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Article

The Efficacy of a Vocabulary Intervention for Dual-Language Learners With Language Impairment

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Purpose: In this study, the authors evaluated the efficacy of a Spanish–English versus English-only vocabulary intervention for dual-language learners (DLLs) with language impairment compared to mathematics intervention groups and typically developing controls with no intervention. Further, in this study the authors also examined whether the language of instruction affected English, Spanish, and conceptual vocabulary differentially.
Method: The authors randomly assigned 202 preschool DLLs with language impairment to 1 of 4 conditions: bilingual vocabulary, English-only vocabulary, bilingual mathematics, or English-only mathematics. Fifty-four DLLs with typical development received no intervention. The vocabulary intervention consisted of a 12-week small-group dialogic reading and hands-on vocabulary instruction of 45 words. Postintervention group differences and linear growth rates were examined in conceptual, English, and Spanish receptive and expressive vocabulary for the 45 treatment words.
Results: Results indicate that the bilingual vocabulary intervention facilitated receptive and expressive Spanish and conceptual vocabulary gains in DLLs with language impairment compared with the English vocabulary intervention, mathematics intervention, and no-intervention groups. The English-only vocabulary intervention differed significantly from the mathematics condition and no-intervention groups on all measures but did not differ from the bilingual vocabulary intervention. Vocabulary growth rates postintervention slowed considerably. Results support the idea that bilingual interventions support native- and second-language vocabulary development.
Conclusion: English-only intervention supports only English. Use of repeated dialogic reading and hands-on activities facilitates vocabulary acquisition.

Key Words: bilingual, language impairment, vocabulary, growth models, children, cultural and linguistic diversity, Spanish

Vocabulary enrichment programs are critical to improve outcomes in children at risk of academic difficulties. At-risk children include those who come from low-income homes, are learning English as a second language in the United States (i.e., dual-language learners [DLLs]), and/or are identified with language impairment. Such programs could ensure that the vocabulary deficiencies and achievement gaps of DLLs do not increase with schooling (Carlo et al., 2004; T. A. Roberts, 2008), given that vocabulary is a significant predictor of reading comprehension in children in general and specifically in DLLs (e.g., Carlo et al., 2004; Proctor, August, Carlo, & Snow, 2006; Proctor, Carlo, August, & Snow, 2005). Programs that address vocabulary knowledge in at-risk preschool DLLs and those with language impairment are limited, and guidelines on instructional techniques and language of intervention are just emerging (Collins, 2010; Garcia & Gonzalez, 2006; Garcia & McLaughlin, 1995). The purpose of the current study was to evaluate the efficacy of a vocabulary intervention for preschool children with language impairment that capitalizes on evidence-based and dual-language instruction.

Language impairment is a broad term that includes specific language impairment (Leonard, 1998), borderline cognitive skills, and cognitive delays. In the context of the current study, we included children with typical and borderline cognitive skills because we deem this population to be more representative of the children attending public schools. We focused on DLLs with language impairment to address the specific needs of this at-risk group.

Language of Intervention

Development of English as a second language (L2) in DLLs is critical for academic success (e.g., Garcia & Gonzales, 2006; Proctor et al., 2006), although it does not have to be at the cost of losing their first language (L1; Kohnert, Yim, Nett, Kan, & Duran, 2005). Research on DLLs with typically developing language indicates that when

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available, bilingual programs are appropriate for L1 and L2 acquisition (Barnett, Yarosz, Thomas, Jung, & Blanco, 2007; Rolstad, Mahoney, & Glass, 2005). For example, Barnett et al. (2007) compared oral language outcomes for DLLs in bilingual programs to outcomes of peers in English-only programs. Students in the bilingual program made equal gains in English and significantly larger gains in Spanish than students in English-only programs. Further, in a meta-analysis of 17 studies that examined the impact of bilingual education on academic achievement in kindergarten through Grade 12, Rolstad et al. (2005) found no advantage for English-only (L2) instruction over bilingual instruction. On the contrary, on average, students enrolled in bilingual education significantly outperformed students in English-only education by effect sizes of .23 in L2 and .86 in L1; however, these studies did not include preschool children. Preschool programs for DLLs with language impairment may not have access to bilingual intervention due to states' language education laws, limited numbers of bilingual professionals, and professionals' recommendations to provide intervention in only one language to children with disabilities (see Kohnert & Derr, 2012, for a discussion). Therefore, DLLs with language impairment need programs that increase the rate of language growth similar to that of their typically developing (TD) peers to close the gap in language development.

L2-only model of intervention for DLLs with language impairment. The L2-only intervention model provides DLLs with instruction only in their L2 (English for programs in the United States), which is often the DLLs' weaker language. The hypothesis motivating English-only intervention is that the longer the child spends learning the L2, the better the acquisition of that language. L2-only education and intervention programs are supported by research that indicates that the amount of time in the L2 country predicts growth in that language (Paradis, 2010; Pearson, Fernández, & Oller, 1993). At the same time, Kan and Kohnert (2012) found that current vocabulary knowledge in one language predicted the acquisition of new vocabulary in that same language; further, given the same amount of support in each language, there were no differences in growth rates in L1 or L2 novel words when different words were taught in each language.

Research on DLLs indicates that children do not necessarily transfer vocabulary labels from one language to the other (Collins, 2010). DLLs' vocabulary in preschool is composed of many unique words in each language versus translation equivalents (Kan & Kohnert, 2005; Peña, Bedore, & Zlatic-Giunta, 2002), indicating that children acquire vocabulary in the context in which they hear it. In the same vein, studies have indicated that the current level of English L2 vocabulary knowledge is a strong predictor of future levels of English vocabulary (Kan & Kohnert, 2008, 2012; Proctor et al., 2005; Simon-Cereijido & Gutiérrez-Clellen, 2009; Yesil-Dagli, 2011); therefore, if the goal is to ensure that DLLs are academically successful in English, they must develop English vocabulary skills.

In general, L2-only programs, including English-only programs in the United States for Spanish-speaking children, have been found to increase students' English development but not their Spanish development; in contrast, bilingual programs have been shown to facilitate the development of both languages (e.g., Barnett et al., 2007; Cobo-Lewis, Pearson, Eilers, & Umbel, 2002; Lugo-Neris, Jackson, & Goldstein, 2010). Although bilingual language programs support both languages, L2-only models may be the only option available to many preschool DLLs with language impairment. Therefore, it is important to understand the impact of bilingual and L2-only programs on the development of preschool DLLs' two languages. Further, when compared to bilingual interventions, it should be determined whether quality instruction in a supportive L2 environment (Kan & Kohnert, 2012) is advantageous to L2 development for DLLs with language impairment.

One caveat with L2-only models of intervention is that research indicates that DLLs' L1 skills are at risk of plateau in development or language attrition, especially in bilingual preschool children who are still developing their L1 (Barnett et al., 2007; Kan & Kohnert, 2005; Restrepo et al., 2010) and more so in children with language impairment (Restrepo, 2003). These studies indicate that when the L1 of preschool DLLs is not systematically and intentionally supported, the L1 growth slows, especially in literacy, vocabulary, sentence length, and sentence complexity (Barnett et al., 2007; Cobo-Lewis et al., 2002; Kan & Kohnert, 2005; Proctor et al., 2005; Restrepo et al., 2010; Tabors, Paez, & Lopez, 2003). Combined, these studies indicate that English-only educational policies may be detrimental to preschool-age DLLs' overall L1 development, which is the language needed for communication in the home and the bilingual/bicultural community at large.

Because the overarching goal of language interventions for children with language impairment is to approximate the language development of TD peers, it is important to document the impact of L2-only instruction on typical DLLs who attend regular preschool programs and compare their language development to DLLs with language impairment in intervention. It is possible that when providing L2-only instruction through a well-designed, supportive program, DLLs with language impairment can improve their English vocabulary skills to the level of TD peers who attend L2 immersion bilingual programs. Therefore, regardless of the language of intervention for language impairment, it is important that these interventions increase the rate of vocabulary development to levels similar to TD peers.

Bilingual programs for DLLs with language impairment. Few studies have investigated the efficacy of bilingual vocabulary interventions with preschool DLLs with language impairment (broad definition of language impairment). Results from these studies indicate that bilingual language instruction does not reduce the rate of L2 acquisition (Kay-Raining Bird et al., 2005; Thordardottir, Weismer, & Smith, 1997) and possibly facilitates L2 acquisition (Perozzi, 1985; Perozzi & Chavez-Sanchez, 1992). Kiernan and Swisher (1990) and Perozzi and colleagues (Perozzi, 1985; Perozzi & Chavez-Sanchez, 1992) found that teaching concepts (prepositions or pronouns) bilingually led to faster acquisition of

those concepts in the L2 receptive modality when compared with teaching them only in the L2. The Perozzi studies are important in that they were the first to demonstrate the need for bilingual teaching approaches in the bilingual language impairment population; however, the studies are limited in scope in that they examined only gains in L2, addressed only one or two concepts per study, and focused on only receptive vocabulary skills. Examination of a broader approach to vocabulary intervention that includes current evidence-based practices in vocabulary instruction is still needed. Further, examination of the impact of bilingual instruction on conceptual development, expressive language skills in the children's L1, and L2 acquisition will help us to better understand how children develop vocabulary in each language in receptive and expressive modalities.

