Spanish. During the first phoneme elision task, children heard a word and then deleted the *first* sound of the word (e.g. "cat" without "k" is "at"; 10 test items (Honig, Diamond, & Nathan, 1999)). During the second phoneme elision task, children heard a word and then deleted the *last* sound of the word (e.g. "time" without "m" is "tie"; 10 test items (Honig et al., 1999)). During the phoneme segmentation task, children heard a word and then repeated the word back, articulating each phoneme separately (e.g. "dog" = /d/ - /o/-/g/ (Yopp, 1995)).

2.2.2. Decoding tasks

Children completed two decoding tasks in Spanish and in English: regular word and pseudoword reading decoding tasks (Woodcock, 1991). The goal of the regular word reading task was to assess the children's ability to read words with phonologically transparent and otherwise common sound-to-letter correspondence. The task consisted of 10 test items chosen on the basis of the Castles and Coltheart (1993), Honig et al. (1999), Woodcock Language Proficiency Battery–Revised (WLPB-R) (Woodcock, 1991) and Woodcock-Muñoz Language Survey (WMLS) (Woodcock & Muñoz-Sandoval, 1993) assessment tools standardized for English and for Spanish languages. The goal of the Pseudoword reading task, which was taken directly from WLPBR and WMLS (Woodcock, 1991; Woodcock & Muñoz-Sandoval, 1993), was to assess children's ability to apply sound-to-letter correspondence reading rules to unfamiliar/non-existent words; the task consisted of 30 items.

2.2.3. Reading tasks

Children completed two reading tasks in Spanish and in English: irregular word and passage comprehension tasks. The goal of the irregular word reading task was to assess the children's ability to read words with difficult sound-to-letter correspondence. The task consisted of 10 test items chosen on the basis of the Castles and Coltheart (1993), Honig et al. (1999), Woodcock Language Proficiency Battery–Revised (WLPB-R) (Woodcock, 1991) and Woodcock-Muñoz Language Survey (WMLS) (Woodcock & Muñoz-Sandoval, 1993) assessment tools standardized for English and for Spanish languages. The goal of the passage comprehension task, also taken directly from WLPB-R and WMLS (Woodcock, 1991; Woodcock & Muñoz-Sandoval, 1993), was to assess children's ability to understand text and consisted of "fill-in-the-blank" sentences.

Importantly, while the two tasks are entered separately into the MANOVA analyses (see results section below), the two tasks are treated as belonging to the same category, as both require English-specific language comprehension and orthographic familiarity skills. In Berens et al. (2013), our prior findings with the larger sample of these participants suggest that bilinguals receiving Spanish-dominant reading instruction outperformed bilinguals with balanced Spanish–English bilingual instruction on phonics, regular word and pseudoword reading tasks in English. In contrast, bilinguals with balanced bilingual instruction had better performance on English irregular and passage comprehension tasks, suggesting that these two measures tap into core English language knowledge and familiarity with English-specific patterns of orthography above and beyond phonics and basic decoding skills.

2.3. Procedure

Each student completed two 30-min videotaped testing sessions in each of their languages (one 30-min session in Spanish and one in English), administered by different testers, who were native speakers of either Spanish or English. The experimenter that administered the tasks did original scoring. Twenty-five percent of the data was scored by a different tester using the video recordings for the sake of reliability. There was a 95% inter-rater agreement; any differences in data scoring were discussed until an agreement was reached.

3. Results

The goal of the study was to explore the combined impact of children's age of first bilingual exposure and reading instruction on the foundational reading skills mastered in the early grades, including phonological awareness (ability to manipulate the sounds of language), reading decoding (ability to map language sounds onto letters), and reading comprehension (familiarity with phonologically non-transparent spellings and ability to understand connected text). Therefore, the analyses included six separate repeated-measures MANOVAs for each type of reading skill: three analyses for English and three analyses for Spanish. Children's performance results are listed in Table 1.

