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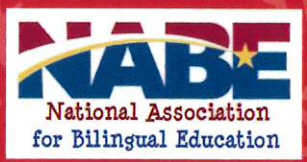

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Should Bilingual Children Learn Reading in Two Languages at the Same Time or in Sequence?

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Is it best to learn reading in two languages simultaneously or sequentially? We observed second- and third-grade children in two-way *dual-language learning contexts*: (a) 50:50 or Simultaneous dual-language (two languages within same developmental period) and (b) 90:10 or Sequential dual-language (one language, followed gradually by the other). They were compared to matched monolingual English-only children in single-language English schools. Bilinguals (home language was Spanish only, English-only, or Spanish and English in dual-language schools), were tested in both languages, and monolingual children were tested in English using standardized reading and language tasks. Bilinguals in 50:50 programs performed better than bilinguals in 90:10 programs on English Irregular Words and Passage Comprehension tasks, suggesting language and reading facilitation for *underlying grammatical class and linguistic structure* analyses. By contrast, bilinguals in 90:10 programs performed better than bilinguals in the 50:50 programs on English Phonological Awareness and Reading Decoding tasks, suggesting language and reading facilitation for surface *phonological regularity* analysis. Notably, children from English-only homes in dual-language learning contexts performed equally well, or better than, children from monolingual English-only homes in single-language learning contexts. Overall, the findings provide tantalizing evidence that dual-language learning during the same developmental period may provide *bilingual reading advantages*.

INTRODUCTION

Thousands of children entering schools each year find themselves wrestling to acquire reading and language skills in a language different from the one that they speak at home. It is commonly

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reported that many of these "bilingual" children perform worse than their monolingual peers in reading acquisition, especially reading in the majority (public) language (August & Hakuta, 1997; Slavin & Cheung, 2003, 2005). A widely asked question has been how best to facilitate reading success in these young bilinguals. Is it best to learn to read in two languages simultaneously, or first learn to read in one language, followed by another?

Both in the United States of America (site of the present study) and elsewhere in the world, different dual-language bilingual learning types have emerged. One response has been the development of two different and unique types of what has been termed "two-way" dual-language programs (also termed "bilingual language programs)," whereupon the overarching goal is for children to learn reading and language skills in both languages. In the present study, we (a) provide novel comparative analyses of these two prevailing dual-language learning contexts, and we (b) discuss the implications that this first-step study can have, in conjunction with other future studies, to help us select and design learning contexts that optimally facilitate the young bilingual's mastery of reading skills in each of his or her two languages.

Further, we shine a novel light on reading and language mastery in children from *English-only* homes. Here we contrast their reading success based on whether they are learning reading in two languages (dual-language Spanish-English instruction) or one language (single-language English-language instruction). To be sure, in the advent of important controversy over whether early bilingual *language* exposure affords *language* processing advantages or disadvantages (Petitto et al., 2001), here we provide a novel extension by asking whether early bilingual *reading* exposure may afford *reading* advantages or disadvantages (Kovelman, Baker, and Petitto, 2008a).

DUAL-LANGUAGE LEARNING CONTEXTS

In many countries, bilingual learning types have been developed with the goal of helping young children to become proficient speakers and readers of the majority language *and* the nondominant (minority) language. Two prevailing bilingual learning types in the United States that fall under the category of "two-way" or "dual-language" bilingual programs are as follows and share important features with similar learning contexts used around the world (a) 50:50, or Simultaneous dual-language, and (b) 90:10, or Sequential dual-language.

In 50:50 dual-language learning contexts, sometimes called "simultaneous" or "paired" dual-language learning (e.g., Kovelman et al., 2008a; Slavin & Cheung, 2005 respectively), reading and language learning occurs in two languages during the same educational and developmental time period (e.g., in the U.S., Spanish and English). Here, the instructional day is equally divided between two languages such that children consistently receive approximately equal amounts of instruction across all subjects in both of their languages, within the identical child developmental time and growth period, typically beginning with Grade 1 or kindergarten (Lara-Alecio, Galloway, Irby, Rodríguez, & Gómez, 2004). For example, this could include students in the U.S. learning in both Spanish and English over the course of a single school day and beyond.

In 90:10 dual-language learning contexts, sometimes called "sequential" dual-language learning (Kovelman et al., 2008a), most of the learning is conducted in the nondominant minority language, with instruction in the majority language slowly increasing (e.g., in the U.S., the nondominant language, Spanish). Here, approximately 90% of the instructional day is in one

language (e.g., the minority language, Spanish) and approximately 10% of the instructional day is in the majority language, English. For 90:10 programs, including the one we studied, students initially spend more of their day learning in Spanish (90%) but then graduate to larger ratios of English through 80:20, 70:30, until the dual-language ratio reaches 50:50 in fifth grade (Lara-Alecio et al., 2004). To be clear, children initially receive most of their academic learning in the minority language first, which continues across many periods of child maturation and higher cognitive development, and which for many of these children is their dominant/home language. Following this, learning in the majority language is slowly introduced over a protracted period of time (again, spanning several child developmental time and maturational growth periods), until finally the amount of learning in both languages is approximately equal by around Grade 5 (ages ~10–11 years old). These two-way programs are distinct from "transitional" bilingual learning, which permits a very brief initial period of instruction in the child's home language (in the U.S., often, Grade 1 only exposure to Spanish) with a rapid and total transition to the majority language (in the U.S., English). To date, the lion's share of previous research on dual-language learning has predominantly compared bilingual children in single-language versus dual-language programs, showing that overall, children benefit from learning in two-way dual-language programs as compared to single-language programs (even when single-language learning is supplemented by second-language tutoring; e.g., Collier, 1992; Cummins, 1992; Genesee, 1989; Kovelman et al., 2008a; Krashen, 2005; Lindholm-Leary, 2001; López & Tashakkori, 2004; Oller & Eilers, 2002; Rolstad, Mahoney, & Glass, 2005; Thomas & Collier, 2002). Studies comparing two-way dual-language learning to transitional learning have also shown that students benefit from learning in two-way dual-language programs (e.g., Alanís, 2000; Carlisle & Beeman, 2000; De Jong, 2006; Friedenberg, 1984; Gertsen & Woodward, 1995; Hofstetter, 2004; Modiano, 1968; Moore & Parr, 1978; Proctor, Carlo, August, & Snow, 2005; Ramírez, Yuen, Ramey, & Pasta, 1991; Slavin & Cheung, 2003, 2005). Nonetheless, there remains a dearth of studies properly comparing learning in the two major types of two-way dual-language learning, 50:50 and 90:10. In the one study that we are aware of that compared two-way dual-language, transitional, and single-language learning, Thomas and Collier (2002) found that children enrolled in two-way dual-language programs (50:50 or 90:10) showed the best mastery in English. *However, the two major types of two-way dual-language programs were not directly compared, leaving open the question about which two-way dual-language learning context is best for majority and minority language learning and mastery.*

As can be gleaned from this, it has indeed been suggested that there is a benefit to dual-language learning over standard single-language education. *Questions prevail, however, about which two-way dual-language learning context is optimally effective for young bilinguals to learn reading.* Each of the two dual-language learning contexts implicitly draws upon *different* assumptions about learning. By making explicit the different assumptions that each dual-language learning context invokes, we ultimately hope to gain a powerful "missing piece" needed for the most complete evaluation of their efficacy.