Given that preschool DLLs with language impairment are at a greater risk of L1 attrition, stagnation, and incomplete acquisition than TD peers (Restrepo, 2003; Restrepo & Kruth, 2000), bilingual language intervention would facilitate the maintenance and development of DLLs' L1, which is critical for communication at home and for culture transmission, among other advantages (Kohnert & Derr, 2012). For young DLLs with TD, bilingual intervention uses the child's L1 as a foundation and is strongly correlated with L1 skills and L2 reading achievement (August, Carlo, Dressler, & Snow, 2005; Carlo et al., 2004). It is presumed that these cross-language relationships also hold true for DLLs with language impairment. Further, the use of L1 instruction first facilitates the learning of the same concept in the L2, especially in early L2 acquisition stages (Calderón et al., 2005; Kroll & Stewart, 1994; Lugo-Neris et al., 2010; Perozzi, 1985; Perozzi & Chavez-Sanchez, 1992; T. A. Roberts, 2008). Therefore, an intervention that teaches the target vocabulary in the L1 first and focuses on increasing both L1 and L2 vocabulary should facilitate concept learning in the two languages, accelerate L2 acquisition, and help children with language impairment maintain their L1.

Evidence-Based Practices in Vocabulary Instruction

Research on dialogic reading indicates that children make vocabulary gains when adults read books using a conversational or social interaction format in which they highlight target vocabulary (Mol, Bus, & de Jong, 2009; Wasik & Bond, 2001; Weizman & Snow, 2001). Such vocabulary highlighting includes providing rich definitions or explanations of the target words. Collins (2010) and Lugo-Neris et al. (2010) found that preschool DLLs with TD who participated in shared book reading with rich target word explanations in their L1 or L2 made significant gains in target vocabulary. In addition, repeated dialogic reading has been found to increase vocabulary to a greater extent than a single reading of a book (Schwanenflugel et al., 2010). These results indicate that repeated dialogic book reading in preschool children's L1 and L2 significantly increases vocabulary knowledge.

Practicing vocabulary words in a variety of semantically rich contexts (Beck, McKeown, & Omanson, 1987) facilitates learning and retention of vocabulary for DLLs learning English (Calderón et al., 2005; Carlo et al., 2004; Collins, 2010). Similarly, preteaching, reading aloud, and reviewing the words learned in previous days and weeks help children learn vocabulary in elementary grades (Vaughn et al., 2006) and in preschool (Schwanenflugel et al., 2004). Further, concrete, hands-on activities in conjunction with repeated reading in the L1 and L2 to teach vocabulary provide not only a variety of semantically rich contexts, but also multiple L1 and L2 opportunities for children to practice the new target words and establish semantic associations. Preschool DLLs with language impairment should benefit from such practices, given that these children need additional exposure to learn new words in comparison to TD peers (Gray, 2003, 2004). Repetition and review are necessary to ensure retention of new words and to maximize learning.

In summary, vocabulary has been identified as a critical skill for at-risk DLLs to improve academic achievement (Carlo et al., 2004; Proctor, et al., 2005, 2006). Low-income preschool DLLs with language impairment are at an increased risk for academic difficulties (Restrepo & Kruth, 2000). Vocabulary intervention may help DLLs with language impairment close the academic achievement gap with their TD peers by increasing their rate of vocabulary learning. Shared book reading, interactive hands-on activities, and repeated vocabulary knowledge use are techniques found to increase vocabulary knowledge. One concern is whether at-risk DLLs can make significant gains in vocabulary that approximate the rate of DLLs with TD, using evidence-based practices. Models of intervention seem to favor bilingual programs; however, L2-only programs are often the only option available to many DLLs with language impairment. It is possible that an L2-only intervention that is rich in language, systematic, and intensive can lead to greater gains in the L2 than a bilingual intervention. In the current study, we examined L2-only and bilingual versions of a vocabulary development program that uses evidence-based vocabulary intervention practices for improving the rate of vocabulary acquisition in preschool DLLs with language impairment.

Purpose of the Study

The purpose of the current study was to evaluate the efficacy of a vocabulary intervention for bilingual (Spanish–English) preschool children with language impairment who attended special needs preschools or Head Start programs. The intervention used evidence-based practices to form text-based scripted vocabulary add-on lessons. Further, the intervention evaluated the language of instruction when presented in English only versus bilingually (2 days in English and 2 days in Spanish per unit). Specifically, we addressed the following questions:

1. Does a bilingual vocabulary intervention for DLLs with language impairment result in the greatest scores and growth rates in (1) Spanish vocabulary and (2) conceptual vocabulary in the receptive and expressive

modalities in terms of scores (a) immediately following intervention and (b) 8 months postintervention when compared with English-only vocabulary intervention, bilingual mathematics intervention, English-only mathematics intervention, and to business-as-usual instruction for DLLs with TD?

2. Does an English vocabulary intervention for DLLs with language impairment result in the greatest scores and growth rates in (1) English and (2) conceptual vocabulary in the receptive and expressive modalities, in terms of scores (a) immediately following intervention and (b) 8 months postintervention when compared with bilingual vocabulary, bilingual math, and English-only math interventions, and to business-as-usual instruction for DLLs with TD?

Specifically, for Question 1, we examine Spanish receptive and expressive vocabulary, and receptive and expressive conceptual vocabulary. For Question 2, we examine English receptive and expressive vocabulary and receptive and expressive conceptual vocabulary. All these measure were obtained immediately after the intervention and 8 months postintervention. Further, we examined growth rates for all measures.

Method

Participants

Fifty-four preschool DLLs with TD (22 boys and 32 girls) age 48 to 64 months (M = 54.50, SD = 3.82) and 202 DLLs with language impairment (122 boys and 80 girls) age 43 to 68 months (M = 53.35, SD = 4.09) participated in the study. The last data collection (Time 4) contained 143 participants; attrition was due to families moving or inability to locate the child for testing. Table 1 reports sample sizes for each group at each time point and demographic and covariate data. Participants were recruited from Head Start or special education preschools in large metropolitan areas in the southwestern United States. Parents reported that all children spoke a Mexican dialect of Spanish. Qualification for free or reduced lunch and mother's level of education were indirect measures of socioeconomic status. Approximately 77% of the children qualified for free or reduced lunch; of the participants' mothers, 11% had a college or professional degree, 30% had a high school diploma, and 35% had completed only primary school. There were no significant differences between the TD and language impairment groups in eligibility for free or reduced lunch assistance, $\chi^2(3) = 3.57$, $p = .31$, or in mother's education, $\chi^2(6) = 7.13$, $p = .31$. As expected, there were significantly more boys than girls in the language impairment group, $\chi^2(1) = 9.96$, $p < .01$, which is consistent with the higher incidence of language impairment in boys than in girls in the broader population (e.g., Leonard, 1998).

Qualification Measures

Parent report of language use and proficiency. We used an adaptation of Restrepo's (1998) parent report measure to profile each participant's language use and proficiency, parental education level, and parents' concerns about their child's speech and language development. For preschool-age children, parent report has been found to be reliable for providing information on L1 use and proficiency (Bedore, Peña, Joyner, & Macken, 2011; Gutiérrez-Clellen & Kreiter, 2003) and concern for language impairment, when combined with other measures (Restrepo, 1998).

Nonverbal cognitive scales. Research assistants (RAs) administered the Kaufman Assessment Battery for Children (K–ABC; Kaufman & Kaufman, 2004) nonverbal scale to 89 participants to obtain nonverbal cognitive scores to rule out developmental delays. This measure was developed for use with Spanish-speaking participants, bilingual participants, and participants with language difficulties. Further, RAs administered the Differential Abilities Scale II (DAS–II; Elliott, 2007) nonverbal scale to 167 participants to obtain nonverbal cognitive scores to rule out cognitive delays. The DAS–II was not designed specifically with Spanish-speaking participants in mind; however, evidence suggests no significant difference in nonverbal composite scores (i.e., nonverbal index) between native-English-speaking children and children who speak English as a L2 (Riccio, Ross, Boan, Jemison, & Houston, 1997).

Spanish assessments. Children participated in four subtests of the Bilingual English Spanish Assessment (BESA). The Spanish morphosyntax subtest of the BESA (Peña, Gutiérrez-Clellen, Iglesias, Goldstein, & Bedore, n.d.) evaluated the Spanish grammatical morphology and syntax of the participants. In a similar population of Spanish–English DLLs, research indicates that children between the

Table 1. Participant demographics and descriptive statistics for covariates by intervention group.

