

Empirically Based Profiles of the Early Literacy Skills of Children With Language Impairment in Early Childhood Special Education

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Abstract

The purpose of this study was to empirically determine whether specific profiles characterize preschool-aged children with language impairment (LI) with respect to their early literacy skills (print awareness, name-writing ability, phonological awareness, alphabet knowledge); the primary interest was to determine if one or more profiles suggested vulnerability for future reading problems. Participants were 218 children enrolled in early childhood special education classrooms, 95% of whom received speech-language services. Children were administered an assessment of early literacy skills in the fall of the academic year. Based on results of latent profile analysis, four distinct literacy profiles were identified, with the single largest profile (55% of children) representing children with generally poor literacy skills across all areas examined. Children in the two low-risk categories had higher oral language skills than those in the high-risk and moderate-risk profiles. Across three of the four early literacy measures, children with language as their primary disability had higher scores than those with LI concomitant with other disabilities. These findings indicate that there are specific profiles of early literacy skills among children with LI, with about one half of children exhibiting a profile indicating potential susceptibility for future reading problems.

Keywords

preschool age, disorders language, literacy

Children with language impairment (LI) are a heterogeneous group, often differentiated at the broadest level into those for whom the language disorder is the primary diagnosis or concern (specific language impairment, or SLI) and those for whom it is a secondary diagnosis (secondary LI) associated with a defining primary etiology (e.g., intellectual disability, autism). Even within each of these two general categories, however, children exhibit a range of individual differences in the domains of language affected, the severity of these impacts, and the extent to which other disabilities co-occur. For instance, children with LI experience relatively high levels of comorbidity for such conditions as attention deficit disorder, speech-sound disorders, and reading disability (Catts, Adlof, Hogan, & Weismer, 2005; McGrath et al., 2008). Thus, although it is common to view LI as an individual difference differentiating non-affected and affected children, it is important to acknowledge that within this disorder there is substantial heterogeneity. An important reason for acknowledging that

such heterogeneity is the norm, rather than the exception, is that it may be influential to designing interventions for children with LI. For instance, children with LI who exhibit comorbid reading disabilities would likely benefit from language intervention that includes targets aligned to their reading-specific symptoms (e.g., deficits in print awareness, phonological awareness, comprehension).

The purpose of the present work was to examine the early literacy skills among preschool-aged children with

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LI and to consider whether there are specific profiles of children who appear most susceptible for future reading disability. The sample includes children with both SLI and secondary LI, as a potentially important individual difference among children with LI. Considerable research shows there to be high levels of diagnostic comorbidity between LI and reading disability with respect to both phenotype (Catts, Fey, Tomblin, & Zhang, 2002; Pennington & Bishop, 2009; Snowling, Bishop, & Stothard, 2000) and genotype (e.g., Logan et al., 2011; Newbury et al., 2011). Studies of comorbidity of language and reading disability are in part motivated by consistent findings showing that children with LI are highly susceptible to reading problems at all stages of development, from the preschool years (Boudreau & Hedberg, 1999; Cabell, Justice, Zucker, & McGinty, 2009; Justice, Bowles, & Skibbe, 2006) and into primary and secondary schooling (Catts et al., 2002; Morgan, Farkas, & Maczuga, 2011; Skibbe et al., 2008). Morgan et al. (2011), examining the reading trajectories of children with LI relative to those with learning disabilities (LDs) and typical reading skills, found children with LI to lag increasingly behind both comparison groups in their reading achievement between kindergarten and fifth grade. In general, one half of children identified with LI at kindergarten will have significant problems with reading (Catts et al., 2002).

A potentially important individual difference among children with LI therefore concerns whether or not they exhibit difficulties with reading or, put differently, are susceptible for reading disability (Catts et al., 2002; Skibbe et al., 2008). From a developmental perspective, we may expect that susceptibility for reading disability might be apparent prior to the primary grades and the advent of formal reading instruction. This expectation is based on prior work identifying specific early literacy skills that are most strongly associated with future reading achievement; conversely, when children show lags in developing these literacy skills, their risk for future reading disability is heightened (Catts et al., 2002).

In the last decade, an increasing number of researchers have examined the early literacy skills of young children, particularly those children who may be considered at risk for future reading difficulties (e.g., Boudreau & Hedberg, 1999; Justice et al., 2006; Storch & Whitehurst, 2002). Although much of this work has focused on only children with SLI (e.g., Skibbe et al., 2008), studies that include children with other typologies of LI indicate that they also experience heightened risk for reading disability (e.g., Catts et al., 2002). There is convincing evidence linking children's early literacy skills as measured at 3 and 4 years of age to their future reading achievement (e.g., Storch & Whitehurst, 2002) as well as risks for future reading disability (e.g., Catts, Fey, Zhang, & Tomblin, 2003). Considerable evidence points to early "code-based skills"

as being particularly important to predicting future reading outcomes in word recognition/decoding (National Early Literacy Panel, 2008); these include (but are not limited to) print awareness, name-writing ability, phonological awareness, and alphabet knowledge.

Print awareness (also referred to as concepts about print) represents children's knowledge about the forms and functions of print. Development of print awareness among young children with disabilities, including LI, tends to lag significantly behind that of typically developing children (Boudreau & Hedberg, 1999; Justice et al., 2006). Interventions to improve young children's print awareness have direct effects on future reading skills (Piasta, Justice, McGinty, & Kaderavek, 2012). Name-writing ability represents children's ability to encode phonological and orthographic knowledge in an early-achieving competency that can be tracked over early childhood. Also a malleable skill that can be improved through intervention (Aram & Biron, 2004), children with LI show lags in the development of name-writing skill in relation to same-age peers (Cabell et al., 2010). Phonological awareness refers to an individual's sensitivity to the sound structure of spoken language, and has causal associations with reading development (Storch & Whitehurst, 2002); it too is underdeveloped in children with LI but can be readily improved through intervention (Gillon, 2000, 2001). Finally, alphabet knowledge typically refers to children's knowledge of names of the upper- and lower-case letters as well as the ability to distinguish among them. Alphabet knowledge is a robust precursor of future decoding skill (Storch & Whitehurst, 2002); children with LI tend to know fewer letters than their typically developing peers at the end of preschool (Cabell et al., 2010).