In the 50:50 dual-language learning context, it has been hypothesized that early exposure to multiple kinds of similar information (for example, two linguistic systems) may afford computational strength and processing agility in speed and accuracy, and, thus, higher cognitive computational and processing *advantages* (Bialystok, Craik, & Luk, 2008; Bialystok, Majunder, & Martin, 2003). Alternatively, 50:50 exposure to two reading systems during the same developmental time period may possibly cause learning confusion and interference between the two

reading and linguistic systems, rendering the young bilingual's mastery of reading incomplete in either language (home or majority language)—in other words, producing a child who is a linguistic "jack of all trades, but ace of none."

In the 90:10 dual-language learning context, it has been hypothesized that it is best to establish language and literacy first in one language, while slowly and gradually introducing the new language over time (Cummins, 2005). The implicit assumption here is that more "time-on-task" (e.g., more time spent in the minority language) is most key in human learning and thus superior over partial learning contexts (such as 50:50 dual-language learning) in learning reading, especially in the majority language (for a review of these accounts see Petitto et al., 2012). In this view, reading and language learning in the minority language may ostensibly disadvantage the child's full mastery of reading in the majority language. Alternatively, and stemming from a brain maturational standpoint, a concern with the 90:10 context is that the learning of reading in the targeted majority language would inevitably entail reading instruction in that majority language at an older developmental age when learning processes in the brain may be less neurally "plastic" (Dubins, Berens, Kovelman, Shalinsky, and Petitto, 2009; Petitto, 2005, 2007, 2009; Petitto et al., 2012).

PRESENT STUDY

We study reading and language performance in second- and third-grade children (matched for age, and socioeconomic status [SES]) who were in 50:50 Simultaneous or 90:10 Sequential (Spanish/English) dual-language learning contexts. We further compare these bilingual children's performance on standardized reading and language tasks to that of English-only children in traditional single-language English learning contexts. Following this, we directly compare reading and language performance in two key groups, specifically, (a) bilingual children from English-only homes learning English in dual-language (bilingual) Spanish-English schools, or (b) monolingual children from English-only homes learning English in single-language schools. We investigate multiple aspects of bilingual language competence (e.g., phonological, semantic, morphosyntactic) and explore the relationships between reading and language development using widely accepted and standardized measures in the field (Adams, 1994; Berninger, Abbott, Billingsley, & Nagy, 2001; Catts, Fey, Zhang, and Tomblin, 1999; Engen & Hoien, 2002; McCardle, Chhabra, & Kapinus, 2008; Scarborough, 1990; Wolf and Katzir-Cohen, 2001).

In the 50:50 dual-language learning context, children use both languages with teachers and classmates and generally are introduced to similar amounts of printed reading material in both languages during the same developmental time period and school grade. The 50:50 programs are based on the learning theory assumption that young children learn best from building foundations of knowledge in multiple domains at the same time, and they can acquire similar knowledge in two domains simultaneously. Notably, acquiring similar knowledge across different domains can actually help a young child build stronger and more distinct representations. (As in the "like" poles of a magnet, the closer the content is, the farther away they will be pushed. For two languages, the farther/stronger their mutually distinct representations will be; Petitto et al., 2001.) Said another way, young children can learn two reading systems and two languages concurrently and without confusion, especially if such dual reading and language exposure occurs early in life (Kovelman et al., 2008a).

In the 90:10 dual-language learning context, children are exposed to both languages orally from teachers and classmates and generally are also introduced to printed reading material in both languages but in vastly different proportions of time and not during the same developmental time period and school grade. The 90:10 programs are based on the learning theory assumption that children learn best by first establishing knowledge in the one domain that they are most comfortable in, and, after building a strong foundation, similar skills in a new domain can be acquired (e.g., Cummins, 2005). That is, children from homes in which only the minority language is spoken, learn reading best by building their skills in their home/dominant language first and then by transferring these skills to learning the new/majority language.

Hypotheses

We seek to test several hypotheses implicit in each of the above bilingual *learning contexts*. Research Hypothesis 1 tests the hypothesis that learning two reading systems within the same developmental period hinders children in 50:50 bilingual learning contexts, or, alternatively helps children, as compared to first learning to read in one language, followed by another (e.g., 90:10 readers), with all being compared to English-only peers. Research Hypothesis 2 tests the hypothesis that *dual-language versus single-language learning contexts* impact reading success differentially. Here we examine whether children from English-only homes, who are being educated in dual-language schools, experience a *reading advantage* as compared to children from English-only homes in traditional single-language English schools.

By joining an evaluation of two prevailing dual-language learning contexts and their underlying implications for learning theory—*especially learning theory concerning successful reading acquisition*—we hope to contribute information that allows educators to predict and evaluate a bilingual child's course of reading acquisition in each language, given the child's unique language and developmental background. Ultimately, we hope that our first steps here, in combination with those of others as well as future studies, may be useful in designing curricula and more targeted interventions for bilingual children to ensure reading mastery and full linguistic proficiency in each of their languages.

METHODS

Participants

We studied a total of 213 children (111 boys and 102 girls), ages 7 to 9, in Grades 2 and 3 (122 in Grade 2 and 91 in Grade 3). Table 1 provides detailed information about participants' age of first bilingual language exposure separated by dual-language learning context (50:50 or 90:10), languages at home, reading at home, language in class, and reading in class. There were *no* evident dialect differences across children. To be sure, our comprehensive battery of participant selection and assessment tasks were designed specifically to catch such examples of possible language variation in our groups. All young pupils observed were identified by both the schools and the parents as being "typically developing," healthy young children, which was further confirmed by our videotaped observations.

TABLE 1
Participant Groups and Language Background Information

Group	*Learning Context*	*N = 213*	*Age of English Exposure*	*Age of Spanish Exposure*	*Languages at Home*	*Reading at Home*	*Reading in Class*
Bilinguals from Home	50:50 dual-lang. 90:10 dual-lang.	46 60	birth–6	birth	English & Spanish	English & Spanish	English & Spanish
Bilinguals from School	50:50 dual-lang. 90:10 dual-lang.	37 21	birth	3–6	English Only	English Only	English & Spanish
Monolinguals	single-lang.	49	birth	NA	English Only	English Only	English Only

Assignment of Participants to Groups

As any scientist knows, it is impossible to achieve a 100% match on participants' home language learning exposure. Rather, participants are rigorously matched on as many levels as is humanly possible, which is the approach used in the current study. This "real-life" distribution of language exposure is a positive attribute, given that the goal of this study is to understand how "real" young children best learn two languages.

Learning Contexts

Children from three different linguistic backgrounds participated: (a) bilingual children in *50:50* Spanish-English two-way dual-language (T = 1 school); (b) bilingual children in *90:10* Spanish-English two-way dual-language (T = 2 schools), and (c) *monolingual* English-only children in English *single-language* (T = 3 schools). To be clear about our terminology, all children educated in dual-language schools are "bilinguals," and all children educated in single-language schools (and who come from single-language homes) are referred to as "monolinguals." Bilinguals are further separated by their home language, either bilingual from home (Spanish and English from home) or bilingual from school (English-only at home; see Table 1). Again, monolinguals were English-only at home and at school. We painstakingly matched the dual-language schools to each other and to the single-language schools on many factors that have been shown to be important for language development, including socioeconomic status (SES), reading instruction type, and type of language and literacy exposure at home, to ensure the most scientifically rigorous design possible. All schools were described as serving low-SES students, using the standardized measure of percentage of free and reduced lunches (Caldas & Bankston, 1997; Kovelman et al., 2008a).

It is important to note that we selected the specific schools that we studied after careful interviews that we first conducted with each candidate school's personnel (teachers, principals, reading specialists) and school district superintendents to determine whether a particular school/school district was using the specific type of language learning we sought to study.

