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Identifying Differences in Early Literacy Skills across Subgroups of Language-Minority Children: A Latent Profile Analysis

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Abstract

Despite acknowledgement that language-minority children come from a wide variety of home language backgrounds and have a wide range of proficiency in their first (L1) and second (L2) languages, it is unknown whether differences across language-minority children in relative and absolute levels of proficiency in L1 and L2 predict subsequent development of literacy-related skills. The purpose of this study was to identify subgroups of language-minority children and evaluate whether differences in level and rate of growth of early literacy skills differed across subgroups. Five hundred twenty-six children completed measures of Spanish and English language and early literacy skills at the beginning, middle, and end of the preschool year. Latent growth models indicated that children's early literacy skills were increasing over the course of the preschool year. Latent profile analysis indicated that language-minority children could be classified into nine distinct groups, each with unique patterns of absolute and relative levels of proficiency in L1 and L2. Results of three-step mixture models indicated that profiles were closely associated with level of early literacy skills at the beginning of the preschool year. Initial level of early literacy skills was positively associated with growth in code-related skills (i.e., print knowledge, phonological awareness) and inversely associated with growth in language skills. These findings suggest that language-minority children are a diverse group with regard to their L1 and L2 proficiencies and that growth in early literacy skills is most associated with level of proficiency in the same language.

Keywords

Early childhood; Language; Early literacy skills; At-risk students; Second-language learning

Language-minority children speak a different language at home than does the majority of the population of the country in which they live. Children who speak Spanish at home are the largest group of language-minority children in the U.S. As of 2015, 55.4 million Latinos live

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in the U.S., and, as of 2011, over 37.5 million people age 5 or older living in the U.S. speak Spanish or a Spanish creole at home (U.S. Census Bureau, 2013, 2015). This population has grown rapidly over the past several decades due to immigration from Latin America. Data from the National Assessment of Education Progress indicate that Latino children perform significantly worse than white children at both 4^{th} and 8^{th} grade on measures of English reading and math skills (Hemphill, Vanneman, & Rahman, 2011), and Spanish-speaking Latino children perform significantly worse than non-Spanish-speaking Latino children on these measures. Therefore, it is important to improve understanding of how academic knowledge and skills develop among language-minority children to identify those children at-risk for academic difficulties and to prevent them from falling further behind their peers.

Researchers and practitioners frequently acknowledge the varying levels of language proficiency present among language-minority children (e.g., Genesee, Lindholm-Leary, Saunders, & Christian, 2006; Goldenberg, 2008). However, terminology used to describe language-minority children (e.g., English-language learners, limited English proficient) implies that these children have limited English-language skills while inadequately describing children's developing Spanish (or other) language skills. According to the U.S. Department of Education (2015, p. 10), schools "…need to assess potential [English learner] students' English proficiency and identify non-proficient students as [English learners] as soon as practicable," without regard for the level of proficiency in the child's home language. Additionally, methods of identifying students as language-minority for inclusion in research vary across studies, including parent report (e.g., Goodrich, Lonigan, Kleuver, & Farver, 2016), school data (e.g., Lindsay, Manis, & Bailey, 2003), and a combination of parent/teacher report and direct assessment of language proficiency (e.g., Peña, Bedore, & Zlatic-Giunta, 2002). Therefore, children identified as language-minority for inclusion in one study may not meet another study's inclusion criteria and may not be classified as English-language learners by schools. It is important that researchers and practitioners become more consistent in how they define this population of children as instructional techniques that are effective for children with some patterns of skills (e.g., average first language [L1], low second language [L2]) may not be effective for children with different patterns of skills (e.g., low L1 and L2).

It is possible that the levels of proficiency in children's L1 and L2, relative to each other, play a prominent role in the development of L2 academic skills. Kieffer (2008) reported that language-minority children who entered kindergarten with average English-language proficiency had developing English literacy skills similar to those of monolingual children but that language-minority children who were not proficient in English at kindergarten entry had significantly slower growth in English literacy skills when compared to monolingual English-speaking children. Similarly, the time at which children were designated as being proficient in English was inversely related to children's reading scores at 5^{th} grade. Therefore, it is important to investigate whether subgroups of language-minority children exist and to determine whether different patterns of L1 and L2 proficiency predict subsequent development in language-minority children's early literacy skills.

Early Literacy

In recent decades, a large amount of research has been dedicated to studying the development of literacy-related skills among monolingual English-speaking children of all ages (e.g., Kamil, Borman, Dole, Kral, Salinger, & Torgesen, 2008; Wagner, Torgesen, & Rashotte, 1994; Wagner, Torgesen, Rashotte, & Hecht, 1997; Whitehurst & Lonigan, 1998). Children's early literacy skills, including phonological awareness, print knowledge, and oral language, are measurable as early as the preschool years (i.e., prior to kindergarten entry and the beginning of formal literacy instruction in school) and are predictive of later reading abilities (Bryant, McLean, Bradley, & Crossland, 1990; Lonigan, Schatschneider, & Westberg, 2008; Storch & Whitehurst, 2002; Whitehurst & Lonigan, 1998). Phonological awareness refers to the ability to detect and manipulate the sound components of words. Print knowledge refers to children's knowledge of letters and letter-sound correspondence, as well as knowledge of the conventions of print (e.g., text is read from left to right in English). Oral language refers to children's ability to understand and convey information effectively, and it includes children's vocabulary, syntactic, and morphological knowledge, among other skills.

Despite a large body of research on the development of early literacy skills among monolingual children, relatively little research has focused on the skills that underlie literacy development among language-minority children. Evidence suggests that the same skills important for the development of literacy in monolingual children are also important for the development of literacy in language-minority children (see August & Shanahan, 2006, for review). Early literacy skills have been shown to be concurrently and longitudinally predictive of language-minority children's conventional reading skills (Lindsey et al., 2003; Manis, Lindsey, & Bailey, 2004) and instructional techniques designed to improve the early literacy skills of monolingual children also improve the early literacy skills of language-minority children (e.g., Farver, Lonigan, & Eppe, 2009). Results of a number of studies suggest that some early literacy skills (e.g., phonological awareness) are significantly related across languages among language-minority children (Goodrich, Lonigan, & Farver, 2013; Gottardo & Mueller, 2009; Manis, et al., 2004), and some researchers argue that children can transfer skills across languages (e.g., Cummins, 2008; Durgunoglu, Nagy, & Hancin-Bhatt, 1993). Cummins' (1979) developmental interdependence hypothesis states that the development of proficiency in L2 is at least partially dependent on the level of proficiency in L1 at the time of sustained exposure to L2, and findings from prior research provide at least partial support for this theory (e.g., Goodrich et al., 2013; Thomas & Collier, 2002). However, even if cross-language transfer of skills is possible, it may not occur for subgroups of language-minority children with low L1 proficiency.

Subgroups of Language-Minority Children

Although language-minority children come from a variety of different language and literacy backgrounds and enter preschool and kindergarten with varying levels of L1 and L2 skills, few studies have evaluated empirically whether distinct subgroups of language-minority children exist based on patterns of L1 and L2 language and literacy skills, and fewer studies have examined whether subgroups of language-minority children differ on developmentally important outcomes. One of the first studies to demonstrate that the development of language and literacy skills differed across subgroups of language-minority children reported that children in the U.S. who were exclusively exposed to Spanish at home prior to entering preschool differed from children who were exposed to both English and Spanish from birth on measures of Spanish and English language skills (Hammer, Lawrence, & Miccio, 2008). Additionally, patterns of growth in English- and Spanish-language skills throughout preschool differed across children who were and were not exposed to English at home prior to entering preschool, suggesting that relative levels of proficiency in L1 and L2 are important for subsequent development of language skills.

More recently, research has utilized statistical modeling techniques to identify subgroups of language-minority children and predict differences in outcomes across subgroups. Ford, Cabell, Konold, Invernizzi, and Gartland (2013) used cluster analysis to determine whether subgroups of Spanish-speaking language-minority kindergarteners could be formed from various measures of children's English code-related skills. Based on measures of phonological awareness, spelling, and alphabet knowledge, four subgroups of language-minority children emerged, including children with strong skills across all measures, children with weak skills across all measures, and children with different strengths and weaknesses in English code-related skills (i.e., average phonological awareness but low alphabet knowledge, average levels of phonological awareness and high alphabet knowledge). Scores on similar measures of literacy-related skills at the end of kindergarten and the beginning of first grade differed significantly across all subgroups, such that children in profiles with stronger early literacy skills than their peers at kindergarten entry continued to have stronger early literacy skills than their peers at least one year later. Kapantzoglou, Restrepo, Gray, & Thompson (2015) used latent profile analysis (LPA) to identify subgroups of language-minority children based on Spanish oral language and language processing skills while controlling for nonverbal cognitive ability. Results supported the presence of three subgroups of language-minority children; however, Kapantzoglou et al. did not evaluate whether these subgroups of language-minority children differed on any outcome.