Constructs of interest in this study—print awareness, name-writing ability, phonological awareness, and alphabet knowledge—were examined in a recent comprehensive meta-analysis of early literacy development (National Early Literacy Panel, 2008); each was shown to be significantly related to future reading achievement. For instance, in the prediction of decoding skills, variance in this outcome explained by these predictor variables ranged from 12% (print awareness) to 25% (alphabet knowledge). Because these predictor variables are malleable—unlike others that explain comparable levels of variance (such as rapid automatic naming and IQ)—they are important candidates for investigation, as children who exhibit weaknesses in these skills can receive intervention tailored to address these weaknesses.

Much of the work investigating early literacy skills among young children has involved variable-centered approaches. However, several recent studies have used person-centered methods to examine whether children can be profiled with respect to their skills and whether these profiles show longitudinal stability (Cabell, Justice, Konold, &

McGinty, 2011; Cabell, Justice, Logan, & Konold, 2013). A motivation for such work is to determine whether there may be specific profiles of children that signal risk for future reading problems. Research that seeks to identify whether there are optimal groupings that are reliably differentiated within a given population (i.e., profiles) is referred to as person-centered research. Person-centered research may be distinguished from variable-centered research that often aims to predict longitudinal outcomes or document relations among variables. Person-centered methods typically seek to empirically identify profiles (also groups and classes) of individuals that represent certain shared characteristics among a set of key variables. In this work, we build on recent findings showing that young children exhibit reliable profiles of early literacy skill, that these profiles show longitudinal stability (particularly children in relatively "poor" profiles), and that profiles can predict future reading achievement (Cabell et al., 2010, 2013; Cabell, Justice, Konold et al. 2011). With one exception, which we discuss below, these recent studies have involved children enrolled in public preschool programs but have not specifically focused on children with disabilities or, more specifically, children with LI.

In an initial effort to profile the early literacy skills of children with LI, Cabell et al. (2010) investigated the early literacy skills of 62 children with LI. Children in that study comprised only those with SLI, in which LI is a child's only disability. These researchers found three reliable profiles of early literacy skill: Profile 1 (prevalence 27%) comprised children with overall high levels of early literacy skill with a particular strength in alphabet knowledge; Profile 2 (prevalence 34%) comprised children with overall average levels of early-literacy skill with a particular strength in print concepts; and Profile 3 (prevalence 39%) comprised children with relatively poor early literacy skills across all dimensions assessed. The researchers contended that children with Profile 3 were likely the most susceptible for future reading problems, given the longitudinal relations between the skills examined and future reading abilities. Although children's age was a significant predictor of group membership among this sample, language skills also played a small but significant role in membership prediction, with children in Profile 1 tending to have higher levels of language skill than children in the other profiles. With a relatively small sample size and participants restricted to only children with SLI, it is unclear whether these profiles might generalize to a broader population of children with LI, to include those with SLI but also those children with secondary LI, in which language disabilities occur concomitantly with intellectual disability, autism spectrum disorders, hearing loss, and other etiologies. There is strong evidence to suggest that children with secondary LI are at greater risk for reading difficulties compared to children with SLI (Catts et al., 2002).

In the present study, the first aim was to determine whether there were reliable profiles of young children with LI with respect to early literacy skill, and also whether some profiles signaled a potentially heightened susceptibility for future reading disability; such profiles would be characterized by skill weaknesses transcending many or all of those early literacy indices predictive of future reading disability. Children with such profiles may be the optimal candidates for receiving early-literacy interventions. In examining the profiles of children with LI, the study can be distinguished in two important ways from the work of Cabell et al. (2010), which used person-centered methods to examine early literacy profiles of children with SLI. The first distinction is methodological: in the present study we used latent class analyses (LCAs) as a means to examine children's early literacy profiles, whereas Cabell et al. used cluster analyses methods. LCA has benefits over cluster analysis in that LCA provides additional model information not obtained in cluster analysis, thus providing improved means for identifying the optimal number of classes that fit the data. In other words, the information obtained in LCA allows for a more empirically driven approach to model fitting.

The second distinction between the present work and the contribution of Cabell et al. (2010) concerns the sample involved. In addition to investigating a much larger overall sample in the present study ($n = 218$) as compared to Cabell et al. ($n = 62$), the current study involved a more heterogeneous sample of children with LI, to include not only children exhibiting LI as a primary etiology (SLI) but also children whose LI is secondary to other developmental disabilities (secondary LI). Children with SLI have impaired language skills as their only disability, and identification of SLI is typically based on exclusionary criteria that rule out cognitive factors (usually based on a threshold of -1 SD of mean on a measure of nonverbal cognition) and any sensorineural involvement, including hearing and motor skill. Children with SLI exhibited elevated rates of reading problems, on the magnitude of about 5:1, compared to children with typical language skills (Catts et al., 2002). Other children exhibit impaired language skills concomitantly with intellectual disability and/or sensorineural concerns, such as children with Down syndrome, hearing loss, and autism spectrum disorders. In such cases, LI occurs secondary to or comorbid with these concerns, and evidence suggests that these children may be more susceptible for reading problems compared to children with SLI.