We respectfully acknowledge that there can be differences between the established curricula and what occurs in the classroom. Given that this was a study in which we administered standardized tests to the children, and not an intervention study, we did not have control over how teachers taught their students throughout the year and, therefore, we respectfully had to assume that the teachers' observed teaching (i.e., adherence to school's curricular, instructional content of their lessons, rigor, style, etc.) was true in daily practice.

As an important and necessary design feature of this study, to be most inclusive of regions in the U.S. (with a balance of urban and rural schools) we selected schools in California, Texas, and in New England. That our schools were located in different geographical regions was necessary, given that each state and municipality in the U.S. plays a substantial role in determining the educational approach and curricula for children in that area. While we found this principled, we remain humble about the sheer number of variables that one could have theoretically controlled for, even though such controls are impossible on a practical level. For more detail on the participant groups, please see Table 1.

We ensured that all schools we visited reported using a "whole-word approach" to teach reading in English both to ensure that differences between learning and learning contexts (school types) were not due to the method of reading instruction and because it is one of the widely used methods for teaching reading in English across the U.S. (Adams, 1994). We acknowledge that characteristics of implementation of the whole-word approach may have varied across schools, but we specifically made every effort to select schools that were dedicated only to this whole-word approach. To the best of our knowledge, schools and their teachers honestly honored what they reported to us. In the whole-word approach children are asked to read (or recognize) a word based on pictures, the meaning of the text, or the first letter of the word. Here, there is little overt and direct instruction given to the complex rules of sound-to-letter correspondences of words in the given language, called the phonics approach. (In a forthcoming article, we directly compare bilingual children in whole-word versus phonics school programs, Kovelman, Berens, Salah-Ud-Din, & Petitto, 2013). For the schools participating in the present study, schools reported using basal readers, such as from the Scott Foresman series, with the school district mandating which whole-word textbooks were used by teachers in the classroom.

Additionally, because English and Spanish differ in the depth of their orthographies, we specifically selected learning contexts using the whole-word approach as a design feature of the present study because this approach has less potential (as compared to the phonics approach) to differentially impact reading instruction in one language over the other. In particular, Spanish has a "shallow" orthography, with consistent sound-to-letter correspondences (for example, *gato*, meaning "cat" in Spanish, is pronounced precisely as the letters are arranged), and few words with irregular patterns (words that do not follow strict sound-to-letter correspondences). By contrast, English has a "deep" orthography with less transparent sound-to-letter correspondences, and many words that have irregular patterns (words such as *cough* and *yacht* in English are examples). These differences in orthography affect the relative importance of certain skills in reading across languages (Katz & Frost, 1992).

50:50 Dual-Language Learning

The 50:50 dual-language school was located in central California and instructed its students in each language approximately 50% of the time; each grade had separate instructors for each

language. To best approximate 50:50, students spent half the day with an English instructor and half the day with a Spanish instructor. Beginning in kindergarten, students were exposed to printed material *both* in Spanish and in English on a daily basis. In each classroom, half the children came from Spanish-speaking homes (or Spanish/English-speaking homes), and half the children came from English-only-speaking homes. There was consistent academic instruction and exposure to literacy in both languages from kindergarten, with the onset of formal reading instruction differing by home language. Importantly, in the 50:50 dual-language learning context, children worked with printed material that was used for school lessons and reading instruction in both languages beginning with kindergarten and throughout the school day (during the same developmental period), which was equally split for Spanish and English. School-wide, 49% of children received free lunches.

90:10 Dual-Language Learning

The two 90:10 dual-language schools were located in South Texas and instructed students in both Spanish and English with time of instruction in each language differing by grade. In these 90:10 schools, language instruction begins in mostly Spanish (90% instruction time Spanish, 10% English) in kindergarten and Grade 1, with an addition of approximately 10% English instruction across school subjects every year (80% Spanish and 20% English in Grade 2, etc.), reaching balanced (50%:50%) instruction in Grade 5. In the 90:10 dual-language learning context, children had exposure to printed material that was used for the school lessons and reading instruction in both languages, though in dramatically different proportions and, importantly, separated in age/developmental time period. All instructors in the 90:10 program were bilingual and taught in both languages. To best approximate the appropriate percentage of time in each language for that grade level (e.g., 80% Spanish:20% English in second grade), the language usage was divided by instructional period, with the number and duration of instructional periods in each language adjusted for the balance of language exposure for that grade level. In one 90:10 bilingual school, 80% of all students received a free or reduced lunch. In the other 90:10 bilingual school, 37% of all students received a free or reduced lunch.

Single-Language Schools with Low SES Students

Three single-language schools that provided English-only learning to children who came from English-only-speaking homes were included as reading instruction, and SES-matched controls. These students from single-language schools were included to serve as a comparison group for children from English-only-speaking homes educated in dual-language schools to address questions about whether dual-language education might afford reading advantages or disadvantages (Research Hypothesis 2). Two of the single-language schools were located in New Hampshire (70% free or reduced lunch), and one was located in Vermont (80% free or reduced lunch).

Language-Exposure Groups

The children in the dual-language learning context were grouped by the languages they were exposed to at home prior to entering school. "Bilinguals from Home" had both Spanish and English exposure at home prior to entering school and were of Hispanic heritage. Often both

parents came from Latin American ancestry, with one parent using primarily English and the other parent using primarily Spanish. Another common exposure pattern is that both parents came from Latin American ancestry, and the child had Spanish exposure at home since birth, and English exposure began with arrival in the U.S. or enrollment in daycare. "Bilinguals from School" had only English exposure at home from birth, with first Spanish exposure after age 5, often coinciding with entry in school (see Table 1). All single-language (English) control children were monolingual and exposed only to English since birth and were of diverse ethnicities.

Background Assessment

The parents of all participants filled out a standardized Language Background and Use Questionnaire that has been previously published in studies of adults and children (Holowka, Brosseau-Lapré, & Petitto, 2002; Kovelman, Shalinsky, Berens, & Petitto, 2008; Petitto & Holowka, 2002; Petitto et al., 2001). In this standardized instrument, parents answered detailed questions about the age and in which context (home, daycare, school) their child was first exposed to each of his or her languages and at what age their child first learned to read in those languages. The parents also answered if, and in what language(s), they typically read with their child. Although it was not possible to obtain detailed information about the specific types and quality of the language exposures, built into our design for further validity and reliability, experimenters conducted structured and videotaped interviews at the beginning of each session with the child for later analysis in making group assignments and for later reliability analyses. In these structured interviews, we asked each child where he or she was born, what languages were spoken in the home by each family member, family members' fluency in each of their language(s), what language(s) the child used with each family member, and whether the child reads at home, in which language(s), alone, or/and with family members. Thus, we received reports about the child's language exposure from multiple corroborating sources. Kovelman et al. (2008a) describe all assessment tasks in greater detail.

READING AND LANGUAGE ASSESSMENT INSTRUMENTS

Standardized reading and language assessment tasks, both in English and in Spanish, were selected and utilized to enable assessment of *multiple components* of reading and language in the young bilingual. The tasks were created to be excellent measures of a variety of grammatical constructs (e.g., passage comprehension) that would be sensitive to English speakers who might vary in terms of their dialect, and the validity of the content of the tasks was established by native speakers of each language. There were an equal number of items in each task across languages, and all task items were equated across languages.

The measures that we chose enabled us to investigate separately—and in relationship to each other—different components of bilingual reading proficiency, components known to be critical for successful reading acquisition. The phonological awareness tasks tap into children's ability to manipulate the sounds of language, which is known to precede and predict reading acquisition. We tested phonological awareness using standardized sound deletion tasks (Yopp, 1995). Another critical reading skill is reading decoding, children's ability to know the relationship between

the sounds of their language and the letters of their alphabet, or sound-to-letter correspondence, which we tested with nonword and regular word reading tasks. Children's abilities to recognize entire word-forms and to understand connected text were tested with irregular word reading and passage comprehension tasks respectively. Finally, bilingual children's oral-language proficiency was assessed using a structured speech elicitation task (LCEP, see description in the Methods section), allowing us to assess children's knowledge of the sounds, words, and grammatical structures of each of their languages. Taken together, these measures allowed us to investigate the strengths and weaknesses each reading approach may exert on the bilingual children's individual reading skills in each of their languages. Examples of each task are provided in the Appendix.

