Early Childhood Research Quarterly 26 (2011) 1–14

Contents lists available at ScienceDirect

Early Childhood Research Quarterly

Profiles of emergent literacy skills among preschool children who are at risk for academic difficulties☆

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ARTICLE INFO

Article history:
Received 19 August 2009
Received in revised form 10 May 2010
Accepted 15 May 2010

Keywords:
Emergent literacy
Code-related skills
Oral language
Preschool
At risk
Person-centered approach

ABSTRACT

The purpose of this study was to explore patterns of within-group variability in the emergent literacy skills of preschoolers who are at risk for academic difficulties. We used the person-centered approach of cluster analysis to identify profiles of emergent literacy skills, taking into account both oral language and code-related skills. Participants were 492 preschoolers (aged 42–60 months) enrolled in needs-based programs. In the fall of the academic year, children were administered eight measures of emergent literacy: four oral language measures (i.e., expressive and receptive grammar, expressive and receptive vocabulary) and four code-related measures (i.e., print concepts, alphabet knowledge, name writing, and rhyme). Controlling for age, hierarchical-agglomerative and *K*-means cluster analysis procedures were employed. Five psychometrically sound profiles emerged: highest emergent literacy (prevalence = 14%); three profiles with average oral language and differential code-related abilities (16%, 24%; 23%); and lowest oral language with broad code-related weaknesses (23%). Profiles were then compared on midyear teacher ratings of emergent literacy as well as end-of-kindergarten literacy performance; results provided convergent evidence of predictive validity. This study highlights the considerable heterogeneity of emergent literacy abilities within an "at-risk" group. The resulting profiles have theoretical and practical relevance when examining both concurrent relationships between oral language and code-related skills as well as longitudinal relationships between early patterns of performance and later reading achievement.

There is an increased interest in the United States in improving the school readiness of preschool children who are at risk for later academic difficulties, particularly in the area of literacy (e.g., Early Reading First Initiative; U. S. Department of Education, 2007). State standards and national frameworks are increasingly specific about the emergent literacy skills and understandings that children should have in place prior to kindergarten entry. Of particular concern are the 47% of three-to-five-year-old children from low socioeconomic status (SES) backgrounds who are enrolled in center-based early childhood care (National Center for Educational Statistics, 2007). Because SES serves as a reliable and positive predictor of reading ability, it is widely accepted that children who reside in low-SES households represent a group who are at risk for later reading difficulty (e.g., Juel, Griffith, & Gough, 1986; see Snow, Burns, & Griffin, 1998). Similarly, it is often assumed that this "at-risk" group is homogenous in terms of emergent literacy abilities; that is, they enter preschool with depressed skills in these areas compared with children who are not "at risk." This assumption draws upon research demonstrating that young children from low-SES backgrounds are likely to have under-developed school readiness in terms of alphabet knowledge, phonological awareness, print concepts, and oral language (e.g., Bowey, 1995; Juel et al., 1986; Lonigan, Burgess, Anthony, & Barker, 1998; Lonigan & Whitehurst, 1998; Neuman, 2006; Smith & Dixon, 1995).

Although concern for children from low-SES backgrounds is warranted with respect to later reading outcomes, evidence suggests that considerable individual differences exist among these preschoolers in terms of emergent literacy performance (e.g., Justice & Ezell, 2001; Welsch, Sullivan, & Justice, 2003). Some children living in poverty may, in fact, have well-developed skills in some aspects of emergent literacy whereas others have under-developed skills, the latter circumstance potentially signifying a need for educational interventions. A more nuanced research approach is needed to move beyond characterizing these children as a single, homogenous group, and in the present study, we explore this variability, with the goal of contributing to theoretical and applied understandings of the heterogeneity of emergent literacy skills among preschoolers who come from low-SES backgrounds.

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0885-2006/$ – see front matter © 2010 Elsevier Inc. All rights reserved.
doi:10.1016/j.ecresq.2010.05.003

Specifically, we determined whether there were distinct profiles of emergent literacy among English-speaking preschool children from low-SES backgrounds, seeking to identify whether patterns of strengths and weaknesses reliably differentiated groups of children considered at risk.