For instance, recent work by Wei, Blackorby, and Schiller (2011) involved examining reading growth from 7 to 17 years for over 3,000 students representing 11 federally defined disability categories. Children with intellectual disabilities had among the lowest reading achievement scores at all time-points. At age 13, the difference in reading achievement between children with speech-language disabilities and those with intellectual disabilities was of a very

large magnitude ($d = 1.31$). An earlier study by Catts et al. (2002) examined the rate of reading disability among children with SLI compared to children whose language difficulties were comorbid with lower nonverbal cognition (which they referred to as nonspecific LI, or NLI). In second grade, children with NLI were more likely to have a reading disability compared to those with SLI (67% vs. 42% disability rates, respectively). To date, there has been little effort to understand the early literacy skills of children with LI who do not meet criteria for SLI. In total, three research aims were addressed:

- (a) to determine (and describe) the number of profiles that best characterize the early literacy skills of young children with LI across indices of print awareness, name-writing ability, phonological awareness, and alphabet knowledge;
- (b) to examine the extent to which these profiles are associated with children's oral language ability; and
- (c) to examine the extent to which there are differences in the early literacy profiles for children with SLI and secondary LI.

Method

Participants

Participants were 218 children (73% male, 27% female) with individual education plans (IEPs) specifying receipt of speech-language services; the children were enrolled in 83 publicly supported early childhood special education (ECSE) classrooms across a single state. The majority of the classrooms utilized inclusive practices, whereby children with disabilities were co-enrolled along with typical peers. The teachers of these classrooms had enrolled in a randomized controlled trial (RCT) involving implementation of a book-reading program in their classrooms; all teachers had consented to participate and were volunteers. Although classrooms enrolled a heterogeneous group of 3- to 5-year-old children, the population of interest in the RCT was children with LI in ECSE classrooms. Study procedures involved following a series of steps to identify children for this study once a teacher/classroom was enrolled. The primary purpose of these procedures was to identify children with LI (based on receipt of speech/language services and language-specific goals) from among the children participating in ECSE classrooms.

Ascertainment procedures. The ascertainment procedures followed were designed to identify children nested within ECSE classrooms who met certain criteria. The intent of the sampling frame was to identify up to four children with LI per classroom for ongoing in-depth assessments (three assessments over a 2-year period). The total sample size,

which sought to enroll up to four children per classroom, was based on *a priori* power estimates for the RCT. First, teachers sent home a consent form to the caregivers of all children in their classrooms coupled with information about the larger RCT. Second, of those children whose caregivers provided consent, which averaged about 85% across classrooms, teachers then completed a screener for each child consisting of eight questions; the questions were designed to identify children with language disabilities in their classrooms. For instance, items included "Does this child currently receive services at school or outside of school for a speech and/or language impairment?" and "Has a professional identified this child as having a speech and/or language impairment?" Third, research staff examined all of the screeners available for a given classroom and identified those who appeared, on the basis of teacher report, to have a primary impairment of language (SLI), to have secondary LI (including children with language-related etiologies, such as Down syndrome and autism), or to have significant problems with language based on teacher report.

Approximately 4 weeks into the fall of the academic year, beginning approximately 1 week following the ranking procedures, a 4-week fall assessment window began within which each child completed a comprehensive assessment of language, literacy, and other skills (e.g., nonverbal cognition, social competence). When staff went into the field to complete assessments, they selected the top-ranked children in each classroom to assess. Assessors moved down the rankings until all available slots within a classroom were filled. As planned for, an average of four children per classroom were enrolled in the study, and ascertainment procedures resulted in oversampling of children with primary and secondary LI among the final sample.

The final sample of children ($n = 218$) was approximately 4 years of age ($M = 4.2$ years); 27%, 62%, and 11% of children were 3, 4, and 5 years of age, respectively. The children's socioeconomic status (SES), as estimated from household income reports provided by primary caregivers, varied widely but can best be characterized, on average, as middle SES (median income = \$50,000 per year, range = \$5,000 to over \$85,000 per year). In terms of race/ethnicity, 75% of the children were White, 16% were Black, and 9% were other or unreported; 95% of the children resided in homes in which English was the primary language spoken. Ninety percent of children had IEPs designating provision of speech-language services in their schools, and an additional 5% of children were receiving speech-language services outside of school. The remaining 5% of children was considered by their teachers to have language skills lagging behind their peers but was not currently receiving speech-language services. About one fifth of the children (21%; $n = 46$) had diagnosed developmental disabilities, including autism spectrum disorder ($n = 24$), cerebral palsy ($n = 8$),

Down syndrome ($n = 6$), Stickler Syndrome ($n = 4$), Tourette Syndrome ($n = 2$), and apraxia ($n = 2$).

To characterize the sample in terms of their language and cognitive skills, the children received, on average, a Composite Language score of 76 ($SD = 18$, based on the Comprehensive Evaluation of Language Fundamentals–Preschool, CELF-P; Wiig, Secord, & Semel, 2004); the mean Expressive Language Composite was 75.5 ($SD = 17$; range = 45 to 128) and the mean Receptive Composite was 78.2 ($SD = 16.7$; range = 45 to 127). Most, but not all, of the children (69%) had Composite Language scores that were more than 1 SD below the standardized mean. The children's mean nonverbal-cognition score was 82 ($SD = 18$, based on the Matrices subtest of the Kaufman Brief Intelligence Test–2; Kaufman & Kaufman, 2004), representing 169 of the 218 participants as the nonverbal cognition was not administered to children under 4 years of age.

Procedures

For the present purposes, all data reported were collected prior to implementation of any program by teachers and thus were not affected by the experimental procedures of the RCT. Study methods included administering a standardized language and nonverbal-cognition assessment to each child (referenced previously), as well as measures of early literacy.

Children were individually assessed in the fall of the year by trained research staff. Assessments were conducted within children's schools in private locations. As needed, assessment sessions were divided into several shorter sessions. Prior to conducting any field assessments, all assessors were comprehensively trained utilizing a multistep process per each measure administered; the final step involved direct supervision of field assessments with study children. Additional steps were taken to reduce error in the data: (a) All test protocols were double-scored for accuracy, (b) computer programs were used to automatize deriving standard scores from raw scores whenever possible, and (c) all data were double-entered.