Condition	N_1	N_2	N_3	N_4	Gender (% female)	Free/reduced lunch	Mother finished H.S.	M_{age} (*SD*)	*M* Sp. morph. (*SD*)	*M* NVI (*SD*)
Eng. math	52	50	40	28	46%	81%	82%	53.56 (4.59)	21.78 (16.11)	92.26 (13.77)
Bi. math	53	52	36	31	30%	78%	66%	52.06 (3.00)	22.57 (15.99)	90.62 (12.27)
Eng. voc.	45	45	36	30	44%	77%	70%	54.18 (4.10)	30.62 (15.86)	95.60 (12.42)
Bi. voc.	52	52	35	23	37%	84%	78%	53.61 (4.65)	20.59 (13.71)	92.53 (15.21)
Control	54	53	36	31	59%	71%	80%	54.50 (3.82)	68.30 (14.33)	102.43 (13.94)

Note. N_1–N_4 = sample size of each group at the four time points, all reported statistics are for the sample at Time 1; H.S. = high school; Sp. morph. = Spanish morphosyntax; NVI = nonverbal intelligence; Eng. = English; Bi. = bilingual; voc. = vocabulary.

ages of 48 and 61 months who scored less than 51% correct or children 62 months or older who scored less than 66% correct on the morphosyntax subtest of the BESA were accurately identified as having a language impairment (Gutiérrez-Clellen, Restrepo, & Simon-Cereijido, 2006). Similarly, on the semantic measure of the BESA, research indicates that children with TD score 6 or more at age 4 or 7 or more at age 5 on this measure (Peña, Gutiérrez-Clellen, Iglesias, Goldstein, & Bedore, n.d.).

The Spanish nonword repetition task of the BESA evaluated the phonological short-term memory of the child participants. Research indicates that when used in conjunction with other tests of language ability, this subtest provides adequate classification accuracy (Gutiérrez-Clellen & Simon-Cereijido, 2010; Simon-Cereijido & Gutiérrez-Clellen, 2007). The Spanish phonology task of the BESA was used to identify children with severe phonological or articulation disorders. This measure was used to exclude from the study children with severe intelligibility problems, given that language impairment and phonological disorders co-occur frequently.

RAs administered or attempted the English subtests of the BESA (morphosyntax, semantics, and nonword repetition) with all participants. Participants who did better in English than in Spanish were excluded from the study. English measures were used to document TD or language impairment when children appeared more bilingual than predominantly Spanish speaking.

Participant Selection Criteria

All participants met the following criteria: (a) parent report indicated no signs of hearing impairment, cognitive delays, or neurological deficits; (b) parent report indicated that the children spoke Spanish as their L1 and were not native English speakers; (c) scored 70 or higher on either the nonverbal scale of the K–ABC or the DAS–II; (d) scored higher than 40% on the Spanish phonology subtest of the BESA; (e) passed a pure tone hearing screening; and (f) were attending preschool.

All participants with TD met the following criteria: (a) teacher report indicated that the child was not receiving special education services; (b) scored higher than 51% if they were between age 48 and 61 months or higher than 65% if they were age 62 months or older on the Spanish morphosyntax subtest of the BESA; (c) scored higher than 69% on the Spanish nonword repetition task of the BESA; and (d) scored higher than a *t* score of 5 if they were between age 48 and 54 months or higher than a *t* score of 6 if they were older than 55 months on the Spanish semantics subtest of the BESA.

All participants with language impairment met the following criteria: (a) teacher report indicated concerns of speech or language impairments or indicated that the child was receiving special education services; and (b) met two out of three of the following: scored less than 51% if they were between age 48 and 61 months or less than 66% if they were 62 months or older on the Spanish morphosyntax subtest of the BESA; scored less than 70% on the Spanish nonword repetition subtest of the BESA; and scored less than a standardized subtest *t* score of 6 if they were between age 48 and 54 months or less than a *t* score of 7 if they were older than 55 months on the Spanish semantics subtest of the BESA.

Experimental Vocabulary Measures

The vocabulary tests administered before and after the 12-week intervention included the target vocabulary words from the intervention. We developed language-specific (Spanish and English) versions of the receptive and expressive vocabulary measures to mitigate memory effects of the words and their pictures; therefore, each Spanish and English version of the receptive and expressive vocabulary measures contained all of the same intervention words. However, the pictures and the foils were different for each test vocabulary version and modality and were not used during intervention to ensure that children did not point correctly because they recognized the pictures. The vocabulary words targeted in intervention and tested in Spanish and English are shown in Appendix A.

Receptive vocabulary. Measures of Spanish and English receptive vocabulary were developed to assess receptive vocabulary knowledge of the target words taught during the vocabulary intervention. The 45 vocabulary words chosen for the intervention were matched with representative color pictures; in addition, three foil pictures were chosen to appear with the target picture. The foil pictures were in the same word class as the target picture (i.e., noun targets paired with noun foils). The position of the target picture in the 2×2 matrix was randomized throughout the 45 items. The order of the items was randomized for pretesting and re-randomized for the duration of post-testing.

Expressive vocabulary. Measures of Spanish and English expressive vocabulary were developed to assess expressive vocabulary knowledge of the words taught during the vocabulary intervention. The expressive vocabulary measures were developed similarly to the receptive measures except the expressive measures included no foils. The order of the items was randomized for pretesting and re-randomized for the duration of post-testing. The experimental intervention used none of the pictures. RAs administered each child all 45 items on the Spanish and English expressive vocabulary measures; however, only during pretesting, RAs used a stop rule of 10 items answered incorrectly in a row on the English expressive vocabulary measure because participants became frustrated. During post-testing, RAs administered the full test.

A 4-point scoring method was used for the Spanish and English expressive vocabulary measures to account for partial word knowledge: 3 points for a correct response to an open-ended question (e.g., pointing to a picture, the examiner asks, "What is this? This is a ____?"), 2 points for a correct response to a prompt that included a description of the item followed by a question (e.g., pointing to a picture of a book, the examiner says, "This thing has a lot of pages and words. It is a ____."), 1 point for a correct response to a phonological prompt (e.g., while pointing to a picture of a

book, the examiner says, ''This is a /b/.''), and no points for an incorrect response or no response. These scores are not comparable to those for receptive or conceptual vocabulary, given the different point system used.

Conceptual vocabulary. Conceptual vocabulary represents the number of concepts a child knows, regardless of the language in which he or she knows the labels for those concepts (Umbel, Pearson, Fernández, & Oller, 1992). For example, if a child knows *mesa* in Spanish and *table* in English, the score for those words is 1, as they refer to a single concept. We calculated conceptual receptive and expressive vocabulary scores for each participant. We calculated the conceptual receptive vocabulary score by comparing the responses across languages (Spanish and English) on the receptive vocabulary measures. Children earned 1 point for each correct response; however, they received only 1 point if they responded correctly to the item in both languages. Similarly, we calculated a conceptual expressive vocabulary score for each participant; however, because we used a 4-point, tiered scoring method for the expressive vocabulary measures, children received credit (1 point) for the conceptual expressive vocabulary score if they received any points (3, 2, or 1) on the expressive vocabulary items. Therefore, scores between Spanish or English expressive tasks and conceptual scoring cannot be compared, given that conceptual and receptive scores are 1 or 0, but the expressive scores are 0 to 3.

Test Administration

Testing schedule. There were four waves of testing. RAs pretested all participants on all measures within 2 to 3 weeks of the start of intervention. All nonattriting participants received testing within 2 weeks after the completion of the 12-week intervention. Follow-up testing occurred 4 and 8 months after the completion of the intervention.

Bilingual language testing. RAs tested a majority of the children in this study in only one language per day; however, different testers administered assessments in different languages if a child needed to be tested in Spanish and English on the same day. RAs administered all qualification measures in random order to control for order effects, except for the experimental vocabulary measures; RAs always administered the expressive measure first and the receptive measure second to control for exposure to the vocabulary words. Trained monolingual English and Spanish–English bilingual undergraduate and graduate students administered all measures.

Intervention

Experimental design. The intervention consisted of two conditions for language of intervention delivery (bilingual or English only) crossed with two conditions of intervention content (vocabulary and mathematics). In addition, a no-intervention, business-as-usual control group was composed of DLLs with TD. We randomly assigned children with language impairment to one of four intervention conditions: bilingual vocabulary intervention, English-only vocabulary intervention, bilingual mathematics intervention, or English-only mathematics intervention; we assigned the selected children with TD to the no-intervention control. The English-only intervention groups received all instruction in English. The bilingual intervention groups received instruction for 2 days in Spanish and 2 days in English per week or unit. For the bilingual groups, each week started with a Spanish lesson on day 1 and an English lesson on Day 2. Days 3 and 4 were counterbalanced throughout the 12 weeks of the intervention; half of the weeks had English on Day 3 and Spanish on Day 4, and the other half had Spanish on Day 3 and English on Day 4.

Description. The vocabulary intervention groups received 45 min of small-group (two to five children) language intervention per day for 4 days per week during three 4-week cycles, for a total of 12 weeks, or 48 sessions. The intervention included 9 weeks of new vocabulary units and 3 weeks of review lessons. For the first 3 weeks, the vocabulary intervention groups read a new book each week; in Week 4, the children reviewed vocabulary from the previous weeks. This cycle repeated during the 12 weeks. Each of the nine intervention units contained five target vocabulary words, for a total of 45 words. Each day of intervention was divided into 25 min of vocabulary instruction and 20 min of mean length of utterance instruction. The mean length of utterance intervention did not use the vocabulary or books from the vocabulary intervention, and we do not report those results here. See Appendix B for a description of the vocabulary lesson framework, and Appendix A for a list of the target words, their frequency per language, and book in which they occurred.