Only one study to date has simultaneously utilized children's Spanish and English skills to evaluate whether subgroups of language-minority children exist. Gonzalez et al. (2015) used LPA to form subgroups of language-minority children based on Spanish and English oral language skills as well as Spanish phonological awareness and letter knowledge. Results indicated the presence of four subgroups of children that were characterized by differential patterns of L1 and L2 proficiency (e.g., average L1 and low L2 versus low L1 and low L2). Subsequent analyses indicated that these subgroups differed on a measure of English listening comprehension completed six months later. Overall, the findings of Gonzalez et al. (2015) and others (e.g., Hammer et al., 2008) support the idea that language-minority children differ in their relative levels of proficiency in both L1 and L2, indicating that a "one-size-fits-all" approach to classification is unlikely to capture the diversity of this group of children adequately, and instruction based on this classification may not be well-aligned with these children's educational needs.

Current Study

Because literacy-related skills are strongly related to children's oral language proficiency (e.g., Storch & Whitehurst, 2002), it would be expected that language-minority children's developing L1 and L2 literacy skills would differ depending on relative levels of language proficiency in L1 and L2. Therefore, the purpose of this study was to evaluate patterns of L1 and L2 receptive and expressive language skills in a large sample of Spanish-speaking language-minority children and determine whether patterns of L1 and L2 oral language skills predicted differing levels and rates of growth of English and Spanish early literacy skills. Based on findings from prior research and school classification systems (Artiles, Rueda, Salazar, & Higareda, 2005; Gonzalez et al., 2015), it was expected that at least three distinct groups of language-minority children would emerge. Specifically, it was hypothesized that groups of children with higher levels of Spanish proficiency than English proficiency (i.e., traditional ELL group), higher levels of English proficiency than Spanish proficiency (i.e., "Spanish language learners"), and relatively equal levels of Spanish and English proficiency (i.e., balanced bilinguals) would be observed and that these groups would emerge independent of children's nonverbal cognitive ability. It was expected that identified groups of language-minority children would differ in initial level and rate of growth of Spanish and English early literacy skills such that children with higher levels of proficiency in either language would have higher initial levels and faster rates of growth of early literacy skills in that language. Consistent with the developmental interdependence hypothesis (Cummins, 1979), it was also expected that children with low levels of proficiency in one language but high levels of proficiency in the other language would demonstrate higher initial levels and faster rates of growth of early literacy skills in both languages than would children with low levels of proficiency in both languages.

Method

Participants

Data for this study came from part of a larger curriculum-evaluation study designed to improve children's early literacy skills. Five hundred twenty-six Spanish-speaking language-minority preschoolers were recruited from 30 Head Start centers in Los Angeles, CA. Approximately half of the sample was male (52%). At the time of initial testing, children ranged in age from 37 to 60 months (M = 51.56, *SD* = 4.67). According to parent report, 99% of participants were Latino, less than 1% of participants were black/African American and less than 1% of participants were of other ethnicities. Additionally, parent report indicated that 99% of participants either spoke primarily Spanish at home (60%) or spoke English and Spanish equally (39%) at home. Because parent report indicated that all children spoke Spanish to some degree, all 526 children were included in the analyses.

Measures

Oral language—Children completed the Auditory Comprehension and Expressive Communication subtests of the Preschool Language Scale--4th edition (PLS-4; Zimmerman, Steiner, & Pond, 2002a). The Auditory Comprehension subtest is primarily a measure of children's receptive language skills, although questions directed toward children may be somewhat more complex than are questions on a typical receptive vocabulary measure. For example, some questions assess vocabulary knowledge while simultaneously requiring children to follow simple instructions (e.g., *show me your wrist*). The Expressive Communication subtest is primarily a measure of children's expressive language skills, although many questions are more complex than are questions on a measure of expressive vocabulary knowledge. For example, in addition to naming pictured objects, children are required to produce basic sentences. Internal consistency reliability for the Auditory Comprehension and Expressive Communication subtests is high for three- to five-year-old children (α = .87–.94 for Auditory Comprehension, α = .92–.95 for Expressive Communication). Children also completed the Auditory Comprehension and Expressive Communication subtests of the Spanish Preschool Language Scale--4th edition (S-PLS-4; Zimmerman, Steiner, & Pond, 2002b). This test is a Spanish-language adaptation of the PLS-4. Internal consistency reliability for the Auditory Comprehension and Expressive Communication subtests of the S-PLS-4 is high for three- to five-year-old children (α = .82–.89 for Auditory Comprehension, α = .86–.90 for Expressive Communication).

Phonological Awareness—Children completed the Blending and Elision subtests of the Preschool Comprehensive Test of Phonological and Print Processing (P-CTOPPP; Lonigan, Wagner, Torgesen, & Rashotte, 2002). This test was the development version of the Test of Preschool Early Literacy (TOPEL; Lonigan, Wagner, Torgesen, & Rashotte, 2007). The Blending subtest required children to blend two words to form a new word, or to blend two parts of a word (e.g., syllables, phonemes) to form a word. For example, children were asked to blend *star* and *fish* to create *starfish* or to blend */f/* and *–ox* to create *fox.* The Blending subtest consisted of 21 items, nine of which were multiple choice and 12 of which were free response. For multiple-choice items children had to point to a pictorial representation of the correct response (out of four pictures). For free-response items children had to say the correct response in the absence of pictures. The Elision subtest required children to remove a word from a compound word to form a new word, or remove parts of words (i.e., syllables, phonemes) to form a new word. For example, children were asked to remove *shoe* from *snowshoe* to create *snow* or to remove *–ster* from *dumpster* to create *dump*. The Elision subtest consisted of 18 items, nine of which were multiple choice and nine of which were free response. Internal consistency reliability for the Blending and Elision subtests was adequate in this sample (for Blending, omega = .85, 95% CI [.83, .87]; for Elision, omega = .72, 95% CI [.64, .78]). Children also completed the Blending and Elision subtests of the P-CTOPPP-Spanish (Lonigan, Farver, & Eppe, 2002). This test was a Spanish-language adaptation of the P-CTOPPP and mirrored that test in structure and form. For the P-CTOPPP-Spanish there were 18 Blending and 18 Elision items. Both subtests consisted of nine multiple-choice items and nine free-response items. Internal consistency reliability for the Blending and Elision subtests ranged from marginal to adequate in this sample (for Blending, omega = .80, 95% CI [.76, .82]; for Elision, omega = .63, 95% CI [.54, .71]).

Print Knowledge—Children completed the Print Knowledge subtest of the P-CTOPPP and P-CTOPPP-Spanish. These subtests assess children's knowledge of letter names and letter-sound correspondence. For example, children were shown four pictures and asked *point to the A,* or, *which one makes the /t/ sound?* Additionally, some items assessed children's knowledge of the conventions of print. For example, children were shown four pictures and asked *which one can you read*? Both the P-CTOPPP and the P-CTOPPP-Spanish Print Knowledge subtests contained 36 items. Internal consistency reliability for these subtests ranged from adequate to high in this sample (for English Print Knowledge, omega = .91, 95% CI [.89, .92]; for Spanish Print Knowledge, omega = .80, 95% CI [.74, .84]).

Non-verbal cognitive ability—Children completed the Pattern Analysis subtest of the Stanford-Binet Intelligence Scales, 4th edition (SB-IV; Thorndike, Hagen, & Sattler, 1986). This subtest requires children to complete shape-related puzzles and recreate patterns shown using block manipulations. Internal consistency reliability for the Pattern Analysis subtest is high for three- to five-year old children (αs = .85–.90).

Procedure

The larger project from which the data for this study were obtained was reviewed and approved by the Florida State University Institutional Review Board (Protocol number: 2011.7243; "Evaluating the Effectiveness of Preschool Literacy Curriculum"). Written informed consent was obtained from parents or guardians of children prior to data collection. Children's receptive language skills and non-verbal cognitive abilities were assessed only at the beginning of the preschool year. Children's expressive language skills, phonological awareness, and print knowledge were assessed at the beginning, middle, and end of the preschool year. All assessments were conducted by trained research assistants who were proficient in both English and Spanish, and assessments took place in a quiet area of the child's preschool center in sessions lasting 20–30 minutes. Order of administration of Spanish and English assessments varied across children, and Spanish and English assessments were administered on separate days.