To address the aims of this study, the following measures from the larger battery administered to children were used to represent the constructs of print awareness, emergent writing ability, phonological awareness, alphabet knowledge, and oral language ability. Though all children were given all assessments, occasionally scores on a given measure were missing. For example, occasionally children would request to stop testing, or children were not given a standard score if they did not establish a basal. We thus provide the number of participants with valid scores on each measure when presenting results.

Preschool Word and Print Awareness (PWWA; Justice et al., 2006): The PWWA, a criterion-referenced task that also provides trait estimates based on item-response theory, was

used to examine children's knowledge of 14 print concepts. Children's knowledge of these concepts is assessed in a storybook reading task. Test developers report an interrater reliability coefficient of .94 and that the measure represents a single trait with a reliability of .74.

The Name Writing subtest of the Phonological Awareness Literacy Screening–PreKindergarten (PALS; Invernizzi, Sullivan, Meier, & Swank, 2004), a criterion-referenced task scored on a 7-point continuum, was used to examine children's emergent writing abilities. Children are asked to draw a portrait of themselves and sign their name to it. The name production is scored on a 7-point scale. The test manual reports an interrater agreement of .99.

The Phonological Awareness subtest of the Test of Preschool Early Literacy (TOPEL; Lonigan, Wagner, Torgesen, & Rashotte, 2007), a norm-referenced standardized tool, was used to examine children's phonological awareness. This subtest includes four sets of items to examine skills in both blending and segmenting across a range of segment sizes (e.g., syllables, rimes, phonemes). This test has adequate psychometric qualities (test-retest reliability = .86 to .99; internal consistency/Cronbach's $\alpha = .82$ to .95).

The Alphabet Knowledge subtest of PALS (Invernizzi et al., 2004), comprising both the upper-case and lower-case tasks, was used to examine children's knowledge of the alphabet. This criterion-referenced subtest includes a total of 52 items (all of the upper- and lower-case letters). Children are presented the individual letters in an array and are asked to produce the name of each letter. The PALS–PreK manual reports an interrater reliability coefficient of .99.

Six core subtests of the CELF-P (Wiig et al., 2004) were administered to children to represent their expressive and receptive language skills: Sentence Structure, Word Structure, Expressive Vocabulary, Concepts and Following Directions, Recalling Sentences, and Basic Concepts. An overall composite (Core Language Composite) is derived from the Sentence Structure, Word Structure, and Expressive Vocabulary subtests. A Receptive Language Composite is derived from the Sentence Structure, Concepts and Following Directions, and Basic Concepts subtests, and an Expressive Language Composite is derived from the Word Structure, Expressive Vocabulary, and Recalling Sentences subtests.

As an additional measure of children's oral language ability, the Definitional Vocabulary subtest of the TOPEL (Lonigan et al., 2007) was used to represent expressive vocabulary skills. It requires children to provide the name of individually presented pictures (e.g., door), and then to provide additional information about that item (e.g., What is it for?). It captures the depth of children's lexicon and thus provides additional information beyond that available in the vocabulary measure of the CELF.

Analytic Technique: Latent Profile Analysis (LPA)

LPA is a special case of LCA that was developed as an empirically driven method to classify individuals into groups. Classification of individuals can be determined by multiple responses on a single test, or by scores on multiple tests. The approach has been used, for instance, to differentiate classes of persons who are and are not susceptible to alcohol abuse (see Muthén & Muthén, 2000). When indicators used to create latent classes are dichotomous (e.g., correct/incorrect responses to test items), the analysis is referred to as LCA. However, when indicators used to create classes are continuous, such as the test scores used in the present study, the LCA technique may be referred to as LPA. In the present study, the LPA technique was used, though both LCA and LPA are identical in conceptualization.

To conduct a LPA, a potential number of profiles (i.e., classes) must be provided by which to estimate classes. Based on the specified number of groups, the LPA will provide a suggested group membership for each person. In the present study, LPA was used to cluster children with LI into groups based on their performance on measures of early literacy skills. If the LPA was asked to find two profiles (classes) of children, the analysis would most likely identify one group of children with very high scores and a second group with very low scores. Unlike well-defined disabilities (such as ADHD), the number of different profiles of early literacy skills among children with LI is unknown. When such is the case, an exploratory analysis can be conducted to determine the optimal number of groups for the data (see Muthén, 2006). The exploratory approach requires that several models be fit to the data, each with an increasing number of groups. Model comparisons are then used to determine which of the models, and thus which number of classes, is the best fit to the data. A variety of indices are used to identify the model that best fits the data, including the Bayesian information criterion (BIC; Kaplan, 1989) and the Akaike Information Criteria (AIC; Kaplan, 1989). Once the most appropriate model fit has been determined, the results can then be interpreted. This approach was used in the present study.

Results

The first aim was to determine the number and characteristics of profiles that best characterized the early literacy skills of young children with LI across indices of print awareness, name-writing ability, phonological awareness, and alphabet knowledge. Table 1 provides an overview of children's performance on these primary measures of early literacy skills. As these data show, there was substantial variability among the children in their performance on these measures. This variability supports the value of using person-centered methods to assess whether the children can be

Table 1. Descriptive Characteristics of Children on Early-Literacy Measures.

Measure	<i>n</i>	<i>M</i>	<i>SD</i>	Range
Print Awareness	212	4.45	3.36	0 to 16
Name Writing	213	2.85	2.18	0 to 7
Phonological Awareness	208	7.56	5.60	0 to 23
Alphabet Knowledge	212	14.41	17.13	0 to 52

Note. All values represent raw scores on individual measures. Print Awareness = Preschool Word and Print Awareness (Justice et al., 2006); Name Writing = Name Writing subtest of the Phonological Awareness Literacy Screening–PreKindergarten (PALS; Invernizzi et al., 2004); Phonological Awareness = Phonological Awareness subtest of the Test of Preschool Early Literacy (Lonigan et al., 2007); Alphabet Knowledge = Alphabet Knowledge subtest of the PALS.

grouped into reliable profiles on these skills and, in turn, whether any such profiles appear to be most susceptible for future reading disability.