3.1. English literacy

3.1.1. Impact of instruction and age of exposure on English phonological awareness

A 2 × 2 × 3 MANOVA for reading instruction (phonics × whole-language), age of first bilingual exposure (ages 0–2 × 3–4), and phonological awareness tasks (initial phoneme deletion, final phoneme deletion, phoneme segmentation) revealed a significant main effect of reading instruction: children in the phonics program had better phonological awareness ability relative to children in whole-language instruction (F (1,52) = 20, $p < 0.001$; Table 1, Figure 1). There was also a significant task by instruction interaction (F (2,104) = 9.8, $p < 0.001$). Post-hoc comparison revealed that the group differences were most significant during the phoneme segmentation task ($t(54) = 26$, $p < 0.001$, Bonferoni-corrected) and not significant during the other two tasks ($p > 0.05$), most likely because children's performance during the elision task approached ceiling levels, while phoneme segmentation was more challenging (Table 1). There were no significant effects of age of exposure or interactions with the age of exposure ($p < 0.05$). In sum, during the phonological awareness tasks, children receiving phonics instruction outperformed children with whole-language instruction.

3.1.2. Impact of instruction and age of exposure on English decoding

A 2 × 2 × 2 MANOVA for reading instruction, age of first bilingual exposure, and decoding tasks (regular and pseudoword reading tasks) revealed a significant interaction between reading instruction and age of bilingual exposure (F (1,52) = 4.1, $p = 0.04$). There was also a main effect of reading instruction (F (1,52) = 5.5, $p = 0.02$). Post-hoc investigation into the interaction effects revealed that group differences were only significant for the later-exposed bilinguals (regular words: $t(31) = 3.0$ $p < 0.01$; pseudowords: $t(31) = 3.6$, $p < 0.01$, Bonferoni corrected), but not for the early-exposed bilinguals ($p > 0.05$). There were no other main effects or interactions ($p > 0.05$). In sum, during the decoding tasks, children with early bilingual exposure to English had similar performance across the two types of reading instruction, while for children with later bilingual exposure, those with phonics instruction had better decoding abilities.

3.1.3. Impact of instruction and age of exposure on English reading

A 2 × 2 × 2 MANOVA for reading instruction, age of first bilingual exposure, and reading tasks (irregular word and passage comprehension) revealed a significant interaction of reading instruction and the age of bilingual English exposure (F (1,52) = 5.4, $p = 0.02$). As can be seen in Figure 1, among the children with earliest bilingual exposure, those receiving whole-language instruction performed better than children with phonics instruction. In contrast, among the children with later bilingual exposure, those receiving phonics instruction performed better than children with whole-language instruction. Post-hoc comparisons did not reveal significant differences for either of the reading

tasks and there were no other main effects or interactions ($p > 0.05$). In sum, consistent with our hypothesis that types of reading instruction can have differential impact on children with varying ages of first bilingual exposure, the findings suggest that children with early bilingual exposure had better performance if they were receiving whole-language instruction, while the opposite was true for children with later bilingual exposure. The importance and implications of this finding is explored in the discussion.

Table 1. Participants' performance (mean and standard deviation (SD)) on reading and phonological awareness tasks