The vocabulary intervention asked children to demonstrate vocabulary knowledge through the following activities: pointing to words in sets of pictures or objects, producing words and definitions through questioning in a script, and using words in sentences through scripted play with manipulative and dialogic book reading. Instructors elicited these vocabulary responses through hands-on activities, story retelling, vocabulary book making, story acting, and dialogic reading. In addition to the activities, the intervention teachers used support strategies, such as providing definitions; scaffolding instruction; scaffolding brief, child-led conversations; modeling; expanding (e.g., using novel words in personal examples); and reviewing.

The intervention used narrative and expository books in an alternating sequence as the theme for each new 4-day cycle. The intervention used bilingual books (Spanish and English text side by side) or separate Spanish and English versions of books. The language of the book matched the language of intervention for that day. Expository books included *Slugs* (*La Babosa*; Schaefer, 2002a) and *Jellyfish* (*La Medusa*; Schaefer, 2002b), and narrative books included *Frog in Love* (*El Sapo Enamorado*; Velthuijis, 2003) and *Floppy in the Dark* (*Floppy en la Oscuridad*; Van Genechten, 2002).

The mathematics intervention group received the *Big Math for Little Kids* program (Ginsburg, Greenes, & Balfanz, 2003), which provided academic skills appropriate for preschool education, for the same amount of small-group

instruction time as the language intervention. Activities included counting combined with movements like clapping, counting objects, tracing numbers, and reading number books. This group also did basic addition of numbers, counted by twos, and completed patterns and shapes. The language of instruction was controlled in the same manner as in the experimental intervention, such that each week started with a Spanish lesson on Day 1 and an English lesson on Day 2; Days 3 and 4 were counterbalanced throughout the 12 weeks of the intervention.

Vocabulary words. The target vocabulary words for intervention were chosen using the following criteria: All words had to occur in the intervention books, five per book; four researchers agreed that the words were at the tier-two vocabulary level for bilingual preschool children with language impairment; all had translation equivalents in English and Spanish; and all had to be imageable for assessment purposes (Cycowicz, Friedman, Rothstein, & Snodgrass, 1997). A team of two faculty members and two doctoral students selected possible target words from each book. Then the team discussed each word's appropriateness for intervention until reaching consensus on the target words for each unit.

Intervention teachers. Fourteen intervention teachers were recruited for the study and were either trained graduate students or previous kindergarten or preschool teachers. Intervention teachers who were bilingual were randomly assigned student groups from any of the four intervention conditions. Teachers who were monolingual English speakers were randomly assigned student groups from the English-only intervention conditions. Due to availability and the bilingual status of the teachers, the number of intervention groups assigned to each teacher varied from 1 to 11. The teachers were trained to fidelity before starting intervention. Teachers were observed by one of the investigators or the other teachers to ensure that they knew their lessons and could follow them with procedural fidelity.

Treatment fidelity. A trained bilingual graduate student observed each of the intervention teachers twice throughout the 12 weeks of intervention. The observer used the intervention lesson plans to monitor the teachers' adherence to the intervention, which included tracking the number of times the teachers presented the intervention vocabulary words and procedural reliability. Because the lessons were scripted, the fidelity was expected to be high. Observers examined fidelity live on 5% of the sessions; intervention teachers presented the target vocabulary the correct number of times, per the intervention script, with 93% accuracy, and they followed the scripted intervention procedures 95% of the time. The mathematics teachers followed the described activities with 97% fidelity. Videotaped coding was not possible due to issues related to consent of videotaping with several children.

Analysis

Following preliminary descriptive analyses, multilevel growth models were specified for each of the six vocabulary outcomes: Spanish receptive, Spanish expressive, English receptive, English expressive, conceptual receptive, and conceptual expressive. The structure of the data consisted of the measures for an outcome at three time points (Level 1), nested within students (Level 2), who were nested within intervention teacher (Level 3). More specifically, for each outcome, the Level 1 data were the three post-treatment assessments for each student; the Level 2 data were student-level predictors, including the dummy-coded intervention group indicators and students' scores on the covariates; and the Level 3 data consisted simply of codes identifying each intervention teacher. The Level 1 model consisted of individual student growth trajectories based on the three post-treatment measures for each student, the Level 2 model predicted variation in growth parameters between students within intervention teachers, and the Level 3 model allowed for variation in growth parameters between intervention teachers. Some intervention teachers delivered multiple interventions, so a teacher identification indicator was included at the third level to account for dependencies in the data arising from teacher effects independent from the intervention itself; however, no substantive predictors were included at this level. Each of the 14 intervention teachers instructed 2 to 45 students; we also included one identifying code for the control group.

A multiple-step modeling process was employed, consistent with the recommendations of Singer and Willett (2003). Full maximum likelihood estimation was used within HLM 6.08. Unconditional means models were first specified to partition the variation in the outcomes and compute Level 2 and Level 3 intraclass correlation coefficients (ICCs) as the proportion of total variance in the outcome that is between students and between intervention teachers, respectively. Unconditional growth models (i.e., with no predictors except time of measure) were estimated for each outcome to assess variation in growth parameters at the student and teacher levels. Conditional growth models containing four covariates at Level 2 were estimated next, followed by models additionally including a set of four dummy-coded indicators of intervention condition at Level 2. Standard dummy-coding procedures were used to indicate the intervention condition in which each student participated. To obtain the contrasts desired in any particular analysis, the five experimental conditions were indicated using a set of four dummy-coded predictors at the student level, with the reference group being either (a) the bilingual vocabulary condition or (b) the English-only vocabulary condition. To control for prior differences between groups on measures related to the vocabulary outcomes, four covariates were grand-mean centered and included as control variables at the student level (Level 2): (a) initial age in months to control for age differences in the sample, (b) Spanish morphosyntax scores to control for severity of language impairment to better determine the effects of the intervention, (c) nonverbal intelligence scores to control for cognitive differences, and (d) pretreatment scores on the outcome for the particular model to control for preintervention vocabulary knowledge. To support evaluation of both initial and final post-treatment differences between treatment groups as well as differences in

slopes, models for all outcomes were estimated twice, with time centered at (a) the initial post-treatment measure (0, 4, and 8 months) and (b) the final post-treatment measure (–8, –4, and 0 months).

Intercepts and slopes for the growth parameters were specified as random effects at Levels 2 and 3, whereas parameters for the Level 2 covariates were not modeled as random effects at Level 3. These parameters were maintained across models both to facilitate comparisons of results across outcomes and to ensure that estimates of parameters and standard errors were not biased by inappropriate constraints that may result if power is insufficient to reject the null hypothesis for a parameter.

Results

Preliminary Analyses

Table 2 reports *M*s and *SD*s for the six vocabulary outcome measures by treatment group and by time of measure. *M* vocabulary scores increased over the four waves of measure with only three exceptions. On the three expressive outcomes (i.e., Spanish, English, and conceptual), the bilingual vocabulary group demonstrated a very large post-treatment gain from Time 1 to Time 2, followed by a slight decline over at least one of the remaining intervals. Table 1 presents descriptive statistics for the covariates by intervention group. The TD control group was slightly (but not significantly) older and scored higher, on average, than the language impairment intervention groups on nonverbal intelligence and particularly on Spanish morphosyntax, which was a selection variable.

Vocabulary Growth Models

Variance components from unconditional means models were used to compute Level 2 and Level 3 ICCs. Proportions of total variance in the vocabulary outcomes that were between students and between intervention teachers were as follows (Level 2 ICC/Level 3 ICC): Spanish receptive (.43/.10), Spanish expressive (.58/.16), English receptive (.48/.04), English expressive (.80/.01), conceptual receptive (.54/.04), and conceptual expressive (.67/.10). Given that between 1% and 16% of the variance in the outcome measures was between intervention teachers, intervention teacher was maintained as a Level 3 cluster variable in subsequent models.

Unconditional growth models for the six outcomes consistently indicated statistically significant fixed effects for initial status and growth rate. Based on pseudo-R_e^2 indices, the time predictor yielded proportional reductions in within-person residual variance ranging from .29 for Spanish receptive vocabulary to .62 for English receptive vocabulary (unconditional linear growth models accounted for between 29% and 62% of the within-person variation in vocabulary observed). Random effects showed significant variation in initial status and growth rate among students that may be explained by student-level predictors. Accordingly, the next models specified included the four student-level covariates, which for all outcomes yielded a statistically significant improvement, as assessed by change in deviance statistics. Age, Spanish morphosyntax, nonverbal intelligence, and the pretest were positively associated with initial post-treatment scores and, to a lesser extent, growth rates on the focal outcomes; covariates were retained regardless of statistical significance.

Table 2. *M*s (and *SD*s) of vocabulary measures by treatment group and wave.