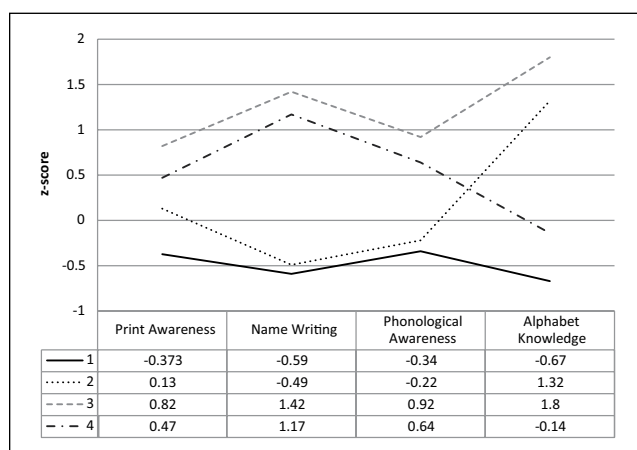
Latent Profile Results

For the present study, five models were generated and compared, each testing for a different number of groups (two, three, four, five, and six groups). As indicated previously, multiple indices were utilized to determine which number of groups was most appropriate for representing the data. These included the BIC (Kaplan, 1989), the AIC (Kaplan, 1989), the Vuong-Lo-Mendall-Rubin (VLMR) likelihood different test (Lo, Mendell, & Rubin, 2001), and entropy (Ramaswamy, DeSarbo, Reibstein, & Robinson, 1993). The -2 Log Likelihood, AIC, and BIC were plotted against the number of classes provided in estimation, and the plots were examined for substantial decreases between classes; when decreases began to level, this indicated that the model should be retained. The results of the LPA for the five different models in relation to these indices are presented in Table 2. All examined indices of model fit suggested that the four-class model was the most optimal fit to the data. The four-class model yielded the lowest BIC with a VLMR p value of $< .05$, indicating that children with LI participating in ECSE can be reliably differentiated into four profiles of children on the basis of their early literacy skills. In particular, Entropy indicated that the four identified profiles were distinct from one another. A graphic representation of the four identified profiles of children is presented in Figure 1; the values presented provide information about each groups' performance on the four indices in z scores, based on a mean of 0 and an SD of 1. Therefore, each of the profile's performance on the measures can be interpreted in SD units against the overall sample mean. Additionally, descriptive data relevant for each profile on the early literacy and language measures collected in this study appear in Table 3. Here, we briefly describe each class using a naming convention based on the extent to which each of the

Table 2. Model Fit Indices for the Five Tested Models.

Model	-2 Log Likelihood	Free Parameters	AIC	BIC	Entropy	VLMR p Value
2 groups	-1,098	13	2,223	2,267	0.9	.00
3 groups	-1,043	18	2,123	2,184	0.94	.00
4 groups	-1,001	23	2,049	2,126	0.93	.00
5 groups	-938	28	2,023	2,117	0.93	0.07
6 groups	-963	33	1,993	2,105	0.9	0.12

Note. Bold indicates best fit. Higher values of -2 Log Likelihood indicate better fit, and lower values of AIC and BIC indicate better fit. Entropy ratings > .8 indicate adequate fit. The model of best fit is identified by the highest number of classes with a significant p value, given adequate fit of the other indices. BIC = Bayesian information criterion, VLMR = Vuong-Lo-Mendall-Rubin likelihood difference test.

**Figure 1.** Latent Profiles of Early Literacy Skills for Children With LI

Note. LI = language impairment.

profile's performance on the early literacy indices suggests susceptibility for future reading disability.

Profile 1: High risk (prevalence = 55%, $n = 119$). The first extracted group, comprising slightly more than one half of the sample, was labeled as high risk. This profile had mean scores on all four of the early literacy measures that were about 0.5 SD below the mean of the overall sample. As a group, these children appeared to know very few concepts about print, could not represent any letters in their names, performed very few phonological awareness tasks with accuracy, and knew about three letters of the 52 upper- and lower-case alphabet letters. Given the overall poor performance of this profile across multiple indices, these children can be characterized as being at significant risk for future reading difficulties, as all four indices are significant predictors of future reading achievement in both decoding and comprehension.

Profile 2: Moderate risk (prevalence = 14%, $n = 31$). The second extracted group, comprising 14% of the sample, showed average performance on print awareness (relative to the group), low performance on the indices of name-writing

ability and phonological awareness (about -0.5 SD of the mean), but quite strong performance on alphabet knowledge (accurately identifying 37 of the 52 upper- and lower-case letters). Although the children's modest performance on two of the four indices suggests some susceptibility for future reading problems, the higher-than-average alphabetic knowledge may provide an important source of resilience, particularly given that it is one of the strongest predictors of future reading achievement in multivariate models (National Early Literacy Panel, 2008).

Profile 3 (prevalence = 11%, $n = 24$) and Profile 4 (prevalence = 19%, $n = 42$): Low risk-high alphabet and low risk-average alphabet, respectively. The third and fourth extracted groups, collectively representing about one third of children with LI in these ECSE settings, appear to show little susceptibility for future reading disability. Profile 3 (low risk-high alphabet) had relatively strong performance across all four early literacy indices, with scores in the $+1$ to $+2$ SD range. Profile 4 (low risk-average alphabet) had scores on three of the four indices (print awareness, name-writing ability, and phonological awareness) in the $+0.5$ SD range. The primary difference between the two extracted groups is on the index of alphabet knowledge, with children in Profile 4 performing much lower than those in Profile 3 but still in the average range in relation to the entire group, knowing about 12 of the 52 upper- and lower-case letters. Although the two groups have some distinctive differences in their profiles, we view them as similar in having low susceptibility for future reading disability.