Language	Tasks	Phonics Mean (SD)		Whole-language Mean (SD)	
		0–2	3–4	0–2	3–4
		n = 14	*n* = 17	*n* = 9	*n* = 16
English phonology	Initial deletion	9.93 (0.3)	9.24 (2.4)	9.44 (0.8)	8.50 (1.5)
	Final deletion	8.79 (3.4)	9.29 (0.9)	8.00 (2.5)	7.44 (3.4)
	Phoneme segmentation	16.9 (3.4)	16.0 (3.8)	10.2 (7.5)	10.1 (7.4)
	Phonology average	11.9 (1.3)	11.5 (1.9)	9.2 (2.6)	8.7 (2.8)
English decoding	Regular words	9.29 (0.9)	9.59 (0.6)	9.00 (1.2)	8.31 (1.6)
	Pseudowords	14.9 (6.1)	15.5 (4.8)	14.6 (7.9)	8.88 (5.8)
	Decoding average	12.1 (3.2)	12.5 (2.4)	11.8 (4.3)	8.6 (3.5)
English reading	Irregular words	4.07 (3.7)	5.35 (2.3)	6.22 (2.4)	3.50 (2.5)
	Passage comprehension	11.7 (1.5)	11.1 (2.9)	12.7 (3.2)	9.19 (3.8)
	Reading average	7.9 (3.0)	8.2 (2.1)	9.4 (2.7)	6.3 (3.0)
Spanish phonology	Initial deletion	8.46 (0.5)	8.24 (0.6)	9.55 (0.3)	9.18 (0.2)
	Final deletion	6.15 (0.8)	7.53 (0.6)	8.66 (0.6)	8.18 (0.3)
	Phoneme segmentation	13.0 (1.6)	11.3 (1.4)	16.2 (1.9)	15.5 (1.5)
	Phonology average	9.2 (2.7)	9.0 (2.5)	11.5 (2.4)	10.9 (2.2)
Spanish decoding	Regular words	8.23 (0.8)	8.82 (0.5)	9.22 (0.5)	9.06 (0.5)
	Pseudowords	20.2 (1.9)	20.1 (1.4)	22.1 (1.6)	24.0 (1.6)
	Decoding average	14.2 (4.5)	14.5 (3.6)	15.7 (3.1)	16.5 (3.2)
Spanish reading	Irregular words	6.54 (0.8)	7.35 (0.5)	7.44 (0.9)	8.17 (0.5)
	Passage comprehension	8.69 (1.5)	10.8 (0.9)	11.1 (2.3)	12.3 (1.0)
	Reading average	7.6 (4.1)	9.0 (2.5)	9.3 (4.4)	10.2 (2.7)

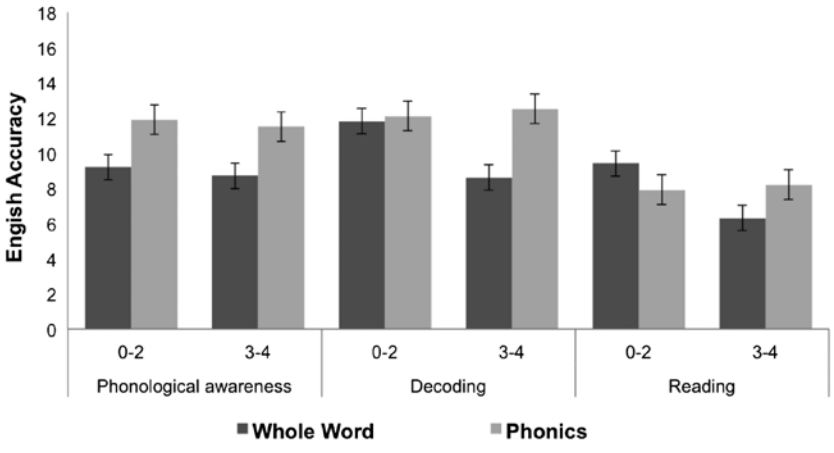

Figure 1. Participants' performance during the English language tasks.

Notes: Accuracy represents mean accuracy across tasks; error bars represent the standard error of the mean.

3.2. Spanish literacy

3.2.1. Impact of instruction and age of exposure on Spanish phonological awareness
A 2 × 2 × 3 MANOVA for reading instruction (phonics × whole-language), age of first bilingual exposure (ages 0–2 × 3–4), and phonological awareness tasks (initial phoneme deletion, final phoneme deletion, phoneme segmentation) revealed a significant main effect of reading instruction: children in the whole-language program had better phonological awareness ability relative to children in the phonics instruction program (F (1,52) = 9.6, p = 0.003; Table 1, Figure 2). While surprising at first glance, the findings are generally consistent with the notion that learners of phonologically transparent orthographies like Spanish benefit the most from reading instruction enriched with complex text and language use, rather than targeted phonics exercises that further obviate the relatively obvious patterns of this language (Goldenberg et al., 2014). See discussion section below for further discussion of these findings.