Data Analytic Plan

This study's primary research questions were (a) if subgroups of language-minority children could be identified based on English- and Spanish-language skills and (b) if initial level and rates of growth of early literacy skills differed across these subgroups. To evaluate these research questions, LPA[1] and latent growth models were conducted using Mplus 7.31 (Muthén & Muthén, 2012). In LPA, a series of continuous indicators is used to form profiles (i.e., subgroups) based on patterns of scores on the indicators. When conducting LPA, it is typical to start with the estimation of a two-profile model. Then, the number of profiles in each subsequent model is increased by one until there is no longer an improvement in model fit. Fit statistics used to compare latent profile models are the Bayesian Information Criterion (BIC), sample-size adjusted Bayesian Information Criterion (ABIC) and the bootstrapped likelihood ratio test (BLRT). Other indices of model fit are available in LPA (i.e., Akaike's Information Criterion, Lo-Mendel-Rubin Likelihood Ratio Test); however, Nylund, Asparouhov, and Muthén (2007) reported that the BIC, ABIC, and BLRT were the

[1]LPA is a person-centered analysis. Traditional variables-centered analyses (e.g., multiple regression with interactions) may be appropriate for the research questions of interest in this study; however, we believe that person-centered analysis allows for a clearer test of our hypotheses, including testing the degree of relative and absolute levels of L1 and L2 proficiency.

best performing model fit indices for LPA with continuous outcomes. Smaller values are preferred for the BIC and ABIC, and differences in the BIC greater than 10 indicate decisive differences in model fit (Kass & Raftery, 1995). The BLRT is a direct test of the model with *k* profiles against the model with *k*-1 profiles. A significant BLRT indicates that the model with *k* profiles fits the data significantly better than does the model with *k*-1 profiles. Model entropy, which ranges from 0 to 1, is an index of how well each case's most likely profile membership corresponds to the actual profile membership in the model (i.e., model classification certainty). For each profile, an average posterior probability value was computed. An average posterior probability of .90 for a profile indicates that 90% of individuals for whom that profile is the most likely profile are actually placed in that profile in the analysis. Higher average posterior probabilities correspond to higher entropy values. Higher entropy values are preferred (Jung & Wickrama, 2008), and prior studies that used LPA employed .80 as a cutoff for entropy values (e.g., Hart, Logan, Thompson, Kovas, McLoughlin, & Petrill, 2016). Based on recommendations from Nylund et al. (2007) as well as other published studies that have used LPA, we determined that any one index of significantly improved model fit for the model with *k* profiles versus the model with *k*-1 profiles was necessary but not sufficient to choose that model for subsequent analyses and interpretation. Therefore, we concluded that the preferred model needed to show significant improvement in both the BIC and ABIC, and have a significant BLRT. Model entropy was considered in selection of the number of classes for the LPA, but we did not adopt a strict cutoff criterion for entropy when it came to model selection, as entropy values can be low in good-fitting models for a number of reasons (e.g., large numbers of profiles leading to greater chance misclassification; Collins & Lanza, 2010). Finally, it was required that no profile in the final model was comprised of less than 1% of the total sample.

Although examining the effects of profile membership on other outcomes could be done with approaches like ANOVA, such an approach does not account for the average posterior probabilities in the estimated profile model, which can lead to biased estimates of how the profiles are related to the outcome. Inclusion of an outcome to a mixture model, however, can affect profile formation (Asparouhov & Muthén, 2014). Several methods designed to monitor how the introduction of the outcome affects the profile model estimation are available in Mplus. One of these methods is the 3-step approach with unequal means and variances assumed across profiles (Vermunt, 2010). This is the best performing method available in Mplus (Asparouhov & Muthén, 2014). The 3-step approach monitors whether the introduction of an outcome variable results in substantial alterations to the profile membership in comparison to the LPA model that did not include the outcome variable. Mplus does not provide statistical tests of differences in the outcome variable across profiles when there are substantial changes in profile membership that are due to the introduction of the outcome variable.

To evaluate research questions for this study, latent growth models of children's Spanish and English expressive language, phonological awareness, and print knowledge skills were estimated, using raw scores, and estimated latent intercepts and slopes were saved to be used as outcomes in subsequent 3-step models. Growth models were analyzed with the intercept at Time 1 and equal distances specified between each assessment point. For poorer fitting growth models (e.g., those with significant chi-square values), latent-basis (spline) models were analyzed, allowing the second time point to be freely estimated. All growth models were cluster corrected based on preschool center to account for the nested structure of the data. Cluster corrections were done using the sandwich estimator option (TYPE=COMPLEX) in Mplus. Intercepts and slopes obtained from latent growth models were regressed on child age and nonverbal cognitive ability to ensure that the resulting parameters were free of the influences of age and nonverbal cognitive ability. After the estimation of growth models, latent profile models were estimated using children's Spanish and English receptive and expressive language skills as well as non-verbal cognitive ability at Time 1 as indicators of the profiles. Standard scores were used to form profiles to ensure that differences in level of proficiency across groups were not due to child age, and non-verbal cognitive ability was included to ensure that profiles truly represented groups that had varying patterns of language skills and not simply higher or lower levels of intelligence. Once the number of profiles was determined, 3-step models with unequal means and variances assumed were estimated to predict differences across profiles in intercept and slope values obtained from latent growth models for children's English and Spanish early literacy skills. Correction for multiple comparisons was done using the linear step-up procedure (Benjamini & Hochberg, 1995). This procedure involves rank ordering the statistical tests from smallest to largest *p*-values and computing a criterion value by dividing the rank order for each *p*-value by the total number of statistical tests and multiplying the resulting values by the expected Type I error rate (in this case, .05). The resulting criterion values are then compared to the observed *p*-values. The null hypothesis is rejected for all *p*-values less than or equal to the largest *p*-value that is smaller than its corresponding criterion value. This procedure represents a less conservative Type I error correction procedure than do other methods (e.g., the Bonferroni correction) while maintaining the Type I error rate at .05.

Results

Preliminary Analyses

Descriptive statistics for the sample are reported in Table 1. Standard scores are reported for children's non-verbal cognitive ability and receptive and expressive language skills in English and Spanish at Time 1 because standard scores were used in the latent profile analysis. All other reported scores are raw scores because raw scores were used in the latent growth curve models. Children's nonverbal cognitive ability was approximately one standard deviation below the normative mean. Children's English-language skills were well below average, approaching two standard deviations below the normative mean. Children's Spanish-language skills were in the low-average range (i.e., slightly less than one standard deviation below the normative mean). There was significant growth across the preschool year for all English and Spanish early literacy skills.

Attrition and missing data—Of the 526 children in the sample at Time 1, 12 (2.3%) did not participate in testing at both Time 2 and Time 3; 40 children (7.6%) did not participate in testing at Time 2 only, and 39 children (7.4%) did not participate in testing at Time 3 only. All children in the study had data for the language measures used to establish profiles, but 28 children (5.3%) were missing scores on the SB-IV Pattern Analysis subtest. To account for missing data, full information maximum likelihood estimation was used in the latent profile analysis, and an expectation-maximization algorithm was used to impute missing data for latent growth models. Analyses of patterns of missing data are reported in the Online Supplementary Materials. There was no association between missing data and profile membership.

Latent Growth Modeling

Fit statistics for latent growth models are shown in Table 2. For English early literacy skills, all growth models provided excellent fits to the data, with the exception of print knowledge. For Spanish early literacy skills, the growth models for blending and elision provided excellent fits to the data; however, the growth models for oral language and print knowledge provided only adequate fits to the data. Because there was an unequal distance between assessment points, some linear growth models did not provide excellent fits to the data (e.g., had significant chi-square values). Therefore, these models were estimated as latent-basis models with the second time point freely estimated. These results are reported for English blending, oral language, and print knowledge, as well as Spanish blending and oral language[2]. The residual variances for the slope term for English blending, elision, and oral language, as well as Spanish blending and elision, were negative and non-significant. Additionally, the residual variance for English print knowledge at Time 3 was negative and non-significant. All negative, non-significant residual variances were fixed to zero.

Unstandardized coefficients for the predictors of intercept and slope in the latent growth models are reported in Table 3. For all outcomes, child age and nonverbal cognitive ability were significant, positive predictors of intercepts, indicating that older children and children with higher non-verbal cognitive ability had higher scores for English and Spanish early literacy skills at Time 1 than did younger children and children with lower non-verbal cognitive ability. Child age and non-verbal cognitive ability were not consistent predictors of growth in English and Spanish skills. However, older children had faster rates of growth of English oral language skills than did younger children, and children with higher non-verbal cognitive ability at Time 1 had slower rates of growth in Spanish elision than did children with lower non-verbal cognitive ability at Time 1. Children with higher oral language skills at Time 1 had slower rates of growth in oral language than did children with lower oral language skills at Time 1, and children with higher scores in English elision, Spanish elision, and Spanish blending at Time 1 had faster rates of growth in these domains than did children with lower scores in these domains at Time 1.