Profile Prediction From Language Ability

The second aim addressed in this work concerned examining the extent to which these profiles may be associated with children's oral language ability. The mean scores on three of the standardized language measures used in this study (Expressive Composite, Receptive Composite, and Definitional Vocabulary) for the four profiles appear in Table 3. Inspection of these data suggests that children in Profiles 3 and 4 had higher overall language skills than children in Profiles 1 and 2. To address this statistically, mean differences on the three

Table 3. Means (and Standard Deviations) for Performance on Main Study Measures by Profile.

Measure	Profile (Name)			
	1 (High Risk)	2 (Moderate Risk)	3 (Low Risk–High Alphabet)	4 (Low Risk–Average Alphabet)
N	119	31	24	42
Early Literacy Indices Raw scores				
Print Awareness	3.2 (2.6)	4.9 (2.8)	7.2 (4.7)	6.0 (2.9)
Name Writing	1.6 (0.9)	1.8 (1.1)	6.0 (1.2)	5.4 (1.2)
Phonological Awareness	5.6 (4.4)	6.3 (5.0)	12.7 (5.7)	11.1 (5.8)
Alphabet Knowledge	2.9 (3.6)	37.1 (8.7)	46.1 (4.6)	12.0 (7.5)
Language Indices Standard scores				
Expressive Composite	69.55 (15)	75.73 (16)	89.45 (16)	83.02 (14)
Receptive Composite	73.06 (15)	76.63 (15)	90.83 (16)	84.76 (15)
Definitional Vocabulary	76.47 (15)	81.23 (17)	95.59 (15)	90.30 (13)

Note. Two students were missing data on two or more early literacy indices, and so were not put into a profile.

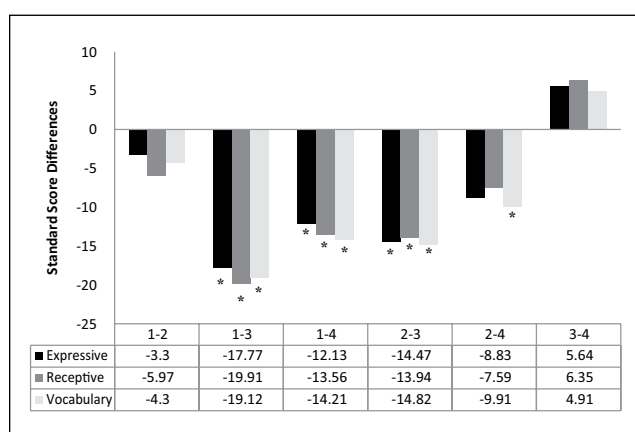


Figure 2. Standard Score Differences Between the Four Extracted Groups (e.g., Profile 1 to Profile 2) on Expressive Composite, Receptive Composite, and Definitional Vocabulary
*Bonferroni-corrected significant differences between standard scores as identified through confidence intervals. The observed standard deviations within each class in the sample are presented in Table 4.

language variables between the four groups were examined using analysis of variance (ANOVA) with Bonferroni corrected *post hoc* comparisons. These were conducted in SAS and tested with a corrected confidence interval. Differences in standard scores (marked for Bonferroni-corrected significant differences) across the three measures for each of the four profiles appear in Figure 2. As can be seen, no differences were observed for any of the three language indices for children in Profile 1 compared to Profile 2 (high risk and moderate risk), or for children in the both low-risk groups (Profiles 3 and 4).

The other contrasts (Profiles 1 to 3; 1 to 4; 2 to 3) showed significant differences in skills: Children in Profile 1 (high risk) had significantly poorer performance on all three language measures compared to children in Profiles 3 and 4 (the two low-risk profiles) and children in Profile 2

(moderate risk) had significantly poorer performance on all three language measures compared to children in Profile 4 and on one of the language measures (vocabulary) compared to children in Profile 4 (low risk). These findings provide evidence that those children at greatest susceptibility for future reading disability also tend to exhibit poorer language skills compared to children who appear to be least susceptible to future reading problems. Indeed, children in the high- and moderate-risk groups tended to exhibit standard scores about 1 *SD* below those of children in the low-risk groups.

Profiles of Primary and Secondary LI

The final aim of this study was to consider whether children with primary and secondary LI tended to exhibit different profiles of early literacy skill. For this purpose, we categorized children in this study into two subgroups, which captured only a segment of the larger sample. Children classified as primary LI (SLI) were those whose expressive, receptive, or overall Language Composite was ≤ 85 , had nonverbal cognition scores ≥ 80 , and had no known additional diagnoses associated with LI (e.g., autism spectrum disorder, Down syndrome). This classification maps onto that used in other studies of reading achievement among children with SLI (e.g., Catts et al., 2002). Children classified as secondary LI were those children whose expressive, receptive, or overall Language Composite was ≤ 85 , had nonverbal cognition scores < 80 , and may have had additional diagnosis associated with LI. This classification is different than the identification of children with NLI that is seen in some studies (e.g., Catts et al., 2002); children referred to as NLI do not have additional diagnoses that may affect language. Because the Kaufman Brief Intelligence Test (KBIT) is not normed for children under age 4; 77 children under 4 years were not included in this

Table 4. Descriptive Characteristics and Profile Membership of Children With Primary LI (SLI) and Secondary LI.

Characteristics/Membership	Primary LI			Secondary LI			<i>d</i>
	<i>M</i>	<i>SD</i>	<i>n</i>	<i>M</i>	<i>SD</i>	<i>n</i>	
General characteristics							
KBIT	94.22	11.04	50	67.31	13.60	67	
Age	54.80	4.37	50	54.56	4.44	66	
Other diagnoses							
No			50			39	
Yes			0			28	
IQ status							
≥80			50			8	
<80			0			59	
Language indices							
Expressive Composite	76.44	11.43	50	67.79	17.51	64	0.60
Receptive Composite	77.96	12.78	50	70.02	17.81	59	0.52
Definitional Vocabulary	84.94	12.36	50	76.85	16.91	61	0.55
Early literacy indices							
Print Awareness	5.00	2.83	50	3.30	2.98	66	0.59
Name Writing	3.61	2.18	49	2.67	2.20	66	0.43
Phonological Awareness	8.92	5.01	49	6.56	5.46	62	0.45
Alphabet Knowledge	12.37	12.84	49	17.02	19.40	66	−0.29
Profile membership							
1 (High risk)			22 (44%)			37 (56%)	
2 (Moderate risk)			5 (10%)			9 (14%)	
3 (Low risk–high alphabet)			3 (6%)			12 (18%)	
4 (Low risk–average alphabet)			20 (40%)			8 (12%)	