3.2.2. Impact of instruction and age of exposure on Spanish decoding
A 2 × 2 × 2 MANOVA for reading instruction, age of first bilingual exposure, and decoding tasks (regular and pseudoword reading tasks) revealed marginally significant instructional differences: children in the whole-language program had better decoding skills relative to children in the phonics instruction program (F (1,52) = 3.1, p = 0.08; Table 1, Figure 2).

3.2.3. Impact of instruction and age of exposure on Spanish reading
A 2 × 2 × 2 MANOVA for reading instruction, age of first bilingual exposure, and reading tasks (irregular word and passage comprehension) did not reveal any significant differences (p > 0.05). Nevertheless, the means suggest children in the whole-language program also had a somewhat better reading performance in Spanish (Table 1; Figure 2).

4. Discussion

Over the course of reading acquisition, children master the rules of mapping their spoken language onto orthography, as well as the general principles of working with printed text. Educators often face the challenge of offering balanced instruction that fits the child's level of competence and need for mastering both of these literacy fundamentals (Seidenberg, 2013). In this study, we explored how two dominant approaches to learning to read, phonics and whole-language, interact with a *bilingual* child's age of first bilingual language exposure. Specifically, the study asked: What is the interaction between the age of bilingual children's first dual-language exposure and the impact that different types of reading approaches have in predicting bilingual children's reading success?

Our findings revealed significant interactions between the age of first bilingual language exposure and the reading approach used with the children. In English, bilinguals with later exposure to English (ages 3–4 years) benefited the most from phonics, rather than whole-language reading instruction,

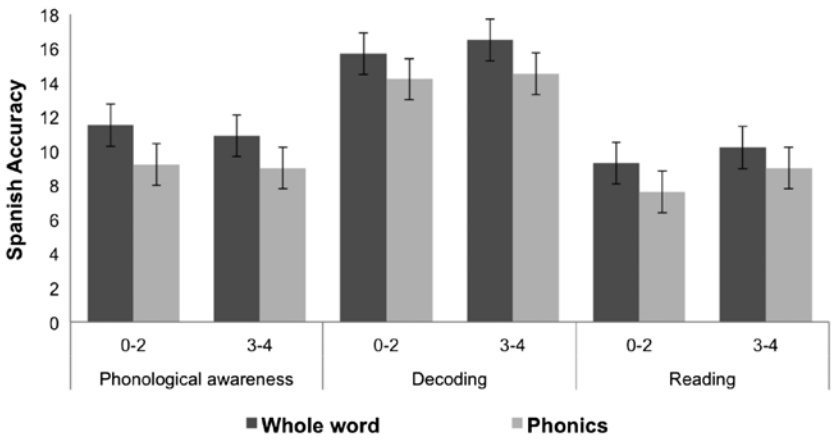

Figure 2. Participants' performance during the Spanish language tasks.

Notes: Accuracy represents mean accuracy across tasks; error bars represent the standard error of the mean.

covering phonological awareness, reading decoding and other reading skills. Bilinguals with birth exposure to their two languages performed well with both types of instruction, with an advantage in phonological awareness from phonics instruction and an advantage in irregular and passage comprehension reading abilities from whole-language instruction. In this group, ability to decode real and pseudowords did not differ between instruction types (Figure 1).

Phonological awareness is foundational for learning to read. Yet, as children's reading ability improves, their knowledge of complex orthographic patterns become increasingly important for achieving advanced literacy for single-word reading and text comprehension (Ehri, 2014). For instance, rather than reading the word "football" through a letter-by-sound conversion, proficient readers might immediately recognize the two items, "foot" and "ball." Here, we found a significant interaction between children's age of first bilingual exposure and type of reading instruction for their English reading and decoding abilities. These significant interactions suggest that whole-language instruction may have been somewhat better for fostering advanced reading skills in bilinguals, but only in those bilinguals with very early (ages birth to age two) bilingual exposure. In contrast, children with later bilingual exposure (ages 3–4 years) benefitted the most from the phonics instruction for both the foundational and more advanced reading abilities.