Latent Profile Analysis

Fit statistics for latent profile models are shown in Table 4. For results of the two- through nine-profile models, the BIC, ABIC, and BLRT all indicated that the model with *k* profiles fit the data significantly better than did the model with *k* -1 profiles. For the 10-profile model the BIC did not decrease significantly. For the 11-profile model there was not a significant decrease in BIC and one profile contained only one child (i.e., less than 1% of the

[2]For Spanish print knowledge the estimated latent basis model did not result in an improvement in model fit. Therefore, the results of the original model are reported.

overall sample). Based on all of the indices of model fit, the nine-profile model was chosen for inclusion in subsequent analyses. Results of the three-profile model closely mapped onto the nine-profile model, with the primary difference being the separation of groups from the three-profile model into smaller groups in the nine-profile model based on absolute levels of proficiency in L1 and L2.

Children's English- and Spanish-language skills within each profile are shown in Figure 1[3] (for comparison, results of the three-profile model are reported in Figure S1 of the Online Supplementary Materials). Average posterior probability of profiles was high, ranging from .85 to .99. Each of the nine profiles represented a distinct pattern of Spanish- and English-language skills. For the purpose of labeling profiles, children's Spanish and English language skills within profile are described as low, average, or high, relative to the scores of children in this sample[4] . When all English and Spanish receptive and expressive language skills were combined, the average score in this sample was 78.6. Therefore, the following was used to label profiles: (a) scores greater than 100 were "very high;" (b) scores between 90 and 100 were "high;" (c) scores between 80 and 90 were "average;" (d) scores between 70 and 80 were "low;" and (e) scores lower than 70 were "very low." Because standard scores from the beginning of the preschool year were used to identify profiles, age did not vary across profile after Benjamini-Hochberg (Benjamini & Hochberg, 1995) correction. Additionally, profiles were roughly equally represented within the different conditions of the curriculum-evaluation study. Therefore, results of profile analysis and three-step models predicting differences in growth across profiles were not influenced by intervention condition.

Although the best-fitting model partitioned subjects into nine profiles, when Spanish- and English-language skills were examined relative to each other within profiles, three super profiles emerged. Four of the profiles (i.e., Profiles 1, 2, 4, and 7) were characterized by children with higher Spanish- than English-language skills (i.e., ELL profiles). Children in Profile 1 had low Spanish skills and very low English skills (Low/Very Low Profile; 99 children; 18.8% of the sample). Children in Profile 2 had very high Spanish skills and average English skills (Very High/Average Profile; 46 children; 8.7% of the sample). Children in Profile 4 had high Spanish skills and low English skills (High/Low Profile; 70 children; 13% of the sample). Children in Profile 7 had high Spanish skills and very low English skills (High/Very Low Profile; 104 children; 20% of the sample). Three of the profiles (i.e., Profiles 3, 5, and 8) were characterized by children with relatively equal levels of Spanish- and English-language skills (i.e., balanced bilingual profiles). Children in Profile 3 had low Spanish skills and average English skills (Low/Average Profile; 99 children; 18.8% of the sample). Children in Profile 5 had very low Spanish skills and low English skills (Very Low/Low Profile; 48 children; 9.1% of the sample). Children in Profile 8 had very high Spanish skills and high English skills (Very High/High Profile; 19 children; 3.6%

[3]Figure S7 of the Online Supplementary Materials provides an alternative format of the data shown in Figure 1 using a line graph.
[4]An alternative method of labeling profiles would be to use the traditional interpretation of standard scores (i.e., scores within 1 *SD* of the normative mean are average, scores between 1 and 2 *SD*s above or below the mean are high or low, and scores greater than 2 *SD*s above or below the mean are very high or very low). However, we chose to label profiles relative to scores of children in this sample because we believe that the traditional labels partially mask the degree of heterogeneity present in this sample (e.g., children in Profiles 3 and 5 have differences in average English proficiency of approximately 10 standard score points but would both be classified as low according to traditional interpretation of standard scores).

of the sample. Two of the profiles (i.e., Profiles 6 and 9) were characterized by children with higher English than Spanish language skills (i.e., “Spanish-language learner” profiles). Children in Profile 6 had low Spanish skills and high English skills (Low/High Profile; 30 children; 5.7% of the sample). Children in Profile 9 had high Spanish skills and very high English skills (High/Very High Profile; 11 children; 2.1% of the sample).

Three-Step Models

Mean intercepts and slopes for English and Spanish early literacy skills by profile are displayed in Figures 2–5. Specific chi-square test statistics for comparisons of intercepts and slopes across profiles are shown in Tables S2–S5 in the Online Supplementary Materials (for comparison, mean intercepts and slopes for the three-profile model are displayed in Figures S2–S5 of the Online Supplementary Materials, and chi-square test statistics for the three-profile model are reported in Table S6 of the Online Supplementary Materials). Because 36 pairwise comparisons were evaluated for each outcome, the Benjamini-Hochberg correction was used to adjust for type-I error rate. Nevertheless, caution is warranted in interpretation of any statistically significant results, as many of these comparisons are exploratory and not based on a priori hypotheses.

Many significant differences across profiles in initial levels and rates of growth of language and early literacy skills emerged. In almost all instances there were more differences across profiles in initial levels and rate of growth for English skills than there were for Spanish skills. Because the latent intercept and slope scores were regressed on child age and nonverbal cognitive ability, the means of the intercept and slope variables used in the three-step models were 0; therefore, in Figures 2–5 a positive slope represents higher than average growth relative to other children in this sample and a negative slope represents lower than average growth relative to other children in this sample.

Evaluation of cross-language transfer—Among profiles with similar levels of proficiency in a given language, an advantage in rate of growth of early literacy skills for children in the profile with higher levels of proficiency in the other language would indicate a cross-language transfer effect. For example, children in Profiles 1 and 7 both had very low levels of proficiency in English; however, children in Profile 7 had high levels of proficiency in Spanish whereas children in Profile 1 had low levels of proficiency in Spanish. If cross-language transfer of early literacy skills occurred for these children, children in Profile 7 would have faster rates of growth of English early literacy skills than would children in Profile 1. The group comparisons that would be indicative of cross-language transfer are shown in Table 5 and are described for each outcome separately below.

Expressive-language outcomes—For English expressive language (see Figure 2a), level of initial skill and rate of growth closely corresponded to the average level of English proficiency for each profile such that children in profiles with higher levels of English proficiency had higher initial levels and slower rates of growth of English expressive language skills than did children in profiles with lower levels of English proficiency. Among profiles with comparable levels of English oral language, higher levels of Spanish oral language were associated with higher initial levels and slower rates of growth of English expressive language skills; however, only the comparison between Profile 1 and Profile 7 was statistically significant (see Table 5).

The pattern of growth across profiles for Spanish expressive language (see Figure 2b), was similar to the pattern of growth for English expressive language; however, differences in initial level and rate of growth across profiles were not as pronounced for Spanish expressive language as they were for English expressive language. Among children with low levels of proficiency in Spanish, children with high levels of proficiency in English (Profile 6) had faster rates of growth of Spanish proficiency than did children with very low (Profile 1) or average (Profile 3) levels of proficiency in English (see Table 5).

Phonological awareness outcomes—For English phonological awareness (see Figures 3a and 4a for blending and elision outcomes, respectively), initial level of skill and rate of growth generally corresponded to the average level of English proficiency for each profile. Moreover, initial level of skill and rate of growth had a one-to-one correspondence, indicating that children in profiles with higher initial levels of English phonological awareness had faster rates of growth of English phonological awareness than did children in profiles with lower initial levels of English phonological awareness. Among children with very low levels of English proficiency, children with high Spanish proficiency (Profile 7) had significantly faster rates of growth of English blending than did children with low levels of proficiency in Spanish (Profile 1), and among children with high levels of English proficiency, children with very high levels of proficiency in Spanish (Profile 8) had significantly faster rates of growth of English elision than did children with low levels of proficiency in Spanish (Profile 6; see Table 5).

Patterns of growth for Spanish phonological awareness (see Figures 3b and 4b for blending and elision outcomes, respectively), were similar to patterns of growth for English phonological awareness. Children in the Low/Very Low Profile had lower initial levels and slower rates of growth of Spanish blending skills than did children in most other profiles; however, initial level and rate of growth was not significantly different across most other profiles. Among children with low levels of Spanish proficiency, children with high levels of English proficiency (Profile 6) had significantly faster rates of growth of Spanish blending skills than did children with average levels of English proficiency (Profile 3), who had significantly faster rates of growth of Spanish blending skills than did children with very low levels of English proficiency (Profile 1; see Table 5).

Print knowledge outcomes—For English print knowledge (see Figure 5a), there was a general pattern of correspondence between average level of English proficiency in each profile and children's initial levels of English print knowledge. Children in profiles with higher levels of English proficiency tended to have higher initial levels of English print knowledge than did children in profiles with lower levels of English proficiency; however, this pattern of relations was not as strong as it was for English expressive language or phonological awareness. Children in the Very High/Average Profile and children in the High/Low Profile had significantly higher initial levels of English print knowledge than did children in profiles with comparable levels of English proficiency (i.e., Low/Average and Very Low/Low Profiles, respectively). Rates of growth of English print knowledge were not generally statistically different across profiles; however, children in the Low/Very Low Profile had significantly slower rates of growth in English print knowledge than did children in most other profiles. Among children with very low levels of English proficiency, children with high levels of Spanish proficiency (Profile 7) had faster rates of growth in English print knowledge than did children with low levels of Spanish proficiency (Profile 1; see Table 5).