Phonological Awareness Tasks

To assess children's phonemic awareness we administered three standardized phonological awareness tasks in English (all children, all schools) and in Spanish (dual-language schools): initial phoneme deletion, final phoneme deletion, and phoneme segmentation. The initial and final phoneme deletion tasks were selected from CORE's (1999) standardized Spanish-English reading assessment tools, and each consisted of 10 items per language. The tasks were comparable across both languages, with the exact same number of practice items, and with all test items made of concrete and child-familiar words, and resulting in child-familiar words once the sound was removed. The child was asked to delete a phoneme from the beginning (initial phoneme deletion task) or end of a word (final phoneme deletion task), and say the remaining part of the word (see Appendix). For all stimuli in the phoneme deletion tasks, the correct answer was a complete real word. The phoneme segmentation task consisted of the original 22 standardized Yopp-Singer items (Yopp, 1995), as well as matched and standardized Spanish items from the Reading Success Network (1997). During the task a child was presented with a word and asked to articulate each phoneme in the word (see Appendix).

Reading Decoding Tasks

We administered four reading tasks in English (all children, all schools) and in Spanish (dual-language schools): regular words, nonwords (pseudowords), irregular words, and passage comprehension (see Appendix).

Reading Decoding

The regular word reading and nonword reading tasks were reading decoding tasks. The goal of the *regular word reading* task was to assess children's ability to decode words with easy sound-to-letter correspondences. This task consisted of 10 test items for each language chosen from CORE's (1999) standardized Spanish-English reading assessment tools. The goal of the *nonword reading* task was to assess children's ability to apply sound-to-letter correspondence reading rules to unfamiliar/nonexistent words. This task consisted of 30 items for each language taken directly from WLPB-R Word Attack subtest (Woodcock, 1991).

Irregular Word Reading

The goal of the *irregular word reading* task was to assess the children's ability to read words with difficult sound-to-letter correspondence. This task consisted of 10 test items for each language selected from the CORE (1999) and Woodcock Word Identification subtest (Woodcock Language Proficiency Battery—Revised, WLPB-R; Woodcock, 1991) standardized reading measures.

Passage Comprehension

The goal of the *passage comprehension* task was to assess children's ability to understand text. This task consisted of 18 items also taken directly from WLPB-R, in which children read a short sentence and supply a missing word in a cloze procedure (Woodcock, 1991).

Expressive Language Task

Children's competence in English and in Spanish was assessed using a standardized Language Competence/Expressive Proficiency (LCEP) task, which has been successfully used to assess children's and adults' expressive language proficiency across six different languages (English, French, Spanish, American Sign Language, Langue des Signes Quebecois, and Nicaraguan Sign Language; Kegl, 1994; Kovelman, Baker, & Petitto, 2008b; Kovelman et al., 2008a; Kovelman et al., 2009; Petitto et al., 2000; Senghas, 1994; Senghas & Kegl, 1994). The goal of the LCEP task is to assess a person's language competence, language expression (production), and proficiency. The task includes a fun 1.5-minute silent cartoon with a series of events that the participant is instructed to watch and then describe to an experimenter (see Appendix).

Procedure

Each testing session lasted approximately 20 minutes. All children in dual-language schools participated both in an English and in a Spanish session (order counterbalanced). Children in single-language schools participated only in one English session. Within each session the tasks were administered in the same order: LCEP, initial phoneme deletion, final phoneme deletion, phoneme segmentation, nonwords, regular words, irregular words, and passage comprehension tasks. Native English speakers administered English sessions, and native Spanish speakers administered Spanish sessions. The testers used only one language throughout the session. All sessions were videorecorded for data transcription and/or coding, analysis, and reliability checks.

Data Transcription, Coding, and Analyses

Assessing Language Background

All of the background information for each participant collected from the school, parental Language Background and Use questionnaires, and videorecorded structured interviews with the

child was entered into a digital participant database. Group assignment was conducted on the basis of this information.

Phonological Awareness and Reading Tasks

All coders were trained to administer the phonological and reading tasks by an experienced coder. For training, new coders were required to code at least four sessions from a videotape prior to administering the task in the schools and to achieve 97% reliability with the original coder from the videotape. For testing, the experimenters coded the children's responses during the session. For reliability purposes, using the video recording, at least 25% of all sessions were also coded off-line by a second experimenter who was also a native speaker of the language of the testing session and had been a coder during the testing sessions. Average reliability between the coders was 98.4% ($SD = 3.8\%$); any disagreements between the online and off-line coders were discussed until there was 100% agreement. All analyses were conducted on the number of items answered correctly by the child for each task.

Language Competence/Expressive Proficiency Task (LCEP)

Children's videotaped narratives in each language were first transcribed by native Spanish or native English speakers using the Computerized Language Analysis (CLAN) program and Child Language Data Exchange System (CHILDES). Twenty-five percent of the transcripts were then subjected to reliability analyses; average reliability between transcribers was 95.3% ($SD = 2.9\%$). Once the transcripts were completed and checked for reliability, native speakers of English or native speakers of Spanish who had taken multiple courses in linguistics and had language transcript experience and who had expertise in coding transcripts from having undergone extensive training on standard transcription methods in the Petitto Laboratory coded the children's speech according to rigorous linguistic coding in accordance with LCEP coding guidelines (Kegl, 1994; Kovelman et al., 2008a; Petitto et al., 2000; Senghas, 1994; Senghas and Kegl, 1994). Transcripts were coded for the phonological, morphological, and grammatical content (correct/incorrect phonological, semantic, and morphosyntactic) of each linguistic "utterance" (phrases, clauses, or sentences) produced by the participant, as well as the number of story events produced (MacWhinney, 1995). In summary, this coding method yielded the total number of utterances produced by each child in each language, the total number of utterances produced correctly (fully grammatical in each respective language), the total number of utterances that contained errors, and, finally, the total number of utterances that contained only unique error types (unique error type constituted same word with the same mistake, e.g., "falled" repeated twice counted as one type of error). Analyses were conducted on the basis of percent correct utterances expressed by the child during the task, estimated from the total number of utterances, minus the utterances with unique error types (Kovelman et al., 2008b; Petitto et al., 2000). See Kovelman et al. 2008a, who investigated the interaction between age of first bilingual language exposure and school type, as it predicted children's reading success, for greater detail about the administration and scoring of this task.

RESULTS

For all analyses, the individual tasks were grouped into five categories of performance, as discussed previously: (a) LCEP task; (b) Reading Decoding (combination of regular word reading and nonword reading tasks); (c) Phonological Awareness (combination of initial phoneme deletion, final phoneme deletion, and phoneme segmentation tasks); (d) Irregular Word reading task; and (e) Passage Comprehension task. As in Kovelman et al. (2008a), for all analyses we combined students across second and third grades. We use a standard alpha level of .05 for all analyses. Note that no datum and/or data points were identified as outliers and removed from this study.