Condition	Time 1	Time 2	Time 3	Time 4	Time 1	Time 2	Time 3	Time 4
	Spanish receptive vocabulary				**Spanish expressive vocabulary**			
Eng. math	15.71 (4.22)	17.86 (2.92)	20.00 (5.27)	22.86 (6.39)	12.25 (10.36)	17.54 (7.88)	23.89 (11.91)	27.00 (14.77)
Bi. math	16.40 (4.97)	17.93 (5.06)	22.10 (7.37)	22.87 (7.61)	18.83 (20.02)	20.60 (13.96)	25.40 (17.66)	28.07 (18.54)
Eng. voc.	16.77 (4.75)	20.30 (6.58)	24.10 (7.26)	25.50 (8.70)	19.70 (19.37)	23.23 (12.48)	28.27 (14.67)	34.40 (19.48)
Bi. voc.	15.83 (4.58)	27.22 (7.33)	27.91 (8.99)	29.22 (8.79)	11.92 (11.75)	39.58 (20.26)	36.08 (18.84)	34.00 (19.18)
Control	21.52 (4.66)	25.17 (5.75)	27.38 (7.01)	26.20 (8.29)	22.55 (19.30)	36.55 (9.98)	46.17 (14.95)	49.24 (14.19)
	English receptive vocabulary				**English expressive vocabulary**			
Eng. math	13.29 (5.66)	15.00 (5.65)	18.36 (7.92)	22.18 (10.29)	4.36 (8.00)	10.57 (11.60)	17.32 (15.74)	23.71 (21.71)
Bi. math	13.10 (7.44)	15.60 (6.55)	16.47 (6.06)	21.87 (8.00)	2.23 (5.83)	8.20 (9.99)	12.90 (12.07)	20.60 (16.26)
Eng. voc.	12.23 (7.37)	20.63 (10.77)	22.67 (10.36)	24.17 (11.28)	2.20 (5.80)	24.80 (25.65)	25.60 (27.72)	31.50 (30.80)
Bi. voc.	13.43 (8.10)	23.48 (10.55)	27.64 (16.41)	28.17 (11.34)	4.63 (10.29)	29.67 (25.14)	33.17 (27.00)	30.63 (30.97)
Control	16.21 (7.23)	19.90 (7.26)	26.14 (8.38)	31.83 (11.14)	10.76 (13.06)	22.24 (18.11)	33.59 (21.10)	45.00 (23.18)
	Conceptual receptive				**Conceptual expressive**			
Eng. math	23.46 (4.12)	26.82 (4.62)	28.18 (6.45)	32.46 (6.93)	5.50 (4.86)	13.50 (5.95)	18.82 (7.69)	21.50 (9.37)
Bi. math	23.63 (6.07)	26.13 (5.26)	29.00 (6.68)	32.93 (8.15)	6.77 (6.77)	14.23 (7.30)	16.83 (8.23)	20.30 (8.18)
Eng. voc.	23.43 (6.03)	30.13 (8.21)	33.10 (6.90)	34.17 (7.11)	6.07 (4.21)	22.60 (11.13)	23.47 (9.83)	26.03 (10.93)
Bi. voc.	23.74 (6.65)	36.52 (5.70)	36.00 (8.22)	36.83 (8.32)	6.88 (6.68)	29.42 (10.92)	29.33 (9.95)	25.63 (11.42)
Control	28.34 (4.17)	32.66 (5.71)	35.86 (6.23)	39.69 (3.64)	14.72 (9.26)	26.69 (5.43)	30.69 (6.53)	33.66 (5.00)

Note. Time 1 = pretest; Times 2–4 = postintervention tests. Scores on the receptive and expressive Spanish and English are not comparable because expressive scores are on a 3-point scale and receptive scores are on a correct–incorrect basis.

For each vocabulary outcome, addition of the set of intervention group predictors indicated a statistically significant intervention effect, controlling for the four covariates, as evidenced by the change in deviance statistics between the covariate-only model and the full model. Tables 3 and 4 contain estimates of the fixed effects for the full models for the relevant outcomes, with the bilingual vocabulary intervention and the English-only vocabulary intervention, respectively, as the designated reference group (tables including standard errors are available from the authors). Both tables present two sets of fixed effects associated with post-treatment level for each outcome—one with time centered at the initial post-treatment wave and another with time centered at the final post-treatment wave. However, the tables present only one set of growth rate parameters (i.e., slopes) because recentering time does not affect these parameters.

A table presenting random effects, their standard errors, and model summary statistics is available upon request from the authors. For brevity, we do not comment on results for the random effects for each model but note that inclusion of the intervention indicators in comparison with the covariate-only model generally resulted in a substantial proportional reduction in student-level variance components, as indicated by pseudo-R^2_{r0} and pseudo-R^2_{r1} indices. The one exception was for pseudo-R^2_{r1} for Spanish receptive vocabulary. Figure 1 contains plots of the linear growth trajectories for the full models for the six outcomes, assuming *M* scores on the covariates.

Spanish receptive vocabulary. Estimated *M*s for the bilingual vocabulary intervention were, on average, five to seven words higher on Spanish receptive vocabulary than all other groups immediately following the 12 weeks of intervention; differences at the final measure were three to six words higher for the bilingual vocabulary group and were statistically significant, except for the control group with TD contrast (the coefficient for this contrast had a greater standard error). These comparisons are observed in the coefficients γ_{050}, γ_{060}, γ_{070}, and γ_{080} in the Spanish receptive vocabulary columns in Table 3. A negative coefficient indicates the predicted score for a treatment group was lower than the predicted score for the referent bilingual vocabulary group. The post-treatment growth rate estimate for the bilingual vocabulary group was statistically significant at .49 words per month, as seen in the intercept for the slope equation in the lower portion of Table 3 ($\gamma_{100} = 0.49$). Consistent with Figure 1, Section A, postintervention growth rates did not differ significantly between bilingual vocabulary and other intervention groups (estimates of differences in slopes are γ_{150}, γ_{160}, γ_{170}, and γ_{180}).

Spanish expressive vocabulary. Estimated *M*s for the bilingual vocabulary intervention were, on average, 18 to 21 points higher on Spanish expressive vocabulary than other treatment groups immediately following the intervention; this advantage persisted by 7 to 11 points at the final measure. As observed in Figure 1, Section B, and in the estimates of initial and final status (γ_{000} in Table 3), the final measure was lower by approximately 1 point than the initial measure for the bilingual vocabulary intervention group, presumably due to exceptionally high scores for this group immediately following the intervention. Accordingly, the postintervention growth rate was nonsignificant, and the

Table 3. Fixed effects of intervention conditions on growth trajectories, with bilingual vocabulary intervention as the reference condition and controlling for age, Spanish morphosyntax, nonverbal intelligence, and pretest score for the respective outcome.

Fixed-effect parameter			Spanish receptive voc.		Spanish expressive voc.		Conceptual receptive voc.		Conceptual expressive voc.	
Status/growth rate	Predictor	Parameter	Initial	Final	Initial	Final	Initial	Final	Initial	Final
Post-treatment status, π_{0ij}	Intercept	γ_{000}	26.91**	30.85**	41.53**	40.86**	36.07**	38.43**	30.54**	29.33**
	Age	γ_{010}	0.11	0.56**	0.24	0.11	0.20*	0.54**	0.38*	0.22
	Sp. morph.	γ_{020}	0.09**	0.07	0.34**	0.44**	0.04	0.08*	0.12**	0.15**
	NVI	γ_{030}	~0.00	0.03	~0.00	–0.05	0.05*	0.09*	0.06	0.10*
	Pretest	γ_{040}	0.48**	0.47**	0.33**	0.48**	0.50**	0.37**	0.39**	0.42**
	Eng. math	γ_{050}	–7.12**	–6.44**	–19.69**	–7.67*	–8.15**	–4.73*	–15.10**	–4.74*
	Bi. math	γ_{060}	–6.24**	–4.50*	–18.05**	–9.79*	–7.29**	–2.28	–13.21**	–5.85*
	Eng. voc.	γ_{070}	–5.14**	–3.58*	–18.41**	–7.58*	–2.76*	–2.49	–5.74 **	–1.85
	Control	γ_{080}	–7.21**	–5.05	–21.34**	–10.74*	–7.00**	–4.17	–14.58**	–6.52*
Post-treatment growth rate, π_{1ij}	Intercept	γ_{100}	0.49*		–0.11		0.30		–0.15	
	Age	γ_{110}	0.06*		–0.02		0.04*		–0.02	
	Sp. morph.	γ_{120}	~0.00		0.01		~0.00		~0.00	
	NVI	γ_{130}	~0.00		–0.01		~0.00		0.01	
	Pretest	γ_{140}	~0.00		0.02*		–0.02		~0.00	
	Eng. math	γ_{150}	0.09		1.51**		0.43*		1.30**	
	Bi. math	γ_{160}	0.22		1.06*		0.63*		0.92**	
	Eng. voc.	γ_{170}	0.21		1.39*		0.04		0.49*	
	Control	γ_{180}	0.27		1.36*		0.35		1.01*	

Note. Fixed effects associated with the intercept are reported for two parameterizations: (1) initial, with time centered at the first posttreatment wave, and (2) final, with time centered at the third and final posttreatment wave. Parameters related to the slope are stable across these parameterizations. Parameter estimates reported as ~0.00 were less than .005 in absolute value.

*$p < .05$. **$p < .001$.

Table 4. Fixed effects of intervention conditions on growth trajectories, with English-only vocabulary intervention as the reference condition and controlling for age, Spanish morphosyntax, nonverbal intelligence, and pretest score for the respective outcome.