For Spanish print knowledge (see Figure 5b), children in profiles with higher Spanish proficiency had higher initial levels and faster rates of growth of Spanish print knowledge than did children in profiles with lower Spanish proficiency. Although non-significant, among profiles with comparable levels of Spanish proficiency, children in profiles with higher English proficiency tended to have higher initial levels of Spanish print knowledge than did children in profiles with lower English proficiency. Tests of differences in initial level across profiles indicated that children in the Very Low/Low, Low/Very Low, and Low/Average Profiles had significantly lower initial levels of Spanish print knowledge than did children in most other profiles. Tests of differences in rate of growth across profiles indicated that children in the Low/Very Low and Very Low/Low Profiles had significantly slower rates of growth of Spanish print knowledge than did children in most other profiles. Among children with low levels of Spanish proficiency, children with high levels of English proficiency had faster rates of growth in Spanish print knowledge than did children with very low levels of English proficiency (Profile 1 vs. Profile 6).

Discussion

The primary purpose of this study was to identify heterogeneity in the developing language skills of Spanish-speaking language-minority children and to evaluate whether differences in the relative and absolute levels of L1 and L2 language skills were associated with subsequent development of English and Spanish early literacy skills. Results indicated that children in this sample could be characterized by nine distinct patterns of L1 and L2 language skills. Consistent with our hypotheses, within these nine profiles, three super profiles emerged: (a) children with higher levels of proficiency in Spanish than in English (i.e., ELLs), (b) children with relatively equal levels of proficiency in English and Spanish (i.e., balanced bilinguals), and (c) children with higher levels of proficiency in English than in Spanish (i.e., "Spanish-language learners"). These super profiles are consistent with findings of prior research (Gonzalez et al. 2015) and with the results of the three-profile model in this study (see Online Supplementary Materials). Within each of the three super profiles, children were distinguished by absolute levels of proficiency in both L1 and L2. There was much greater variation across profiles in children's English and Spanish proficiency than there was in non-verbal cognitive ability. Initial levels of L1 and L2 early literacy skills for each profile were primarily associated with children's level of proficiency in the same language, consistent with findings of prior research (Lonigan, Farver, Nakamoto, & Eppe, 2013). Although rate of growth for each profile was inversely related to initial level of skill for oral language, rate of growth closely corresponded to initial skill level for children's code-related skills (i.e., phonological awareness, print knowledge), replicating findings of prior studies (Ford et al., 2013). Overall, these findings indicate that Spanish-speaking language-minority children represent a diverse group with respect to proficiency in both L1 and L2, and that absolute level of proficiency in each language is meaningfully associated with level and rate of growth of early literacy skills in that language across the preschool year.

Profiles of Language-Minority Children

This study demonstrated that substantial variation in both the relative and the absolute levels of proficiency in L1 and L2 exists among language-minority children, consistent with findings of prior studies (e.g., Gonzalez et al., 2015; Kapantzoglou et al., 2015). Although prior research has established that not all language-minority children have identical patterns of language and literacy skills, this study is the first to identify subgroups of children based exclusively on children's levels of oral language proficiency in both L1 and L2. Terminology frequently used by researchers and practitioners to describe language-minority children (e.g., ELL, LEP) implies that these children have higher levels of proficiency in L1 than in L2. Results of this study demonstrated that language-minority children's language skills in both Spanish and English were characterized by significant heterogeneity, with both Spanish and English skills representing very low to high levels of proficiency. Consistent with the low correlation between Spanish and English language skills observed in most studies of language-minority children (e.g., Goodrich et al., in press; Gottardo & Mueller, 2009), results of this study demonstrated independence of both absolute and relative levels of language skills in Spanish and English.

Approximately 60% of the children in this sample had higher levels of proficiency in Spanish than in English, a pattern of skills consistent with the typical conceptualization of ELLs; however, only 14% of these children had average levels of Spanish proficiency when compared to national norms. The 25th percentile (i.e., standard score of 90) is often used as a cutoff for distinguishing typically developing children from children at risk for learning disabilities (e.g., Fletcher et al., 1994), and 86% of the children in the ELL super profile had average standard scores for Spanish language that were below 92.4. Examination of the balanced-bilingual super profile yielded similar results, with approximately 90% of children having levels of proficiency in both languages below the 25th percentile. In contrast, all children in the Spanish-language-learner super profile had levels of proficiency above the 25th percentile in at least one language; however, these children represented less than 8% of the overall sample. Therefore, the majority of children in this sample were at significant educational risk based on levels of proficiency both in their L1 and in their L2. These results indicate that language-minority status alone does not place children at risk for academic difficulties, as there was a wide range of proficiency in both Spanish and English in this sample. Children that participated in this study were enrolled in Head Start centers; thus, the majority of the children in this sample came from low-income backgrounds, which may partially explain the low overall levels of proficiency in L1 and in L2 for children in this study.

Profile Membership and Growth in Early Literacy Skills

Consistent with hypotheses, children's level of proficiency in the language of the outcome was associated with initial levels of early literacy skills, which were in turn related to rate of growth of early literacy skills. Level of initial skill was negatively related to growth for children's oral language skills. Hammer et al. (2008) reported that whether children were exposed to English prior to preschool entry was related to levels of Spanish and English language skills, such that children who were exposed to English prior to preschool had stronger English language skills and children who were not exposed to English prior to preschool had stronger Spanish language skills. After accounting for child age, growth in English vocabulary was inversely related to initial level of English vocabulary, consistent with the findings of this study; however, Hammer et al. reported that growth in Spanish vocabulary across the two groups was fan-spread, indicating that children with higher initial levels of Spanish vocabulary experienced more growth than did children with lower initial levels of Spanish vocabulary. It is possible that children with low English proficiency at the beginning of the preschool year are those children that come from homes in which Spanish is spoken almost exclusively. Thus, these children may simply need sufficient exposure to English to begin to catch up to the children who are exposed to more English at home. The measure of oral language used in this study assessed more complex aspects of oral language than did the vocabulary measure used by Hammer et al. (2008). Once children are exposed to English in preschool, there may be sufficient exposure to Spanish at home for those children with strong initial Spanish skills to maintain an advantage in vocabulary knowledge over those children who are exposed to less Spanish at home; however, there may not be sufficient exposure to Spanish at home for children to maintain an advantage in more complex aspects of Spanish oral language, such as syntactic knowledge.

For children’s code-related skills, initial level of skill was positively associated with rate of growth, such that children in profiles with higher initial skills typically had faster rates of growth of those skills, representing a Matthew effect (Stanovich, 1986). This finding is similar to the findings of prior research indicating that, for language-minority children, rate of growth in English reading skills in elementary school was associated with level of English proficiency at kindergarten entry and beyond (Kieffer, 2008, 2011). This study replicated the findings of Kieffer and extended them to preschool children and to children’s developing Spanish early literacy skills. This study also replicated the findings of Ford et al. (2013) who reported that subgroups of language-minority children with strong English early literacy skills continued to demonstrate advantages in English early literacy one year later.

Cross-Language Transfer

Cummins (1979) hypothesized that children with higher levels of proficiency in L1 at the time of initial exposure to L2 would be better equipped to acquire L2 than would children with lower levels of proficiency in L1. Other researchers have reinforced this idea, suggesting that a higher level of proficiency in L1 serves as a protective factor for the development of skills in L2 (e.g., August & Shanahan, 2006). Overall, the results of this study did not provide strong support for this hypothesis. Only 22 of 88 comparisons that would support cross-language transfer (10 of 32 for Spanish-English transfer, 12 of 56 for English-Spanish transfer) were statistically significant. For example, children in Profiles 2 and 3 had similar levels of English proficiency, but children in Profile 2 had higher levels of Spanish proficiency than did children in Profile 3. If level of proficiency in L1 served as a protective factor for language-minority children, children in Profile 2 would have had significantly faster rates of growth of English early literacy skills than would children in Profile 3. Although children in Profile 2 had somewhat faster rates of growth in English blending and elision skills than did children in Profile 3 (see Figures 3a and 4a), the difference between them was not statistically significant. Such results have important theoretical and practical implications. Based on the results of this study, it appears that children's proficiency in the language of the outcome is a better sign of future development than is potential cross-language transfer. Therefore, proficiency in the language of an outcome may represent a better basis for identifying children at risk for later reading difficulties. Contrary to theoretical expectations based on Cummins' hypothesis, it is not clear that children with high levels of proficiency in L1 will easily acquire L2, and these children may need the same intensity of L2 instruction as do children with low levels of proficiency in L1.