Table 2 lists scores and standard deviations for each task for children separated first by learning context and then by language exposure group. For English, Table 2 shows that Bilinguals from School (English-only homes) outperform Bilinguals from Home on 8 of 8 English tasks in both 50:50 programs (top and second rows) and 90:10 programs (fourth and fifth rows), with scores between the groups more similar for 90:10 programs. Notably, Bilinguals from School (English-only homes) in 50:50 programs (top row) outperform monolinguals in English-only schools (bottom row) on 7 of 8 tasks. Bilinguals from School (English-only homes) in 90:10 programs (fourth row) outperform monolinguals in English-only schools (bottom row) on 5 of 8 tasks. For Spanish, Table 2 shows that Bilinguals from Home outperform Bilinguals from School on 7 of 8 (50:50 programs) and 8 of 8 (90:10 programs) Spanish tasks, again with scores more similar for the 90:10 program.

English Tasks

All Bilingual Children

To evaluate the impact of the two prevalent two-way dual-language learning contexts on English reading and language learning and mastery (Research Hypothesis 1), we compared children in 50:50 ($n = 83$) and 90:10 ($n = 81$) dual-language learning contexts. In a repeated-measures MANOVA, we compared performance of all 50:50 and 90:10 bilingual children on English tasks. Results showed that the bilingual children in 50:50 and 90:10 dual-language learning context overall performed similarly on English tasks, $F(1,161) = 1.704$, $p > .05$, partial $\text{Eta}^2 = .010$. Based on the Mauchly's statistic of sphericity, $\chi^2 = 742.727$, $df = 9$, $p < .05$, we used a Greenhouse-Geiser ($\varepsilon = .344$) correction for our tests of task and interaction. The main effect of task was significant, $F(1.374, 221.253) = 1338.359$, $p < .01$, partial $\text{Eta}^2 = .893$. The interaction between dual-language learning context and task categories approached but did not reach significance, $F(1.374, 221.253) = 2.814$, $p > .05$, partial $\text{Eta}^2 = .017$. In a planned mixed 2 (between; 50:50 vs. 90:10) $\times$ 5 (within; tasks) MANOVA, we compared performance on each of the five English task categories for all students in the two dual-language learning contexts (50:50 and 90:10; see Figure 1). Our results showed no significant differences in overall performance between the 50:50 and 90:10 dual-language children in the performance on the Language Competence/Expressive Proficiency task, $F(1,161) = .085$, $p > .05$, and the Passage Comprehension task, $F(1,161) = 1.115$, $p > .05$.

Results showed that 90:10 dual-language children performed significantly better than the 50:50 dual-language children on both the Phonological Awareness tasks, $F(1,161) = 20.64$, $p <$

TABLE 2
Percent Correct Scores (With Standard Deviations) for (a) English and (b) Spanish Tasks for Each Reading Task Separated First by Learning Context and Then by Language Exposure Group

			Reading Decoding		Phonological Awareness				
		LCEP	Regular Words	Nonwords	Initial Deletion	Final Deletion	Phoneme Segmentation	Irregular Words	Passage Comprehension
English									
50:50 Dual-Language	Bilinguals from home	60.43 (22.2)	81.52 (17.8)	30.29 (22.3)	84.34 (18.93)	72.39 (31.7)	45.45 (32.0)	36.09 (27.4)	49.03 (23.1)
	Bilinguals from school	86.58 (9.7)	94.32 (9.3)	60.00 (17.7)	98.65 (3.5)	95.41 (8.4)	77.76 (21.9)	68.92 (21.3)	86.94 (13.1)
	OVERALL	72.23 (21.9)	87.23 (15.9)	43.53 (25.1)	90.72 (15.9)	82.65 (26.7)	59.86 (32.2)	50.72 (29.7)	65.93 (27.0)
90:10 Dual-Language	Bilinguals from home	68.72 (20.7)	88.00 (14.9)	49.61 (18.4)	96.33 (9.2)	90.50 (14.1)	74.62 (15.0)	37.33 (27.6)	59.63 (21.9)
	Bilinguals from school	85.98 (11.0)	89.52 (12.0)	56.19 (21.2)	98.57 (6.6)	91.43 (13.5)	78.14 (16.1)	51.90 (30.8)	67.2 (17.0)
	OVERALL	73.19 (20.1)	88.40 (14.2)	51.32 (19.2)	96.91 (8.61)	90.74 (13.9)	75.53 (15.3)	41.11 (29.0)	61.59 (20.9)
English Single-Language	English Monolinguals	84.35 (13.8)	87.96 (16.3)	54.01 (22.1)	94.69 (15.3)	89.18 (19.0)	84.51 (16.1)	54.9 (32.5)	75.62 (20.0)
Spanish									
50:50 Dual-Language	Bilinguals from home	68.74 (17.39)	88.04 (19.8)	74.35 (18.9)	91.09 (12.3)	81.74 (15.4)	68.28 (28.5)	74.78 (27.8)	65.94 (29.7)
	Bilinguals from school	40.20 (32.2)	60.00 (25.5)	49.10 (18.8)	90.27 (18.6)	77.03 (20.4)	74.45 (24.1)	50.81 (23.0)	19.37 (25.8)
	OVERALL	59.36 (26.7)	75.54 (26.4)	63.09 (22.6)	90.72 (15.4)	79.64 (17.8)	71.03 (26.6)	64.10 (28.3)	45.18 (36.3)
90:10 Dual-Language	Bilinguals from home	70.81 (15.6)	95.17 (7.0)	81.17 (15.5)	94.00 (13.7)	88.17 (17.4)	84.47 (17.4)	88.83 (9.6)	76.94 (18.6)
	Bilinguals from school	56.38 (23.2)	94.00 (8.2)	80.33 (16.5)	94.5 (6.0)	92.5 (16.5)	92.27 (16.8)	84.00 (10.5)	63.89 (17.2)
	OVERALL	67.2 (18.7)	94.13 (7.3)	80.96 (15.6)	94.13 (12.2)	89.25 (15.2)	86.42 (17.5)	87.63 (10.0)	73.68 (19.0)

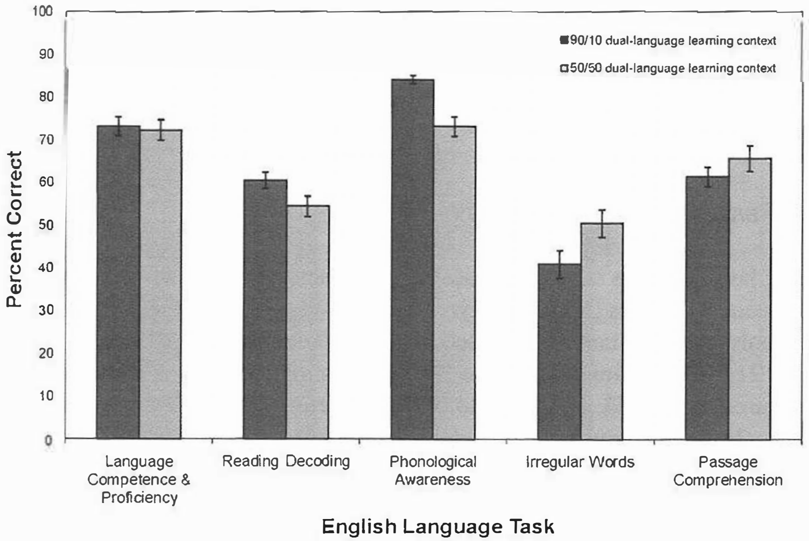

FIGURE 1 Mean percent correct and standard error results for bilingual children educated in 90:10 and 50:50 dual-language learning contexts on the five categories of English tasks: Language Competence/Expressive Proficiency, Reading Decoding, Phonological Awareness, Irregular Words, and Passage Comprehension.

.001, and on the Reading Decoding tasks, $F(1,161) = 4.79$, $p < .05$. The 50:50 dual-language children performed significantly better than the 90:10 dual-language children on the Irregular word reading task, $F(1,161) = 3.97$, $p < .05$ (see Figure 1).