Note. LI = language impairment; KBIT = Kaufman Brief Intelligence Test, Expressive Index, Receptive Index, and Core Language are derived scores of the Comprehensive Evaluation of Language Fundamentals (CELF). Other diagnoses = number of students with language-related diagnoses (e.g., autism, Down syndrome); IQ status = the number of students fitting in each category, including students too young for age standardization.

analysis. In addition, there were 21 children who did not meet the criteria for primary or secondary LI applied. Thus, the following analyses exclude 101 children from the original sample. Table 4 provides descriptive data for the subsamples of children with primary LI/SLI ($n = 50$) and secondary LI ($n = 67$) used to address the third aim, as well as effect sizes of the mean differences between the two groups. These data show that across three of the four measures of early literacy, children with SLI had higher scores than those with secondary LI (the exception being alphabet knowledge). These differences were consistent with large effect sizes. These data also show that the children with secondary LI tended to have lower language scores than those with SLI, consistent with very large effect sizes.

The number of children with SLI and secondary LI within each latent class is reported in Table 4. Examining the literacy profile memberships of the SLI sample, 22 children (44% of the SLI sample) were placed in Profile 1 (high risk). The majority of the remainder of the SLI sample was placed in Profile 4 (low risk–average alphabet; 40% of the SLI sample). Very few children with SLI were in Profile 2 (10%) or Profile 3 (6%). A chi-squared analysis revealed

that there was a statistically significant relation between SLI status and profile membership, $\chi^2(3) = 13.55, p < .01$, such that children with SLI have a higher-than-chance probability for being in a profile characteristic of high susceptibility for future reading problems.

For the secondary LI sample, the majority was placed in Profile 1 (high risk; 56%), and only a few children were in the other three groups (14% in Profile 2, 18% in Profile 3, and 12% in Profile 4). A chi-squared analysis revealed that there was also a statistically significant relation between secondary LI status and profile membership, $\chi^2(3) = 19.02, p < .01$, showing a higher-than-chance probability of being classified as high risk (Profile 1). The main difference between the group memberships of the children with SLI and secondary LI was the comparably higher percentage of children with SLI placed in Group 4 (the group with average performance but poor alphabet skills), such that very few children with secondary LI were in the low risk–average alphabet group. Note also that a higher percentage of children with secondary LI (56%) were classified into the high-risk group compared to the children with SLI (44%).

Discussion

In the present work, we sought to determine the extent to which young children with LI, drawn from ECSE classrooms, exhibited reliable profiles of early-literacy skills. A rationale for this descriptive work is that it might help to differentiate among children at high risk for future reading disabilities from those at lesser risk. Prior literature has suggested that risk for and resilience to future reading disability among children with LI can be largely determined by the extent of early literacy skill that they bring to reading instruction (Catts et al., 2002). In considering the results of this work, there are three findings of the present study that warrant discussion and that may, in our opinion, have bearing on future research on this topic as well as educational and clinical practice.

The first concerned the results of the LPA, which showed there to be four profiles of early literacy skill that reliably represented the 218 3- to 5-year-old children studied for this work. Results thus showed that there are indeed reliable profiles of children with LI that allow us to differentiate groups on key predictors of future reading achievement. Importantly, of the profiles observed, about one half of the 218 preschoolers with LI constituted a profile we deemed high risk for future reading problems, given accumulated literature on the relations between the observed skills (e.g., alphabet knowledge, phonological awareness) and future reading achievement (see National Early Literacy Panel, 2008). These 119 children exhibited a profile of early literacy skill consistent with relatively poor performance across all four literacy indices in relation to their peers. As compared to their peers, these youngsters knew only about 3 of 14 concepts about print, could not write their own names (scoring on average 1 to 2 points on a 7-point scale, corresponding to use of a scribble with no symbols or letters), and knew only three letters of the alphabet.

To contextualize these findings somewhat, Cabell et al. (2010) presented descriptive data on the early literacy skills of 4-year-olds with SLI. A point of comparison between the two studies is that of alphabet knowledge: Cabell et al. reported that children with SLI knew 7.5 letters, on average, at age 4 (by comparison, their typical peers knew about 11 letters). The children in the present study comprising the least-desirable profile knew few letters (less than three, specifically), in comparison. Because alphabet knowledge is one of the more robust predictors of future decoding abilities (see National Early Literacy Panel, 2008), the finding that the largest profile of children, representing 55% of those in this study, had such limited alphabet skills is an important one, especially given that performance on the alphabet measure seemed to serve a distinguishing role among all of the profiles including those in the high-risk profile.

A second finding of note concerns the contribution of children's spoken language skills as a relevant factor toward identifying those children at highest risk for future reading difficulties. In this study, two profiles of children were identified to be at greatest risk. One group, the high-risk group, had overall low literacy skills as compared to peers, whereas a second group, the moderate-risk group, also had generally low literacy skills concomitantly with unexpectedly high performance on alphabet knowledge. These two profiles of children can be differentiated from those in the low-risk profiles (Profiles 3 and 4). An important finding regarding the two higher risk profiles is that these two groups were distinguishable from the lesser risk profiles in terms of their language skills. As the depiction of data in Figure 2 makes clear, the children in Profiles 1 and 2 have significantly poorer language skills than those in Profiles 3 and 4.