Fixed-effect parameter			English receptive voc.		English expressive voc.		Conceptual receptive voc.		Conceptual expressive voc.	
Status/growth rate	Predictor	Parameter	Initial	Final	Initial	Final	Initial	Final	Initial	Final
Post-treatment status, π_{0ij}	Intercept	γ_{000}	24.69**	27.70**	32.04**	36.99**	33.31**	35.94**	24.80**	27.48**
	Age	γ_{010}	0.33*	0.75**	0.91**	1.34**	0.20*	0.54**	0.38*	0.22
	Sp. morph.	γ_{020}	0.01	0.11*	0.08	0.03	0.04	0.08*	0.12**	0.15**
	NVI	γ_{030}	0.14**	0.17**	0.13	0.33*	0.05*	0.09*	0.06	0.10*
	Pretest	γ_{040}	0.58**	0.54**	1.20**	1.33**	0.50**	0.37**	0.39**	0.42**
	Eng. math	γ_{050}	–7.94**	–3.14	–19.41**	–9.65*	–5.40**	–2.24	–9.36**	–2.89
	Bi. math	γ_{060}	–6.18**	–1.45	–14.72**	–6.94*	–4.53**	0.21	–7.47**	–4.00*
	Bi. voc.	γ_{070}	0.63	4.27	1.35	1.20	2.76*	2.49	5.74 **	1.85
	Control	γ_{080}	–6.91*	–3.06	–21.72**	–5.55	–4.24*	–1.68	–8.84*	–4.67
Post-treatment growth rate, π_{1ij}	Intercept	γ_{100}	0.39		0.62		0.34*		0.33*	
	Age	γ_{110}	0.05*		0.05		0.04*		–0.02	
	Sp. morph.	γ_{120}	0.01		–0.01		~0.00		~0.00	
	NVI	γ_{130}	~0.00		0.02*		~0.00		0.01	
	Pretest	γ_{140}	~0.00		0.02		–0.02		~0.00	
	Eng. math	γ_{150}	0.60*		1.21*		0.39*		0.81**	
	Bi. math	γ_{160}	0.59*		0.97*		0.59*		0.43*	
	Bi. voc.	γ_{170}	0.45		–0.02		–0.04		–0.49*	
	Control	γ_{180}	0.46		2.02*		0.31		0.52	

Note. Fixed effects associated with the intercept are reported for two parameterizations: (1) initial, with time centered at the first posttreatment wave, and (2) final, with time centered at the third and final posttreatment wave. Parameters related to the slope are stable across these parameterizations. Parameter estimates reported as ~0.00 were less than .005 in absolute value.

*$p < .05$. **$p < .001$.

other treatment groups evidenced significantly greater growth rates in comparison with the bilingual vocabulary group. (Note that points are not equivalent to words in this measure because the responses were scored on a 0–3 scale.)

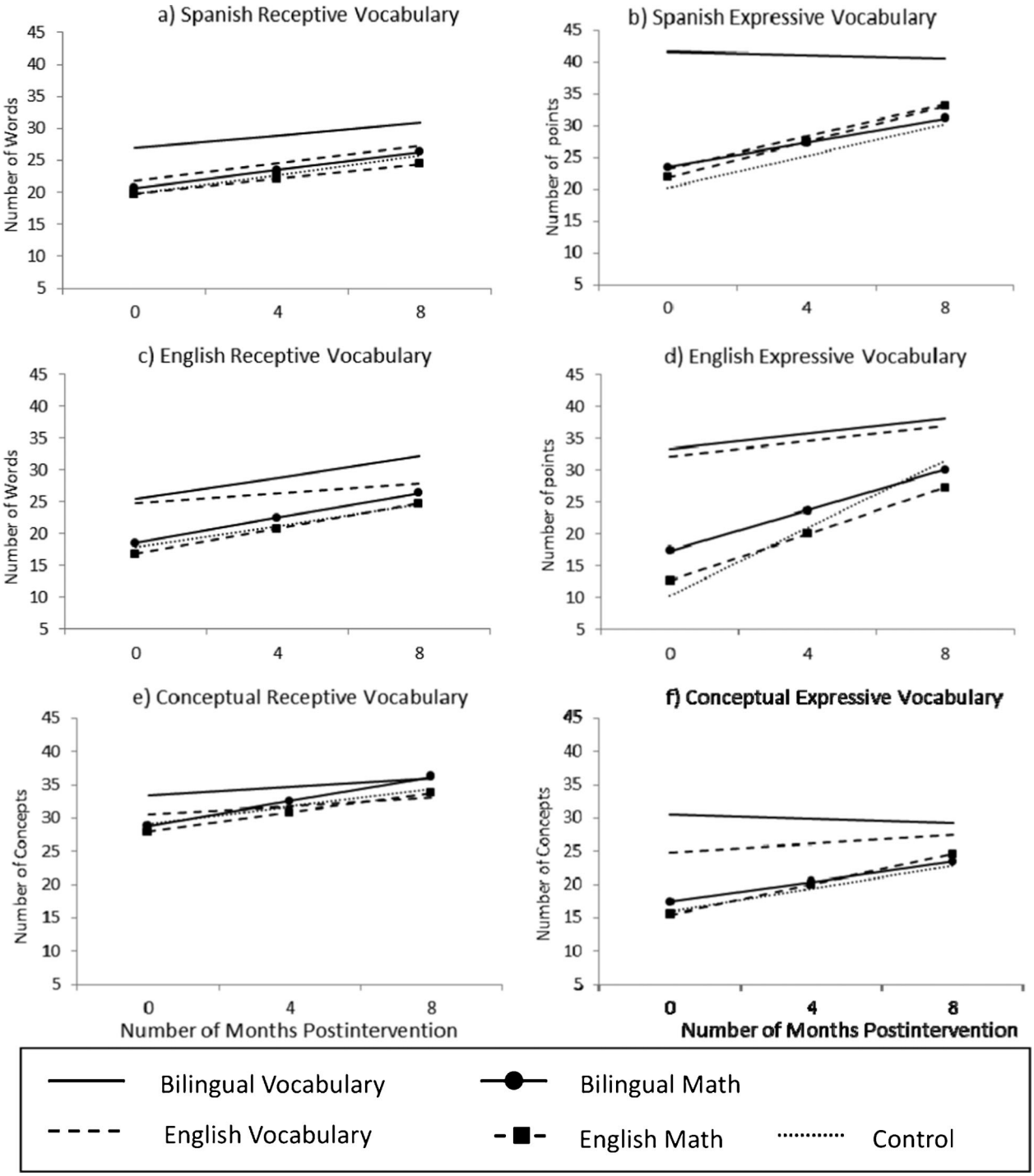
English receptive vocabulary. Table 4 shows fixed effects for models predicting English receptive vocabulary, with the English-only vocabulary intervention serving as the reference group. Children in the English-only vocabulary intervention scored significantly higher (by about six to eight words) immediately postintervention than those in the English-only mathematics, bilingual mathematics, and control groups, but did not differ from the *M* for the bilingual vocabulary intervention group. The post-treatment growth rate for the English-only vocabulary group was 0.39 words per month and was not statistically significant. Both the English-only mathematics and bilingual mathematics groups exhibited significantly greater postintervention growth rates but did not outscore either vocabulary intervention group at the final measure (see Figure 1, Section C).

English expressive vocabulary. Figure 1, Section D, depicts growth trajectories for English expressive vocabulary. As shown in Table 4, controlling for the four covariates, children in the English-only vocabulary intervention significantly outscored (by about 15–22 points) children in the English-only mathematics, bilingual mathematics, and control groups immediately postintervention; however, there was no significant difference between the English-only and bilingual vocabulary intervention group. At the final measure, the English-only vocabulary group maintained higher expressive vocabulary scores than the English-only mathematics and bilingual mathematics groups but was not significantly different from the bilingual vocabulary group. English-only mathematics, bilingual mathematics, and the control groups exhibited significantly greater growth rates than the English-only vocabulary group but still were lower than both vocabulary intervention groups at the final measure.

Conceptual receptive vocabulary. Conceptual receptive vocabulary was estimated first with the reference group specified as the bilingual vocabulary intervention (see Table 3) and again with the English-only vocabulary intervention as the reference group (see Table 4) to obtain all desired contrasts. Figure 1, Section E, displays growth trajectories for conceptual receptive vocabulary. After controlling for the four covariates, children in the bilingual vocabulary intervention significantly outscored those in all other groups at the initial posttreatment measure by approximately two (English-only vocabulary) to eight (English-only mathematics) concepts but maintained a significant advantage over only the English-only mathematics group at the final measure. The growth rate for the bilingual vocabulary group was 0.30 concepts per month but was not significant, and only the two groups with lowest initial status—the two mathematics interventions—displayed significantly greater growth rates.

Children in the English-only vocabulary intervention significantly outscored English-only mathematics, bilingual mathematics, and control groups by about four to five concepts on the initial posttreatment measure of conceptual receptive vocabulary but were below the bilingual vocabulary group by approximately three concepts. The English-only vocabulary group did not differ significantly from any other group on the final measure. The estimated postintervention

Figure 1. Plots of postintervention growth trajectories for the five experimental conditions on the six outcomes, given *M* levels on the four covariates in each model.



growth rate for the English-only vocabulary intervention was 0.34 and significant, and, again, only the two groups with lowest initial status—the two mathematics interventions—had significantly greater growth rates.