There were some instances in which Cummins' (1979) hypothesis was supported (e.g., difference between Profiles 2 and 3 for English print knowledge; see Figure 4a and Table 5). Cummins' (1979) threshold hypothesis suggests that there is a level of proficiency that needs to be met in L1 and L2 for children to receive the various cognitive benefits of bilingualism (e.g., Bialystok, 2011), one of which may be transfer of skills from L1 to L2. It is possible that higher than average levels of L1 proficiency are needed for children's developing L2 skills to benefit from previously developed L1 proficiency, and vice versa. In this study, profiles were labeled relative to the average level of skills displayed by children in the sample. That is, although children in Profile 2 were labeled as having "very high" Spanish proficiency, their absolute level of proficiency in Spanish would fall into the average range compared to the normative mean for the PLS. Further research is needed to fully disentangle the complex interrelations between children's L1 and L2 proficiencies and the development of early literacy skills.

Limitations

Despite the strengths of this study (e.g., large sample size, longitudinal design), it had a few limitations. First, all of the children in this study came from low-SES backgrounds and were consequently at risk for the development of reading difficulties. It is possible that different profiles would emerge among a sample that included language-minority children from a broader range of SES backgrounds. Similarly, children's levels of Spanish and English proficiency were below the normative mean. A sample of children with a broader range of language abilities may yield more substantive differences in level of skill and rate of growth across profiles. Results of this study should be interpreted with caution, as scores on the English and Spanish language assessments used in this study may not be directly comparable because of differences in standardization samples. Additionally, data were only collected at three time points over the course of the preschool year and there was no long-term follow-up assessment of children's reading abilities that would allow evaluation of whether groups of language-minority children differ in level and rate of growth of conventional reading skills. Consequently, only linear growth rates could be examined in this study, and it is possible that non-linear (e.g., quadratic) growth models would provide better fits to the data for some models. Furthermore, although prior research examining growth in children's English reading skills throughout elementary school reported results consistent with those of this study (Kieffer, 2008), it is possible that transfer of skills is a process that unfolds over a longer period than one school year. Finally, LPA is an exploratory data analytic technique. Thus, results of this study should be interpreted with caution. Future research should replicate whether the three general patterns of L1 and L2 proficiency as well as the differences in absolute levels of proficiency within each pattern can be obtained among different samples of language-minority children. Additionally, future studies should attempt to replicate the finding that level of proficiency in a language is the strongest indicator of subsequent growth in literacy-related skills in that language, both in early childhood and beyond.

Conclusions

The results of this study demonstrated that Spanish-speaking language-minority children represent a heterogeneous group with regard to their relative and absolute levels of proficiency in L1 and L2. The results fit a pattern in which the level of proficiency in the same language as the outcome was the better predictor of initial status and growth over time than were alternative explanations. That is, neither overall strength of language skills nor super profile classification (i.e., ELL, balanced bilingual, Spanish-language learner) predicted initial level and rate of growth of early literacy skills better than did level of proficiency in the language of the skill being assessed. Taken together, the findings of this study highlight the need for early attention to both L1 and L2 proficiency when identifying language-minority children at risk for the development of reading difficulties in L1 and L2, respectively. Furthermore, the need for early identification of risk for reading difficulties is critical for this population, as children who had weaker early literacy skills than their peers at the beginning of the preschool year fell even further behind as the year progressed, despite beginning to catch up in level of oral language proficiency. Additional research is needed to identify those language-minority children at the highest risk for academic difficulties and evaluate the co-development of English and Spanish language and literacy skills both in the preschool years and beyond.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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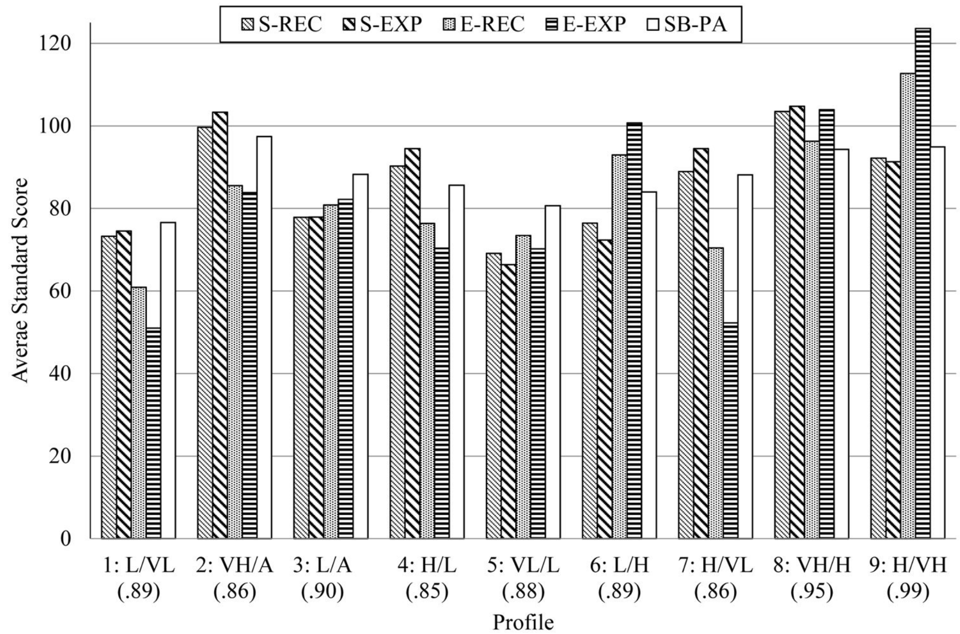

Figure 1.

Means for latent profiles (with average posterior probabilities) for Spanish and English receptive and expressive language skills for nine-profile model. VL = Very Low. L = Low. A = Average. H = High. VH = Very High. S = Spanish. E = English. REC = Receptive Language. EXP = Expressive Language. Initial profile descriptor refers to Spanish language; second profile descriptor refers to English language.

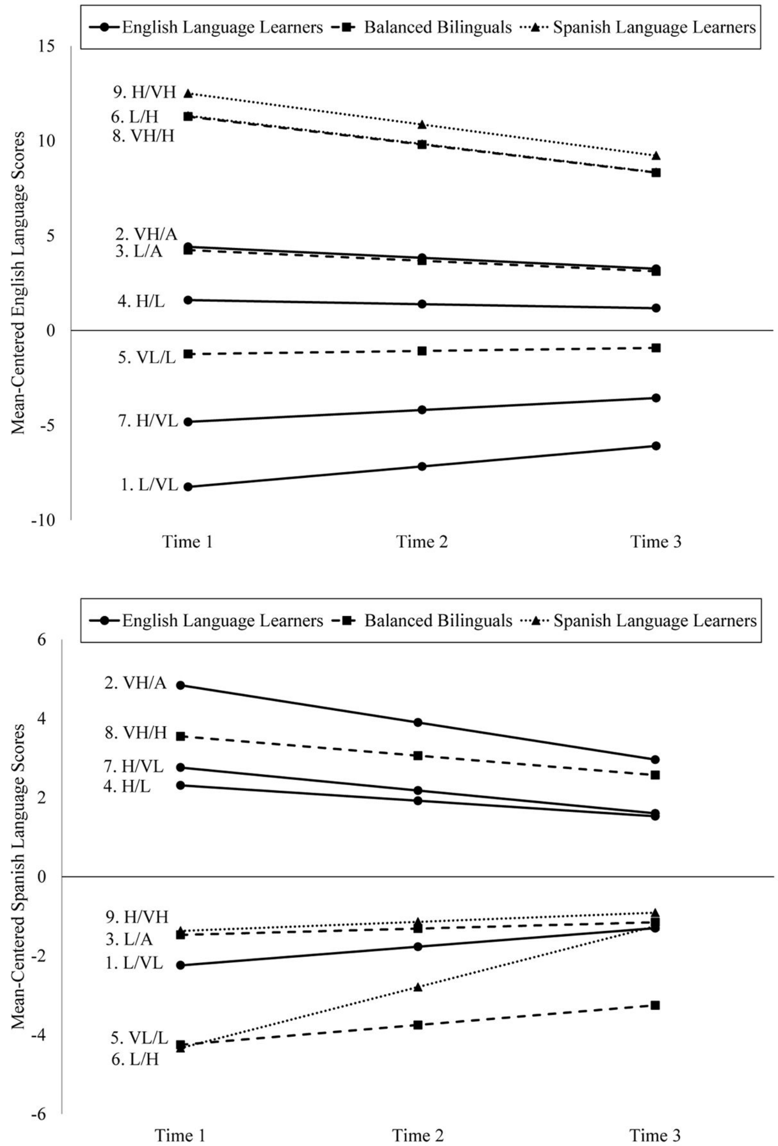

Figure 2.