All Children

Planned additional analyses were conducted between children in the two dual-language learning contexts ($n = 164$) and children in the single-language learning context ($n = 49$) for the three task categories in which we found a significant difference between the two dual-language learning contexts. These analyses revealed that the specific dual-language learning group that performed better for each task group performed similarly to all single-language learning context children (e.g., the 90:10 dual-language learning group performed better than the 50:50 dual-language learning group, and similar to the single-language learning context children, on the Phonological Awareness tasks; see Table 2). This finding suggests important differences in the depth of processing learned in each dual-language learning context.

In particular, addressing Research Hypothesis 1, our results show that children in the 50:50 dual-language learning context performed similarly to all children in single-language learning contexts and significantly better than children in the 90:10 dual-language learning context, on the Irregular word reading task requiring strength in deep language structure analysis, $F(2,208) = 4.015$, $p < .019$ (see Figure 1; Table 2). Children in a 90:10 dual-language learning context performed similarly to all single-language learning context children, and significantly better than

children in the 50:50 dual-language school, on the Phonological Awareness tasks, $F(2,208) = 19.782$, $p < .001$, and the Reading Decoding tasks, $F(2,208) = 3.710$, $p < .03$ (see Figure 1; Table 2), suggesting strength in surface language structure analysis. We return to these Research Hypothesis 1 findings and discuss their implications in the Discussion section.

Children From English-Only Speaking Homes

To evaluate how learning context impacted performance of English tasks by children from English-only speaking homes (Research Hypothesis 2), we compared the children's performance from English-only-speaking homes, educated in (a) 50:50 dual-language ($n = 37$), (b) 90:10 dual-language ($n = 21$), and (c) single-language English learning contexts ($n = 49$; see Table 1). In a repeated measures MANOVA we found no overall difference in performance between children from English-only homes educated in 50:50 dual-language, 90:10 dual-language, and single-language learning contexts, $F(2,103) = 1.61$, $p > .05$, partial Eta 2 = .030. Based on the Mauchly's statistic of sphericity $\chi^2 = 329.310$, $df = 9$, $p < .05$, we used a Greenhouse-Geiser ($\varepsilon = .466$) correction for our test of main effect of task and an interaction. The main effect of task was significant, $F(1.862, 191.814) = 2456.155$, $p < .01$, partial $\text{Eta}^2 = .960$. The interaction between learning context and task categories for children from English-only homes was not significant, $F(3.725,191.814) = .738$, $p > .05$.

In a planned mixed 3 (between; learning context) x 5 (within; task categories) MANOVA, we compared performance on each the five English task categories for the three learning contexts for children from English-only-speaking homes (90:10 dual-language, 50:50 dual-language, and single-language English learning context; see Figure 2; Table 2). Our results showed no significant differences in overall performance among the three learning contexts on performance on the Language Competence/Expressive Proficiency task, $F(2,103) = .392$, $p > .05$; the Phonological Awareness tasks, $F(2,103) = .252$, $p > .05$; and the Reading Decoding tasks, $F(2,103) = 1.252$, $p > .05$ (see Figure 2).

There was, however, a significant effect of learning context for the Irregular Word reading task, $F(2,103) = 3.148$, $p < .05$, with children from English-only homes educated in a 50:50 dual-language learning context performing best and children from English-only homes educated in a 90:10 dual-language learning context performing worst (see Figure 2). Based on the significant main effect for the Irregular word task across the three groups, we conducted post hoc Tukey comparisons between learning contexts and found no significant effects, $p > .05$.

There also was a significant effect of learning context for the Passage Comprehension task, $F(2,103) = 9.420$, $p < .001$, again with children from English-only homes educated in a 50:50 dual-language learning context performing best and children from English-only homes educated in a 90:10 dual-language learning context performing worst (see Figure 2). Based on the significant main effect for the Passage Comprehension task, we conducted post hoc Tukey comparisons between learning contexts. Our Tukey tests showed that children from English-only homes educated in a 50:50 dual-language learning context performed significantly better than children from English-only homes educated in a 90:10 dual-language learning context, $p < .001$. Remarkably, post hoc Tukey tests also showed the children from English-only homes educated in a 50:50 dual-language learning context performed significantly better than children from English-only homes educated in a single-language learning context on this Passage Comprehension task,

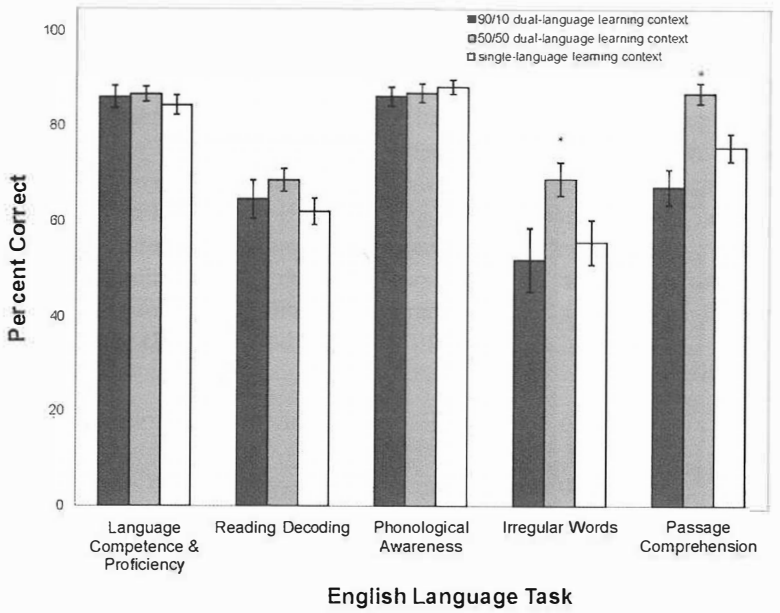

FIGURE 2 Mean percent correct and standard error results for children from English-only homes educated in 50:50 dual-language, 90:10 dual-language, and monolingual single-language learning context on the five categories of English tasks: Language Competence/Expressive Proficiency, Reading Decoding, Phonological Awareness, Irregular Words, and Passage Comprehension.

$p < .015$. These findings speak to Research Hypothesis 2, showing evidence of a *bilingual reading advantage* for children from English-only homes learning in a dual-language context.

Spanish Tasks

All Bilingual Children

To evaluate the impact of the prevalent two-way dual-language learning contexts on Spanish reading and language mastery (Research Hypothesis 1), we compared all children in 50:50 ($n = 83$) and 90:10 ($n = 81$) dual-language learning contexts (see Table 1). In a repeated-measures MANOVA, we compared performance of all 50:50 and 90:10 dual-language children on the five Spanish task categories. As predicted, 90:10 dual-language children (who received intense early instruction in Spanish) significantly outperformed 50:50 dual-language children on all Spanish tasks, $F(1,145) = 18.65$, $p < .001$, partial $\text{Eta}^2 = .114$. In planned comparisons, we separately compared performance on the five Spanish task categories for the two dual-language learning contexts (50:50 and 90:10; see Figure 3; Table 2). Our results showed that 90:10 dual-language children performed significantly better than 50:50 dual-language children on the Language Competence/Expressive Proficiency, Reading Decoding, Phonological