Conceptual expressive vocabulary. Figure 1, Section F, displays growth trajectories for conceptual expressive vocabulary. Children in the bilingual vocabulary intervention significantly outscored those in all other groups on the initial

measure of conceptual expressive vocabulary by approximately five (English-only vocabulary) to 15 (English-only mathematics) concepts and maintained a significant five- to six-concept advantage over all groups except English-only vocabulary at the final measure. The estimated growth rate for the bilingual vocabulary group was not significantly different from zero, and other treatment groups evidenced significantly greater postintervention growth rates in comparison with the bilingual vocabulary group.

Children in the English-only vocabulary intervention significantly outscored English-only mathematics, bilingual mathematics, and control groups by about seven to nine concepts on the initial posttreatment measure of conceptual expressive vocabulary, controlling for the covariates, but were below the bilingual vocabulary group by approximately six concepts. The English-only vocabulary group differed significantly from only the bilingual mathematics group on the final measure. The estimated growth rate for the English-only vocabulary intervention was 0.33 and significant; both mathematics interventions exceeded this postintervention growth rate.

Discussion

In the current study, we examined the efficacy of bilingual and English-only vocabulary interventions for preschool DLLs with language impairment. Students learned trained vocabulary words through dialogic reading, rich definitions and conversations, English as a L2 instructional techniques, and target vocabulary that was of medium difficulty for DLLs with language impairment. We compared the experimental interventions to mathematics interventions delivered bilingually or in English only, as well as to DLLs with TD who received regular preschool instruction. Efficacy was defined as significant improvement in vocabulary performance across languages and modalities.

Bilingual Vocabulary Intervention Effects on Spanish and Conceptual Vocabulary Skills

Immediately following the intervention, the bilingual vocabulary group scored significantly higher than all other groups, including the DLLs with TD, on the Spanish receptive and expressive vocabulary measures. The DLLs with language impairment in the bilingual vocabulary intervention learned, on average, five Spanish receptive vocabulary words more than the DLLs with language impairment in the English-only vocabulary intervention and seven words more than the DLLs with TD who received typical preschool instruction. The receptive results indicate that when presented with the challenge of improving L1 receptive vocabulary in DLLs with language impairment, a bilingual approach is efficacious (Perozzi, 1985; Perozzi & Chavez-Sanchez, 1992). The second result suggests that the L1 receptive vocabulary gap between DLLs with language impairment and DLLs with TD can be narrowed with intensive and systematic bilingual intervention. We do not know of any previous study in which investigators examined whether bilingual intervention with DLLs with language impairment yields receptive vocabulary learning rates that approximate those of DLLs with TD. These results may be due to both gains in DLLs with language impairment due to treatment and/or due to plateau in L1 vocabulary development in the DLLs with TD, as has been noted in previous studies (e.g., Barnett et al., 2007; Kan & Kohnert, 2005).

In Spanish expressive vocabulary, DLLs with language impairment in the bilingual vocabulary intervention scored nearly twice as many points as all other groups, indicating that the Spanish intervention was efficacious for increasing target vocabulary in the expressive modality. These results corroborate those of programs that have additive bilingual approaches for DLLs with TD attending preschool (e.g., Barnett et al., 2007) and DLLs with disabilities (e.g., Kay-Raining Bird et al., 2005). Further, in this study we revealed stronger evidence for studies that have provided more traditional add-on language interventions supplementing a regular program for DLLs with TD (e.g., Restrepo et al., 2010) and DLLs with language impairment (Thordardottir et al., 1997). In addition, compared to the TD group, the bilingual intervention children scored significantly higher on the expressive target vocabulary measure, which is not surprising, given that the TD group did not receive vocabulary intervention. That is, the DLLs with language impairment learned the vocabulary that was taught.

Similarly, the bilingual intervention group outperformed all groups in initial gains on receptive and expressive conceptual vocabulary. By the final testing point, the remaining groups had nearly caught up in conceptual receptive vocabulary. In contrast, the bilingual vocabulary intervention maintained a significant advantage over all groups, except the English-only vocabulary group, on conceptual expressive vocabulary. No studies have examined this effect in relation to DLLs with language impairment.

Our results corroborate previous findings that direct vocabulary instruction is necessary to increase the rate of acquisition of medium-difficulty vocabulary (Beck, McKeown, & Kucan, 2002) in DLLs, especially in those with language impairment (e.g., Lugo-Neris et al., 2010; Perozzi & Chavez-Sanchez, 1992; Proctor et al., 2005). Further, these results are consistent with those that indicate that for DLLs with language impairment, bilingual language intervention supports both languages (Kay-Raining Bird et al., 2005; Thordardottir et al., 1997), and these results expand on studies that examined only bilingual instruction effects on receptive English L2 vocabulary (Collins, 2010; Lugo-Neris et al., 2010; Perozzi, 1985; Perozzi & Chavez-Sanchez, 1992). To make gains in Spanish as an L1, direct and sustained L1 instruction is necessary; short-term interventions may not be sufficient, given that DLLs with language impairment maintain their expressive vocabulary level but do not continue to grow when intervention is discontinued. Preschool special education programs need to provide instructional time in Spanish (the children's L1) that is planned, intensive, and systematic to ensure the home language continues to develop, so that communication at home is effective (Kohnert et al., 2005; Restrepo et al., 2010).

Given that the bilingual intervention was an add-on program, the current study indicates that an itinerant staff person or bilingual assistant can provide L1 support and that a full-time bilingual teacher or speech-language pathologist is not necessary (see Restrepo et al., 2010, for an example of a similar model). However, such an itinerant staff person or bilingual assistant would need a systematic and intensive curriculum to follow. Further, these results showed gains in Spanish vocabulary with only half of the total bilingual intervention days provided in Spanish. In contrast, English-only intervention did not significantly influence Spanish skills in the DLLs with language impairment, which suggests no transfer of vocabulary knowledge from the L2 to the L1.

English-Only Vocabulary Intervention Effects on English Skills

We hypothesized that a highly structured intervention using English as L2 instructional techniques (Echevarria, Short, & Powers, 2006) and evidence-based vocabulary instruction could lead to greater gains in English vocabulary scores than in a bilingual vocabulary intervention. Immediately following the intervention, the English-only vocabulary group scored significantly higher than all other groups, except the bilingual vocabulary group, on the English receptive and expressive vocabulary measures. These results suggest that an intensive and systematic vocabulary intervention that capitalizes on English as a L2 practices promotes significant gains in English receptive and expressive vocabulary above that of DLLs with TD who attend typical preschool programs. However, this program did not promote greater gains in English vocabulary compared with the same vocabulary intervention program provided in a bilingual modality. These findings counter the argument often made by clinicians that bilingual instruction hampers gains in L2. In addition, the findings support those of Kan and Kohnert (2012) that to gain L2 vocabulary (in this case, the children's weaker language), supportive and quality instruction in the language leads to gains in the L2. Therefore, the training program was effective in that the children learned the new words they were taught. These results cannot be generalized to broader vocabulary measures or language areas, which should be examined in future research.

The lack of observed differences in the current study between the bilingual and English-only vocabulary groups on the English expressive and receptive vocabulary measures tempers the conclusions from several smaller studies that found that the bilingual modality leads to faster L2 vocabulary acquisition (e.g., Kiernan & Swisher, 1990; Perozzi, 1985; Perozzi & Chavez-Sanchez, 1992). Had the bilingual intervention been better for English vocabulary learning, we should have found an advantage in English scores in the bilingual modality as compared to the English-only condition. It is possible that the researchers observing greater L2 vocabulary learning in the bilingual modality focused on only one or two concepts that were measured receptively, whereas in our study, we focused on the learning of 45 different words in the receptive and expressive modalities.

At 8 months postintervention, there were no observed differences between any of the groups on the English receptive vocabulary measure. In contrast, on the English expressive vocabulary measure, the English-only vocabulary group scored significantly higher than the mathematics groups, but it did not outperform the bilingual vocabulary or TD control groups. Despite the efforts to provide a highly structured and intensive English vocabulary intervention that used evidence-based practices, DLLs with language impairment in the bilingual vocabulary intervention made the same gains with instructional time divided evenly between English and Spanish. We found, therefore, that the vocabulary intervention was efficacious and that the English-only version does not give an advantage to English vocabulary targets. Thordardottir et al. (1997) found similar effects in a single-subject intervention study for home vocabulary, although effects were higher for school vocabulary taught in the L2.

Examination of the growth rates indicated that for the Spanish receptive vocabulary measure, after the initial gain due to the treatment effect, there were no significant differences between groups in postintervention growth rates. Such a finding stresses the need for continued intervention for DLLs with language impairment, so that receptive language continues to grow. For the Spanish expressive vocabulary measure, the initial postintervention scores were much higher than those for all other groups, and this elevated score was maintained at a fairly constant level through the subsequent follow-up measures; accordingly, all other groups grew at a significantly higher rate but never caught up to the expressive vocabulary of the bilingual vocabulary group (see Figure 1, Section B). Similarly, after displaying the highest English receptive and expressive vocabulary immediately after intervention, the English-only and bilingual vocabulary intervention groups had the flattest postintervention growth rates after the intervention was discontinued. Other vocabulary may be acquired between postintervention measures, considering that these students' classes often consist of English-only instruction, even with bilingual staff members in the classrooms.