Growth curves of English (2a) and Spanish (2b) expressive language skills over the course of the preschool year for each profile in the 9-profile model. VL = Very Low. L = Low. A = Average. H = High. VH = Very High. Sample-mean latent intercept and slope scores are zero; therefore, a positive slope represents faster than average growth relative to other children in this sample and a negative slope represents slower than average growth relative to other children in this sample.

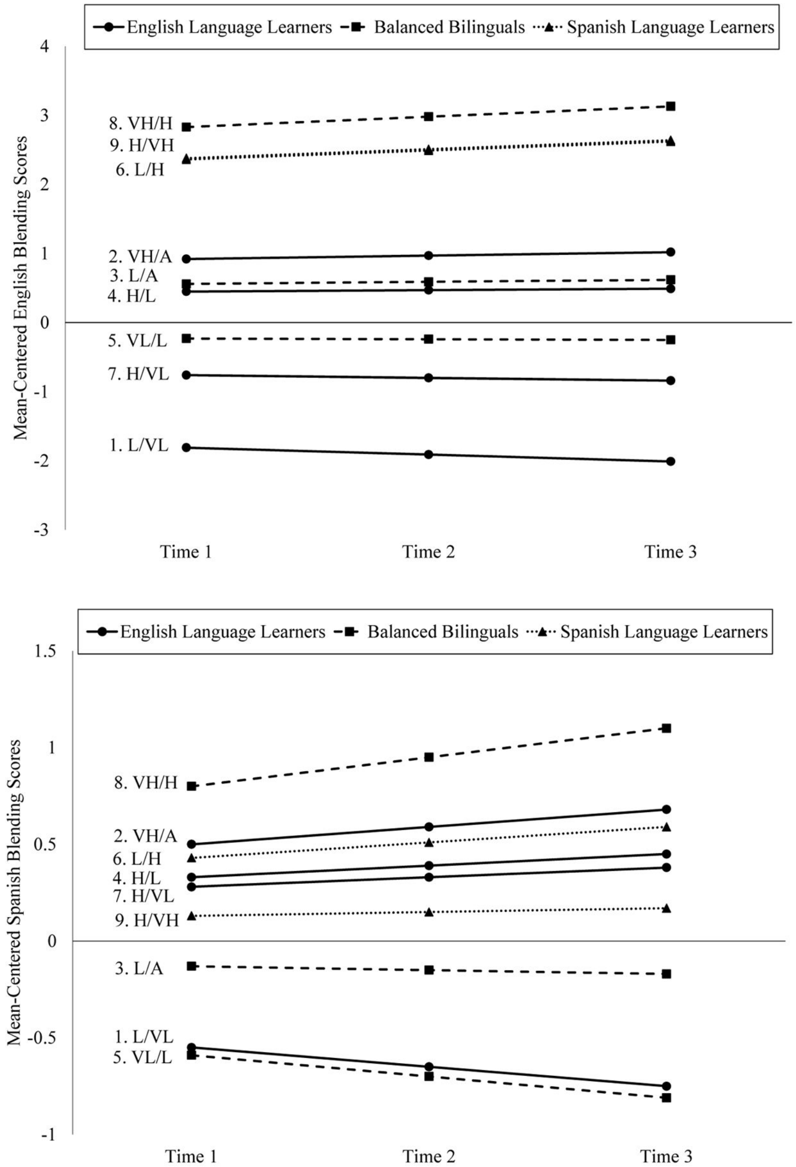

Figure 3.

Growth curves of English (3a) and Spanish (3b) blending skills over the course of the preschool year for each profile in the 9-profile model. VL = Very Low. L = Low. A = Average. H = High. VH = Very High. Sample-mean latent intercept and slope scores are zero; therefore, a positive slope represents faster than average growth relative to other children in this sample and a negative slope represents slower than average growth relative to other children in this sample.

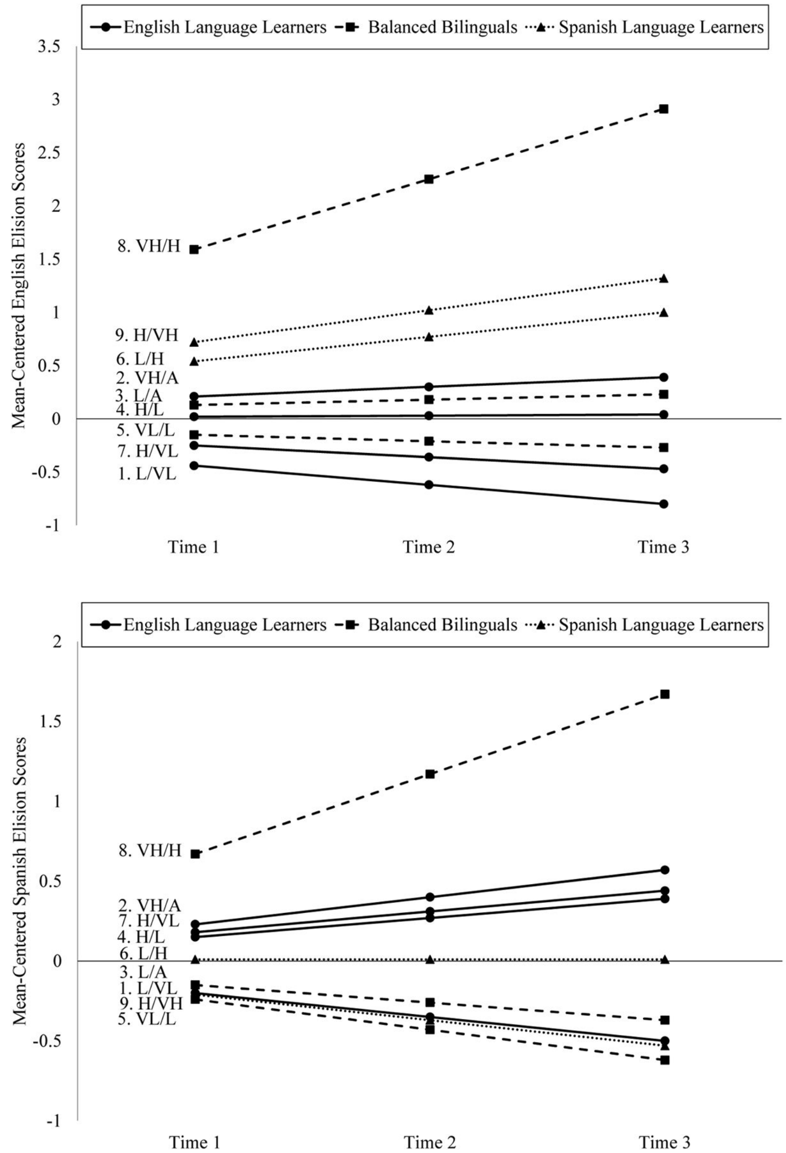

Figure 4.

Growth curves of English (4a) and Spanish (4b) elision skills over the course of the preschool year for each profile in the 9-profile model. VL = Very Low. L = Low. A = Average. H = High. VH = Very High. Sample-mean latent intercept and slope scores are zero; therefore, a positive slope represents faster than average growth relative to other children in this sample and a negative slope represents slower than average growth relative to other children in this sample.

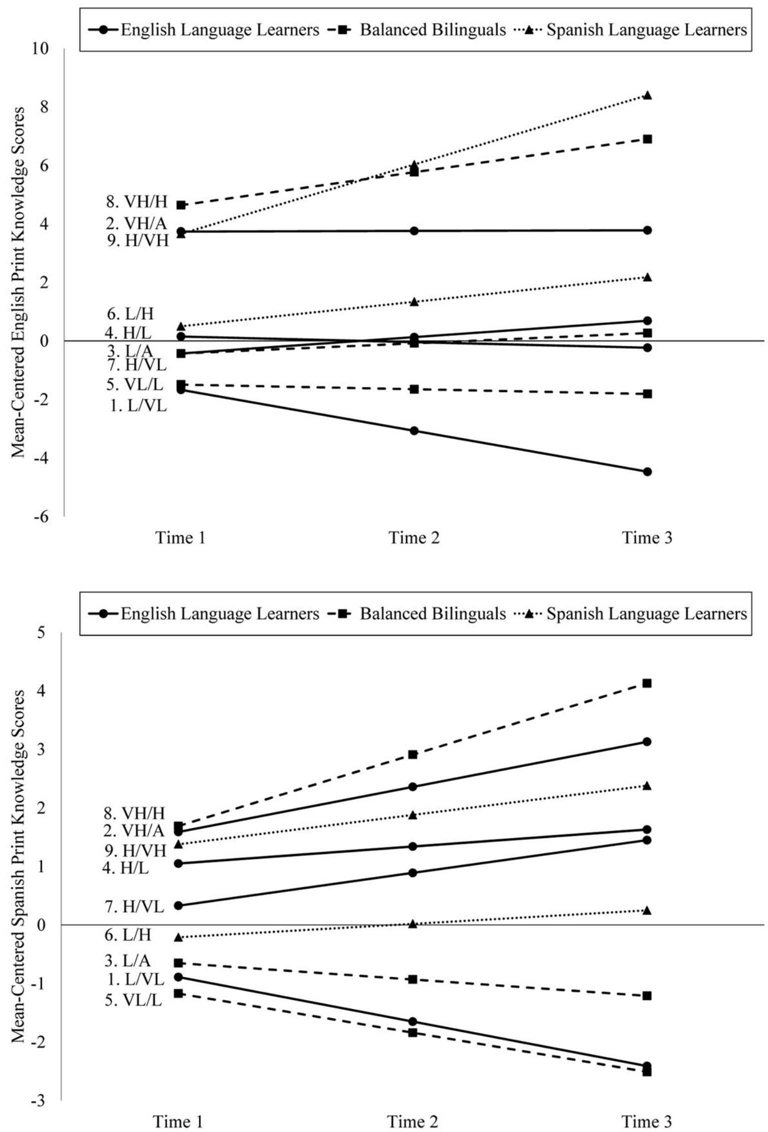

Figure 5.