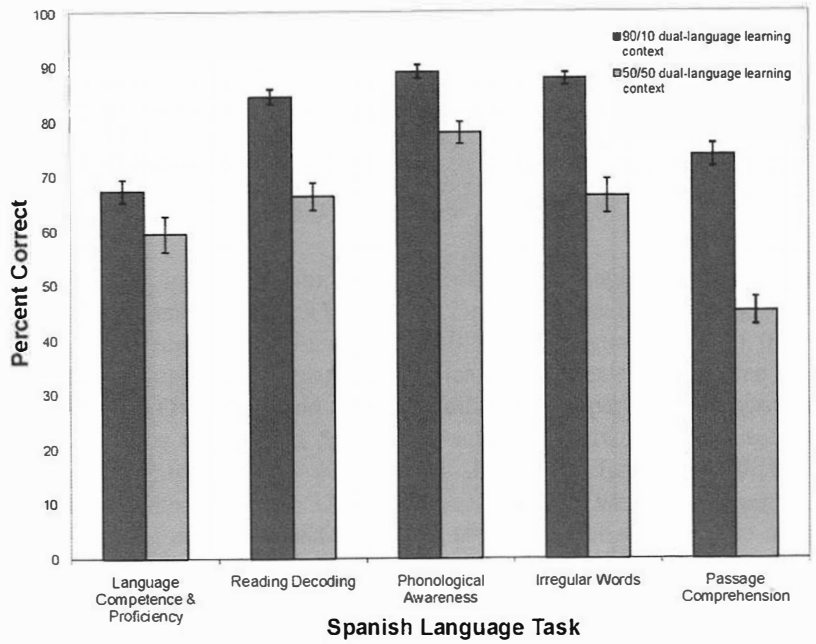

FIGURE 3 Mean percent correct and standard error results for bilingual children educated in 90:10 and 50:50 dual-language learning contexts on the five categories of Spanish tasks: Language Competence/Expressive Proficiency, Reading Decoding, Phonological Awareness, Irregular Words, and Passage Comprehension.

Awareness, Irregular Words, and Passage Comprehension tasks in Spanish ($p < .05$). Here we see that Spanish language and reading mastery is best in children in a 90:10 dual-language learning context.

DISCUSSION

In this study we asked which of the two prevailing dual-language learning contexts ("Simultaneous" 50:50 or "Sequential" 90:10) leads to optimal reading and language mastery in each of a young bilingual's two languages, with two primary discoveries ensuing. We found important differences between learning in the 50:50 and 90:10 dual-language learning contexts and the bilingual children's reading and language mastery on our battery of standardized tasks taken from multiple tests and sources. We found a surprising *reading advantage* in bilingual children learning in a dual-language learning context (both 50:50 and 90:10) as compared to monolingual children learning in a single-language learning context. Bilingual children from English-only homes who attended a *dual-language* Spanish-English school, with maximally 50% of their instruction in English, performed equally well and even better on English reading tasks than their matched monolingual English-only peers with 100% instruction in their

single-language English learning context. All of this remarkable English reading advantage occurred in addition to early instruction in Spanish!

In drawing together the children's reading and language-learning performance differences across simultaneous (50:50) and sequential (90:10) dual-language learning contexts and the impact of dual-language versus single-language learning contexts, we have identified several crucial factors (of many possible factors), such as proportion spent in each language, which our findings suggest can be helpful when planning dual-language educational curricula. These findings are early, and future studies are urgently needed. At the same time, we hope to have contributed new ideas regarding some of the key factors to consider when designing optimal reading and language programs for young bilingual children—those that advance bilingual reading and language learning in the classroom and across the lifespan.

Dual-Language Learning Context and English Performance

Children across the two dual-language learning contexts (50:50 and 90:10) showed no differences in performance on the English LCEP task (see Figure 1). By contrast, the children across the two dual-language learning contexts showed distinct patterns of performance on some of the reading tasks. We do acknowledge that our schools being located in different geographical regions, which as we discuss previously was a necessity, could play a role in these results, but we believe it is more likely that the difference in reading and language performance was due to the different dual-language learning contexts. Children educated in a 90:10 dual-language learning context excelled at more language-general, phonologically based tasks (Phonological Awareness, Reading Decoding; see Figure 1), which rely heavily on surface phonetic sound analyses and sound-to-letter analyses. Children educated in 50:50 dual-language learning contexts excelled at language-specific, structural tasks (Irregular Word task, Passage Comprehension; see Figure 1), which rely heavily on deeper underlying grammatical and structural analyses. These findings are indeed helpful as they shed new light on how the different dual-language learning contexts (50:50 and 90:10) tap into *different aspects* of reading and language processing, and, thus, enhance our understanding about the different benefits gained from each dual-language learning context.

90:10 Dual-Language Learning Context

That the children educated in 90:10 dual-language learning contexts excelled on the phonologically based tasks in English is predicted by a core assumption about learning that is implicitly at the heart of this dual-language learning context: that it is best to establish a firm base of knowledge in one domain for successful *transfer* to the acquisition of a new domain, whereupon conceptual bridges are drawn between the two domains based on shared relevance, similarity, context, and structure (for a lively discussion of the key principles and debate in this literature see Barnett & Ceci, 2002; Gentner, Holyoak, & Kokinov, 2001; Mestre, 2002; Singley & Anderson, 1989; Thorndike & Woodworth, 1901). Recall that children in 90:10 programs first learn to read in Spanish, a language with a shallow orthography that relies very heavily on phonological skills and sound-to-letter correspondence and then, gradually over time, are introduced to greater and greater amounts of English (which is a language with "deep" orthography). Here, the idea is

that children in 90:10 dual-language learning will first build reading skills within the minority language (in this case, Spanish) and then transfer them to the new majority language (in this case, English). Thus, Spanish readers may, and in our study did, successfully transfer their strong sound segmentation and decoding skills to English. However, as noted earlier, English has "deep orthography" that requires deeper grammatical/structural word-specific knowledge for successful reading, and these are the levels of language organization in reading that children in the 90:10 program found more challenging, and they likely require more time through at least Grade 5 for mastery.

50:50 Dual-Language Learning Context

That the children educated in 50:50 dual-language learning contexts excelled on the tasks requiring deeper underlying word-specific and grammatical analyses in English is predicted by a core assumption about learning that is implicitly at the heart of this dual-language learning context—that exposure to two similar domains (e.g., the two sets of meaningless phonetic units of two languages)—pushes the learner beyond surface analyses, and, instead, to attend to deeper underlying structural regularities or patterns, which facilitates understanding of the key differences that make the two structures (two languages) utterly distinct. Though fascinating and counterintuitive at first; rather than the similarities causing confusion, it is the very closeness of these similarities that causes the perceiver to *pull apart* the two related systems and to establish strong and distinct representations (e.g., Petitto et al., 2001). Children in 50:50 dual-language programs receive a more balanced blend of English and Spanish instruction within the same developmental growth time period. Here, the idea is that children in 50:50 programs build reading skills that not only include, but push beyond, surfaces similarities, and, instead, engage in deeper tacit comparative analyses of the underlying conceptual structures in the two languages — especially involving the core lexical/semantic and morphosyntactic representations in the printed text in reading. In our study these 50:50 children indeed performed better on tasks that require a strong underlying structural analysis capacity, although they were slightly weaker in phonetic decoding skills. Importantly, they learned two reading systems and two languages simultaneously, without delay or confusion.

Dual-Language Learning Context and Spanish

It is of little surprise that the children in 90:10 dual-language programs performed well and better than children in the 50:50 dual-language program on the Spanish reading and language tasks, and it is consistent with previous findings (Carlisle and Beeman, 2000; Howard, Sugarman, & Christian, 2003; see Figure 3). Again, these 90:10 children spent the lion's share of their day learning in Spanish over a protracted period of time (spanning Kindergarten–Grade 5), and, in many cases, the children's home language was Spanish. This better performance suggests that children in 90:10 dual-language programs are indeed developing an understanding of the phonological and structural components of the Spanish language. To be sure, these 90:10 children are well performing, and they are learning successfully what they are being taught, namely, Spanish, but powerful equal and comparable facility with the underlying linguistic structures in English and in Spanish was not evidenced in our data.