These findings are of note as they imply that the *severity* of children's language problems may be associated with children's early literacy skills and, perhaps, their future reading achievement. Although impaired language skills is the defining feature of LI, children with LI vary in the extent to which their language skills are affected. Some children exhibit only mild impairments in language skills, whereas others' skills are more severely affected. For school-age children with LI, severity of LI (based on whether LI resolved between kindergarten and fourth grade) has been linked to reading achievement, with those less severely affected being significantly better readers than those more severely affected (Catts et al., 2002). Among pre-kindergarteners, there has been limited empirical attention to examining how severity of children's spoken language difficulties might be associated with one's risk for reading problems. Given that many prior studies of young children with LI have involved only those with SLI (e.g., Boudreau & Hedberg, 1999; Cabell et al., 2010; Justice et al., 2006), the range in language skills is also more constrained than that seen in the present study, which involved children with both SLI and secondary LI. [As observed here and reported elsewhere (Catts et al., 2002), children with secondary LI tend to have lower language skills than those with SLI.] The present results suggest that those children at greatest susceptibility for future reading disability also tend to exhibit poorer language skills; put differently, children with more severe LI exhibit lower levels of literacy skill than those with mild LI. Children in the high-risk profile had language scores about 1 *SD* below those in the two low-risk groups. Recognizing that all of the children in this study, with only a few exceptions, were receiving speech-language services, the results presented here argue for the necessity of identifying those with the most widespread difficulties across language and literacy development for the most targeted therapeutic efforts.

The third finding warranting discussion concerns the analyses regarding profile membership among the subgroups of

children with primary LI and those with secondary LI. The children in this study were heterogeneous with respect to the nature of their language disability, and we explored whether profiles seemed associated with these subgroups. Typically, studies of the early literacy skills of children with LI includes only those who exhibit LI as their only disability, and thus children with relatively low nonverbal cognition and who have other disabilities, such as autism spectrum disorder and hearing loss, were excluded from participating (e.g., Boudreau & Hedberg, 1999; Cabell et al., 2010; Justice et al., 2006). We therefore know relatively little about children who exhibit LI concomitantly with other disabilities. In part, the investigation of profile membership with respect to these LI typologies was conducted to extend work by Catts et al. (2002), which examined the prevalence of reading disabilities among second and fourth grade children with LI. That study showed that children with NLI (subsumed in our secondary LI sample) were more likely to exhibit reading disability than those children with SLI (67% and 42% at second grade, respectively). Such findings suggest that among children with LI, those with SLI are at less risk than other subgroups, including children with comorbid intellectual disabilities. This was substantiated in the present study, in which 56% of those children characterized with secondary LI were categorized into the high-risk profile, as compared to 44% of those characterized as SLI. Recent work on reading achievement among children with disabilities has shown that those children with secondary LI, such as autism and intellectual disabilities, underperform substantially over the primary grades in reading, even in relation to children with speech-LI as the primary diagnosis (Wei et al., 2011).

Limitations and Future Directions

Several important limitations of this work warrant mention, as well as some directions for future research. The first and most important limitation is that we examined children's early literacy skills as a single point in time, yet argued that certain profiles of children placed them at high or moderate risk for future reading disabilities. Such claims can be made on theoretical grounds (e.g., Storch & Whitehurst, 2002), as well as considerable correlational evidence showing the strong positive relations between early literacy skills and future reading accomplishments (e.g., National Early Reading Panel, 2008). However, we can only speculate as to whether children comprising the high- and moderate-risk profiles are more susceptible for reading difficulties than those in the lesser risk profiles, and future longitudinal work examining longer term outcomes is necessary. Recent work by Cabell, Justice, Konold et al. (2011) did provide evidence regarding the predictive validity of such profiles to future reading achievement among high-risk preschoolers. However, this work did not

explicitly include children with disabilities, and thus generalizations should be made cautiously.

Second, the approach to identifying children with LI was largely based on participation in ECSE and eligibility for speech-language services. Most research on children with LI, including that addressing their early literacy skills, applies an *a priori* gold standard criterion designed to carefully include only a subset of those children affected by LI, namely those with SLI. Many children with SLI do not receive clinical services, as their language difficulties are above thresholds often used in educational settings. Although the present findings have strong generalizability and therefore relevance to professionals working in ECSE settings, replication with more refined samples of children with LI may be desirable.

Third, in this work we did not use a nonverbal cognitive assessment with children under 4 years of age. Thus, in our analyses in which we explored profiles among children with SLI and secondary LI, which used nonverbal cognition scores to identify groups, we were limited to using only a subset of our sample. There is a need to more fully understand early literacy development among children with LI concomitant with other concerns, including lower nonverbal cognition as well as such developmental etiologies as hearing loss and Down syndrome. Considerable evidence, including that contained here, suggests that these children may be at greater risk for future reading disability than children with SLI, and we hope that future research examines more intensively how such risks can be attenuated through early intervention activities.

A compelling avenue for future research, based on these findings and other early literacy research, involves longitudinal assessment of reading achievement among children with LI using the person-centered orientation featured in the present work. Person-centered approaches provide a valuable complement to variable-centered approaches, as they seek to identify whether there are groups of individuals that represent certain shared characteristics among a set of key variables. Such profiles could be used to develop aptitude-treatment interactions (ATIs; Cronbach & Snow, 1977; Snow, 1989). For example, Cabell, Justice, Piasta et al. (2011) showed that the impacts of a classroom-based language intervention were more effective for children with relatively high vocabulary skills. Similarly, Connor, Morrison, and Slominski (2006) found that children with low alphabet knowledge made substantial gains when classroom instruction targeted that knowledge and that the same instruction was not effective for children who already had high alphabet knowledge.

The heterogeneity of the early literacy skills of children with LI presented here suggests that children with LI (be it primary or secondary) may benefit from the design of interventions using ATI. More explicitly, tailoring interventions using the ATI approach can better identify specific profiles

of the early literary abilities of children with LI and can thus be used as a basis to target the particular weaknesses of individual children, potentially resulting in more substantial gains in literacy skills. However, longitudinal work focused specifically on literacy instruction using this approach is clearly warranted to support this suggestion.

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