Growth curves of English (5a) and Spanish (5b) print knowledge skills over the course of the preschool year for each profile in the 9-profile model. VL = Very Low. L = Low. A = Average. H = High. VH = Very High. Sample-mean latent intercept and slope scores are zero; therefore, a positive slope represents faster than average growth relative to other children in this sample and a negative slope represents slower than average growth relative to other children in this sample.

Table 1

Descriptive statistics for Spanish and English early literacy skills

Variable	Standard Scores		Raw Scores					
	Time 1		Time 1		Time 2		Time 3	
	Mean	*(SD)*	Mean	*(SD)*	Mean	*(SD)*	Mean	*(SD)*
Age			51.55	(4.67)	55.73	(4.62)	58.13	(4.57)
Nonverbal	43.37	(7.52)						
English								
Rec Lang	75.92	(15.10)						
Exp Lang	70.48	(18.48)	33.93	(16.25)	41.88	(9.87)	45.81	(9.80)
Blending			9.75	(4.16)	11.54	(4.12)	12.01	(4.12)
Elision			5.14	(2.09)	6.04	(2.18)	6.34	(2.51)
Print			7.76	(4.52)	12.42	(6.55)	14.34	(7.13)
Spanish								
Rec Lang	82.77	(14.55)						
Exp Lang	84.46	(17.46)	37.34	(10.40)	46.41	(7.76)	49.80	(7.33)
Blending			10.34	(3.55)	11.37	(3.43)	11.52	(3.33)
Elision			5.24	(1.73)	5.54	(1.85)	5.79	(1.95)
Print			7.50	(3.57)	9.16	(4.28)	11.23	(5.06)

Note. Nonverbal = Nonverbal cognitive ability. Rec Lang = Receptive language. Exp Lang = Expressive language.

Table 2

Model fit statistics for latent growth curve models of emergent literacy skills

	Chi-Square	RMSEA	CFI	TLI	SRMR
English Outcomes					
Oral Language	1.97	.00	1.00	1.01	.02
Blending	5.36	.04	.99	.98	.02
Elision	8.45	.05	.98	.97	.02
Print	22.15***	.11	.97	.90	.02
Spanish Outcomes					
Oral Language	8.51*	.08	.98	.90	.05
Blending	1.15	.00	1.00	1.03	.01
Elision	.47	.00	1.00	1.02	.01
Print	10.54*	.07	.97	.92	.03

Note. $N = 526$. Missing data imputed using expectation maximization estimation. RMSEA = Root mean square error of approximation. CFI = Comparative fit index. TLI = Tucker-Lewis index. SRMR = Standardized root mean square residual

*** $p < .001$,

* $p < .05$

Table 3

Unstandardized path coefficients predicting intercept and slope from latent growth curve models of English and Spanish emergent literacy skills

	English Oral Language		**English Blending**		**English Elision**		**English Print**	
	Intercept	**Slope**	**Intercept**	**Slope**	**Intercept**	**Slope**	**Intercept**	**Slope**
Age	$.87^{***}$	$.12^{**}$	$.30^{***}$	−.02	$.15^{***}$	−.05	$.27^{***}$	.07
Nonverbal	$.43^{***}$	−.04	$.07^{**}$	.01	$.06^{***}$	−.02	$.21^{***}$	.04
Intercept		$-.13^{***}$		.05		$.42^{*}$		.04
	Spanish Oral Language		Spanish Blending		Spanish Elision		Spanish Print	
Age	$.79^{***}$	.12	$.20^{***}$	−.04	$.08^{***}$	−.04	$.23^{***}$	.01
Nonverbal	$.27^{***}$	−.01	$.06^{**}$	.00	$.05^{***}$	$-.04^{**}$	$.14^{***}$	.01
Intercept		$-.27^{*}$		$.19^{*}$		$.76^{***}$		.08

Note. Nonverbal = Nonverbal cognitive ability.

* $p < .05$.

** $p < .01$.

*** $p < .001$.

Table 4

Model fit statistics from latent profile analyses

	BIC	Δ BIC	ABIC	Δ ABIC	Entropy	BLRT
2 Profiles	21065.35	--	21082.80	--	.67	297.29***
3 Profiles	20958.10	107.25	20888.26	194.54	.90	213.09***
4 Profiles	20883.80	74.30	20794.92	93.34	.83	111.88***
5 Profiles	20843.20	40.60	20735.20	59.72	.79	78.20***
6 Profiles	20808.34	34.86	20681.37	53.83	.82	72.45***
7 Profiles	20784.40	23.94	20638.38	42.99	.83	61.54***
8 Profiles	20761.85	22.55	20596.79	41.59	.85	45.31***
9 Profiles	20714.20	47.65	20530.09	66.70	.87	70.87***
10 Profiles	20711.33	2.87	20508.18	21.91	.85	40.46***
11 Profiles	20709.97	1.36	20487.77	20.41	.86	38.95***

Note. BIC = Bayesian Information Criterion. Adj. BIC = Sample Size Adjusted Bayesian Information Criterion. BLRT = Bootstrapped likelihood ratio test. Missing data imputed using EM estimation.

*** $p < .001$.

Table 5

Chi-square test statistics for differences in initial level and rate of growth of early literacy skills across profiles necessary for evidence of cross-language transfer

			Growth Model Outcome							
			Language		**Blending**		**Elision**		**Print**	
			Intercept	**Growth**	**Intercept**	**Growth**	**Intercept**	**Growth**	**Intercept**	**Growth**
Spanish-English Transfer (L1-L2)										
Profile 7 (H/VL)	>	Profile 1 (L/VL)	**9.42****	**9.39****	**9.43****	**9.77****	1.40	1.55	7.92**	**31.34*****
Profile 2 (VH/A)	>	Profile 3 (L/A)	.02	.02	.84	.88	.17	.16	**24.10*****	.34
Profile 4 (H/L)	>	Profile 5 (VL/L)	.99	.99	2.98^{+}	3.08^{+}	1.46	1.49	**14.36*****	.00
Profile 8 (VH/H)	>	Profile 6 (L/H)	.00	.00	1.39	1.37	**11.04****	**10.92****	**11.94****	.11
English-Spanish Transfer (L2-L1)										
Profile 9 (H/VH)	>	Profile 4 (H/L)	**5.54***	2.53	.17	.18	3.24^{+}	3.21^{+}	.25	.48
Profile 6 (L/H)	>	Profile 3 (L/A)	**7.26****	**16.91*****	**7.62****	**7.67****	.80	.83	.79	3.15^{+}
Profile 4 (H/L)	>	Profile 7 (H/VL)	.68	.60	.01	.01	.07	.05	1.12	.53
Profile 3 (L/A)	>	Profile 1 (L/VL)	1.63	1.87	**6.76****	**6.81****	.48	.49	1.21	4.29*
Profile 8 (VH/H)	>	Profile 2 (VH/A)	1.41	1.54	1.25	1.29	2.73^{+}	2.72^{+}	.02	.85
Profile 6 (L/H)	>	Profile 1 (L/VL)	3.95*	**9.93****	**24.18*****	**24.31*****	1.45	1.52	2.32	**18.04*****
Profile 9 (H/VH)	>	Profile 7 (H/VL)	**7.34****	4.31*	.30	.35	4.11*	4.04*	3.52	.03

Note. L1 = First language. L2 = Second language. VL = Very low. L = Low. A = Average. H = High. VH = Very high. Bolded test statistics remained significant after application of the Benjamini-Hochberg correction for multiple comparisons.

$^{+}$ $p < .10$.

* $p < .05$.

** $p < .01$.

*** $p < .001$.