In the introduction, we raised several hypotheses, including one, in which bilingual children might be in need of simplified and more targeted phonics reading instruction or the reverse—they might be in need of a context-rich language and reading experience. Our findings suggest that both of these seemingly contradictory predictions are correct, especially when the age of first bilingual language exposure is taken into consideration. Therefore, when selecting the path of reading instruction for a young child, our findings suggest that researchers and educators alike should not only take into consideration whether a young child is either monolingual or bilingual, but also *when* the young bilingual child first had exposure to his or her new language.

Infants and young children are most sensitive to the frequently occurring patterns of language (e.g. sounds, syllables, words, and how they cluster to form sentences), which allows them to build the foundations of their dual language competence (Petitto, 2005). Early life sensitivity to phonological information has been linked with the development of specific left hemisphere brain regions, especially left inferior frontal and superior temporal gyri (Jasinska & Petitto, 2013; Petitto et al., 2012). Importantly, children who learn a language later in life show atypical (non-native) language organization in the brain, as well as lower levels of language proficiency (Kovelman et al., 2008a, 2008b). In the later years (typically, around age 3 years), when the fundamentals of language reach automatic levels of processing both behaviorally and in the brain, a child demonstrates a greater sensitivity to less frequent and more memory/attention demanding levels of linguistic input, which, consequently, enables the child to master advanced levels of sentence structure and relations among meanings (Hoff, 2009; Wexler, 2003).

Children who were exposed to English later in development (ages 3–4 years) showed better phonological awareness, decoding, and reading performance when they received the phonics type of instruction. These group differences reached significance for the decoding tasks, but were also present for all other English tasks (the lack of significance for other comparisons was likely due to the low sample size; Table 1, Figure 1). Here, we suggest that the heightened emphasis on decoding rules that are typical of phonics instruction provides a highly regularized and repetitive level of language input that may be naturally beneficial to children, who are in the process of acquiring the foundations of a new, additional language later in childhood.

In contrast, the significant interaction between age of exposure and type of instruction for the English reading tasks suggests that children with early exposure to English benefit from the rich contextual input of the whole-language approach. The results suggest that children with early bilingual exposure may have been better prepared to benefit from a less-regularized, low-frequency, and more memory demanding input that fosters advanced language and literacy growth.

Finally, in Spanish, children with whole-language instruction showed better performance on all literacy tasks; the differences were significant for the phonological awareness tasks and marginally significant for the decoding and the reading tasks (lack of greater significance is likely due to low sample size, Table 1, Figure 2). These differences in reading performance might be explained by the general notion that Spanish offers underlying sound-to-letter regularities, and thus children benefit the most from varied complex text exposure when learning to read in Spanish (Berens et al., 2013; Kovelman et al., 2008a). Thus, the findings suggest that one format of reading instruction does not fit all bilingual learners equally. Prior research had questioned the utility of phonics-heavy reading instruction for Spanish (Goldenberg et al., 2014), given the phonologically transparent nature and easy sound-to-letter correspondence in Spanish. The present findings offer further support to the notion that once children master the basic rules of orthographic coding (which may happen earlier for learners of Spanish than learners of English), children benefit the most from linguistically and contextually rich literacy instruction (Goldenberg et al., 2014; Wolf, 2008).

In sum, our findings suggest that bilingual children with *different language exposure backgrounds*, in turn, have *different learning needs* that can potentially be addressed when the age of first bilingual language exposure is taken into account. One of the caveats of the present study is the relatively limited sample size for each of the experimental groups. Nevertheless, each of the groups was carefully selected to fit the age and reading instruction criteria from the larger sample for the project (Berens et al., 2013; Kovelman et al., 2008a). Moreover, even though the study used assessments in both languages, future research should consider including more extensive evaluations of decoding and text comprehension abilities, overtime and across a larger number of schools.

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