Dual-Language versus Single-Language Learning

It is remarkable that our results show that children from English-only homes educated in 50:50 dual-language programs performed better than children from English-only homes educated in 90:10 dual-language programs *and* monolingual children from English-only homes educated in a single-language learning context on the Irregular Words and Passage Comprehension tasks, given that these tasks require crucial components for achieving reading mastery. Correct reading of irregular words requires that the reader be familiar with the underlying structure of such words because these words have a low sound-to-letter correspondence (recall English is a language with deep orthography). Correct performance on the Passage Comprehension task requires the convergence of many different aspects of language decoding and processing, including reading regular and irregular words, semantics, syntax, and morphology. This reading task tapped most deeply into children's knowledge and understanding of the English language. Our results show that dual-language schooling for children from English-only homes most certainly does not harm reading and language development in their native language (English), and most notably, may provide a *reading advantage* in their native language (Kovelman et al., 2008a) along the way to becoming bilingual.

Which Dual-Language Learning Context Is Optimal for Learning?

Both the 90:10 and 50:50 dual-language learning contexts have strengths and weaknesses, which we first briefly summarize. We then propose that the 50:50 dual-language learning context, with key expansions, may be the most optimal learning path if the goal is to promote comparable and comparably high reading and language mastery in two languages. The key factors that compel this conclusion include identification of (a) which of the two learning contexts supports greater dual-language reading knowledge and competency, and (b) which of the two learning contexts supports greater memory and skill competency.

Long-Term Dual-Language Reading Knowledge and Competency

The 90:10 learning context promotes strong phonological awareness in Spanish and in English, which is one of the crucial foundational pillars of early reading acquisition and development. Yet our results showed that for these second- and third-grade students, 90:10 dual-language learning was not overly powerful in terms of promoting learning of deeper grammatical, structural, and semantic relational analyses when reading in English. It is probable that these 90:10 students may show more evidence of transfer on these deeper levels of language at upper levels of schooling (e.g., Collier & Thomas, 2009; Howard et al., 2003; Lindholm-Leary, 2001; Rolstad et al., 2005; Thomas & Collier, 2002). However, addressing this question is beyond the scope of the current study.

By contrast, our results showed that 50:50 dual-language learning promotes comparably high grammatical, structural, and semantic relational analyses in second- and third-grade children when reading English (though less so in Spanish), which studies have shown to be a particularly important predictor of reading proficiency (e.g., Baker, Stoolmiller, Good, & Baker, 2011). While these 50:50 dual-language children were not as adept as the other children in phonological

awareness skills or Spanish reading skills, the 50:50 children showed no evidence of delay or confusion as a result of learning to read in two languages at once (see Figures 1 and 3). We predict that these 50:50 students will continue to show good performance on these deep aspects of language and likely will improve their phonological awareness skills in the upper grades.

It is now understood that sensitivity to the phonological patterns of a language in early life is important to successful reading acquisition. Such phonological training has also been shown to be effective in increasing phonemic skills and reading ability (e.g., Bruck & Genesee, 1995; National Institute of Child Health and Human Development, 2000; Torgesen, Wagner, & Rashotte, 1994; Wolf & Katzir-Cohen, 2001), although these benefits to skilled reading are attenuated as children move up in school grades. With birth exposure to Spanish, a language that has a shallow orthography, and later exposure to English—a situation that can be most common in the United States—a 90:10 program can have a healthy prognosis toward enabling this child to achieve language and reading mastery because children learning a language with shallow orthography show excellent phonological decoding skills, as they did in this study. Here, children moving from early shallow to later deep orthographies appear to do well in the 90-10 program.

Our previous studies (Kovelman et al., 2008a; Kovelman et al., 2013), and the current study, have shown that 50:50 bilingual programs are strong, and excellent for gaining deep knowledge of language(s), particularly if the child had *early* exposure to his/her two languages, in this case English and Spanish. Thus, we propose that an important factor in predicting a child's dual-language success also involves the nature of the child's new language's target reading-writing (orthographic) system. In particular, the 50:50 learning context with a crucial "expansion" may ultimately prove to be most optimal for learning. Specifically, we propose increasing explicit exposure to and training in phonological (phonetic and phonemic) decoding, manipulation, and sound-to-letter (grapheme) patterns during *only* the early school years in both languages (e.g., Grades 1 and 2) to the 50:50 children so that they have a solid foundation in both surface and deep grammatical features from the beginning of their education. We hypothesize that this expansion will be particularly beneficial for children who are exposed to languages with a deep orthography from birth (e.g., English or English and Spanish from birth) because of the added language and reading benefits from training in phonological decoding. Our hypothesis here is that the benefits of the dual-language program are likely influenced by the specific combination of bilingual orthographies being acquired and the age of acquisition of each language, and one we further investigate in Kovelman et al. (2013). More research is needed to examine this hypothesis with other bilingual pairings, such as going from deep to shallow, or shallow to shallow, and the like, which might show different patterns of success.

CONCLUSIONS

Overall, the present findings provide tantalizing evidence for the new hypothesis that the orthographies of the home language(s) and the languages to be learning play an important role in determining which bilingual program is most optimal. For children coming from languages with a deep orthography, learning in the 50:50 dual-language learning context, whereupon reading and language activities take place in two different languages during the same developmental time period, may actually provide children with *bilingual reading and language processing advantages*. Based on our findings, we propose that the 50:50 dual-language learning, in combination

with phonological training in the early school years, may provide the most optimal and enduring type of bilingual language learning—a hypothesis that suggests especially rich avenues for future investigations, particularly longitudinal studies. Another intriguing observation that follows from the present study is that dual-language education may provide bilingual children from English-only homes with a "reading advantage," whereby they may develop key components of successful reading and language ahead of their monolingual peers in a single-language learning context. Additional research is vitally needed, as studies of this sort involving hundreds of children, different schools spanning a nation, and a vast array of empirical factors, are naturally challenging. Nonetheless, it is our hope that the present evidence will be helpful to scientists, parents, educators, and educational policy makers alike, especially when planning optimal educational environments both for bilingual and for monolingual children to learn.

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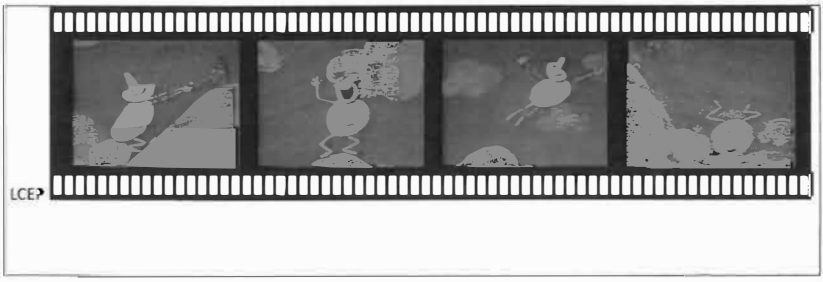
APPENDIX: READING AND LANGUAGE TASK INSTRUMENTS

Task Category for Analysis	Task Name	Example Task with Answer
Phonological Awareness Tasks	Initial Deletion	"cat" without the /c/ is....."at"
	Final Deletion	"seat" without the /t/ is...."sea"
	Yopp-Singer	What are the sounds in "dog".../d/ /o/ /g/
Reading Decoding Tasks	Regular word reading	cold
	Nonword reading	lish
Irregular word reading		loser
Passage Comprehension		The ____ is on the chair...."hat"



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