Intervention Strategies and Future Considerations

Given that the intervention used a variety of evidence-based practices for vocabulary intervention, we were not able to discern which components or active ingredients of the intervention were most effective. However, the combined use of dialogic repeated reading (Jiménez, Filippini, & Gerber, 2006; Lonigan & Whitehurst, 1998; Wasik & Bond, 2001; Weizman & Snow, 2001; Whitehurst et al., 1988); direct vocabulary instruction that is rich in elaboration (e.g., Gray, 2003; Lugo-Neris et al., 2010; McGregor, Sheng, & Ball, 2007); and hands-on activities that have the child hear, repeat, say, define, and use the words multiple times seem to have an impact on their learning. The intervention used these techniques throughout the lessons and controlled these techniques across units and activities.

The order of the language of instruction was based on research on L2 acquisition (Kiernan & Swisher, 1990;

Lugo-Neris et al., 2010; MacSwan & Rolstad, 2005; Perozzi, 1985; Perozzi & Chavez-Sanchez, 1992). For example, Perozzi (1985), Perozzi and Chavez-Sanchez (1992), and Kiernan and Swisher (1990) found that introduction of the concept in the L1 first led to faster acquisition of the concept in the L2. In this study, children were selected on the basis of their home language being primarily Spanish, although the schools used English instruction but had some bilingual staff. The facilitative effect (L1 informing L2) is often found in sequential DLLs in the initial stages of learning a L2 (Kroll & Stewart, 1994). The first reading of a book and introduction of the vocabulary was always done in Spanish, the L1. Further, the second lesson of the unit, which included the second reading of the book and introduction of the English vocabulary, was done in English; the vocabulary was introduced using hands-on activities and objects rather than pictures. This sequence ensured that the children had heard a book and the vocabulary definitions in their stronger language (L1, Spanish) before being introduced to the book and the vocabulary in their weaker language (L2, English). On Days 3 and 4 of a unit, the languages were counterbalanced. The balanced design for the language of instruction created a learning environment that encouraged the children to develop and use their two languages in different contexts.

The selection of vocabulary words was challenging because the words we conceptualized as being of medium difficulty for DLLs with language impairment may not have been of medium difficulty for DLLs with TD. That is, we hypothesized the words selected for the intervention would need direct instruction. The DLLs with language impairment in the bilingual vocabulary intervention made the greatest gains; however, a few of the DLLs with TD learned some of the intervention words without direct instruction. Clinical judgment is required to best select the words for instruction that children would not likely know and would need to know to understand the book; initial testing indicated that the children did not know the selected vocabulary.

In summary, DLLs with language impairment in the bilingual vocabulary intervention made gains in English comparable to those of children in the English-only intervention. The study also found that to make significant gains in English, it is not necessary to provide intervention in that language alone. The English-only intervention was effective in English, but it did not have positive effects in Spanish (L1). Clinically and for overall language development, findings of this study suggest that bilingual interventions are more effective than L2-only interventions for DLLs with language impairment. The current study demonstrates the great need for continued research with bilingual populations, including DLLs with language impairment. The gains seen in our study indicate that such intensive intervention in small groups yields gains in vocabulary; however, it is unclear whether these gains generalize to greater overall vocabulary gains. Further, our study attempted to evaluate the intervention independent of the regular preschool curriculum, and the intervention did not have a corresponding home program. However, language intervention programs may work best if they are integrated into the curriculum and the home (M. Y. Roberts & Keiser, 2011), thus providing more intensity and carryover.

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Appendix A

Vocabulary Word List: 45 Words and the Word Class, Frequency, and Intervention Book in Which They Appeared

English	Spanish	Class	Eng. freq.	Span. freq.	*Book*
deep	*profundo*	Adjective	2.14	1.68	*Jellyfish*
adult	*adulto*	Noun	1.95	1.27	*Jellyfish*
waves	*olas*	Noun	1.55	1.08	*Jellyfish*
clear	*transparente*	Adjective	2.37	1.25	*Jellyfish*
hunt	*cazar*	Verb	1.47	0.94	*Jellyfish*
bones	*huesos*	Noun	1.64	1.21	*Slugs*
woods	*bosque*	Noun	1.52	1.7	*Slugs*
crawl	*arrastrar*	Verb	0.95	1	*Slugs*
smooth	*lisa*	Adjective	1.57	0.82	*Slugs*
damp	*húmedo*	Adjective	1.46	1.19	*Slugs*
cover	*cubrir*	Verb	2.02	1.29	*Snakes*
thin	*delgada*	Adjective	1.9	1.03	*Snakes*
add	*agregar*	Verb	1.93	0.72	*Snakes*
scales	*escamas*	Noun	1.02	0.68	*Snakes*
empty	*desocupado*	Adjective	1.92	0.44	*Snakes*
dangerous	*peligroso*	Adjective	1.92	1.55	*Lizards*
hide	*esconder*	Verb	1.52	0.8	*Lizards*
claws	*garras*	Noun	0.92	0.9	*Lizards*
rough	*áspero*	Adjective	1.65	0.87	*Lizards*
sharp	*afilada*	Adjective	1.79	n/a	*Lizards*
hard	*dura*	Adjective	2.42	1.7	*Goldilocks*
rest	*descansar*	Verb	2.34	1.31	*Goldilocks*
soft	*blando*	Adjective	1.9	0.92	*Goldilocks*
medium	*mediano*	Adjective	1.31	0.68	*Goldilocks*
commotion	*revuelo*	Noun	0.63	0.77	*Goldilocks*
sick	*enferma*	Adjective	1.84	1.3	*Little Red Riding Hood*
hunter	*cazador*	Noun	1.1	1	*Little Red Riding Hood*
gather	*recoger*	Verb	1.38	1.45	*Little Red Riding Hood*
straight	*derecho*	Adjective	2.09	2.12	*Little Red Riding Hood*
stones	*piedras*	Noun	1.56	1.82	*Little Red Riding Hood*
stretch	*estirar*	Verb	1.61	0.74	*The Ugly Duckling*
pond	*estanque*	Noun	1.19	0.86	*The Ugly Duckling*
freeze	*helar*	Verb	0.98	0.19	*The Ugly Duckling*
greet	*saludar*	Verb	0.94	1.07	*The Ugly Duckling*
surprised	*sorprendido*	Adjective	1.83	0.86	*The Ugly Duckling*
riverbank	*orilla*	Noun	0.13	1.3	*Frog in Love*
bookshelf	*biblioteca*	Noun	0.21	1.48	*Frog in Love*
worry	*preocuparse*	Verb	1.89	1.03	*Frog in Love*
jump	*salto*	Noun	1.45	1.46	*Frog in Love*
heartbeat	*latido*	Noun	0.46	0.77	*Frog in Love*
cape	*capa*	Noun	1.22	1.51	*Floppy in the Dark*
tremble	*temblar*	Verb	0.68	1.06	*Floppy in the Dark*
tent	*carpa*	Noun	1.58	0.47	*Floppy in the Dark*
melted	*derretir*	Adjective	1.01	0.07	*Floppy in the Dark*
flashlight	*linterna*	Noun	0.72	0.96	*Floppy in the Dark*

Note. Eng. freq. = English word frequency—log10 word frequency calculated from CELEX using N-Watch (Davis, 2005); Span. freq. = Spanish word frequency—log10 word frequency calculated from LEXESP using B-PAL (Davis, 2006); n/a = not available.

Appendix B

Vocabulary Lesson Format

Day 1 Teacher will	Child will
Preview the book. Preview the words. Relate each word to the child. Read the book. Review words in the book. Define each word once. Test receptive recall of words. Test for ability to name.	Hear each word from the teacher at least nine times, not counting feedback. Repeat the word once as part of a group and once individually. Hear the definition twice. Point to the picture once. Name the picture once. Relate the definition to the book once.

Day 2 Teacher will	Child will
Review the book quickly. Review the words. Read the book and review words from the book. Provide a hands-on activity for each word. Ask questions during the hands-on activity using the word.	Hear each word from the teacher at least six times beyond feedback and book. Answer a question with the word in a hands-on activity. Repeat the word individually once. Hear definition twice. Repeat the word in a sentence or produce a sentence spontaneously. Have some experience with the word.

Day 3 Teacher will	Child will
Show pictures of the words. Model retelling the story. Use words in personal statements. Facilitate making a book. Ask about the words while reading book.	Use the word in a sentence relating to personal life. Label the word twice. Identify the word in set of four pictures. Hear each word from the teacher seven times. Use the word in a sentence during a game. Hear the word in a personal example once. Retell the story.

Day 4 Teacher will	Child will
Review words and ask for definitions. Act out the story. Discuss words in different semantic contexts. Evaluate each child individually.	Hear each word from the teacher at least six times beyond feedback and the book. Answer two questions with the word, expanding its semantic base. Repeat the word individually once. Provide the definition twice (one explicit definition and one embedded definition). Gain experience with the word through other pictures or objects.