1. Theoretical model of emergent literacy

The term *emergent literacy* connotes the understanding that children's reading, writing, and oral language develop in an interdependent fashion in the years prior to formal reading and writing instruction, and that *emergent literacy skills* serve as precursors to skilled and fluent reading (Whitehurst & Lonigan, 1998). For the present study, we adopted a model specified by Whitehurst and colleagues (Storch & Whitehurst, 2002; Whitehurst & Lonigan, 1998, 2001) proposing that children's emergent literacy skills are separated into two distinct, albeit interrelated, domains that relate to subsequent reading achievements: oral language and code-related skills. *Oral language skills* comprise the modalities of both expression and comprehension in the areas of form (e.g., syntax) and content (i.e., vocabulary). Although these skills are predictive of decoding early in the reading process (e.g., National Early Literacy Panel [NELP], 2008; NICHD Early Child Care Research Network [ECCRN], 2005), research demonstrates that young children's oral language skills provide their greatest contribution to reading comprehension abilities later in the reading process (Roth, Speece, & Cooper, 1996; Speece, Roth, Cooper, & De La Paz, 1999; Storch & Whitehurst, 2002). *Code-related skills* enable young children to "break the code" and acquire early understanding of the alphabetic principle. These include abilities such as print concepts, alphabet knowledge, emergent writing, and phonological awareness. Code-related skills are both theoretically and statistically distinct from oral language skills, and with respect to reading achievement, are most predictive of skills in beginning reading acquisition (Kendeou, van den Broek, White, & Lynch, 2009; NELP, 2008; Storch & Whitehurst, 2002; Whitehurst & Lonigan, 1998).

Whitehurst and colleagues' theoretical model and other empirical research support the interrelationship of the two domains during the preschool period (Burgess & Lonigan, 1998; Chaney, 1994; Dickinson, McCabe, Anastasopoulos, Peisner-Feinberg, & Poe, 2003; Kendeou et al., 2009; Lonigan et al., 1998; Storch & Whitehurst, 2002). For instance, measures of preschoolers' skills in syntax exhibit statistically significant positive and moderate correlations with concurrent code-related skills in rhyme and alphabet knowledge (Burgess & Lonigan, 1998). However, the majority of these studies employed variable-centered approaches, which do not reveal patterns of strength and weakness across the two strands of emergent literacy, as would occur in a person-centered approach. This study, thus, expands upon the Whitehurst model by looking for *within-child patterns* of performance across the two domains of emergent literacy and seeks to better understand the complexity of skills within an at-risk population.

2. Emergent literacy development among preschoolers from low-SES backgrounds

Children from low-SES backgrounds tend to perform more poorly across both domains of emergent literacy skills than children from middle-class homes (e.g., Bowey, 1995; Justice, Bowles, & Skibbe, 2006; Neuman, 2006; Whitehurst, 1997). It is important to consider why children reared in poverty consistently exhibit underdeveloped emergent literacy skills. There are likely child-level and experiential-level reasons for the lagged emergent literacy development of children living in poverty. At a child level, given the interrelationships among emergent literacy skills, developmental weaknesses in one domain may have a cascading effect, creating a broader deficit across skills. For example, a child with weaker vocabulary skills may also display impoverished phonological awareness skills (see Goswami, 2001). At an experiential level, children living in poverty are likely affected by increased stress in their environments and consequently may be exposed to reduced quality of parental language input (e.g., Hart & Risley, 1995), a factor shown to affect language development (e.g., Hoff, 2006a; Hoff & Naigles, 2002; Huttenlocher, Vasilyeva, Cymerman, & Levine, 2002). In addition, poverty is associated with lower quality home literacy environments (see Neuman, 2006). The focus of this paper is on understanding child-level factors in the emergent literacy development of children living in poverty. By pinpointing preschool profiles of emergent literacy and their relation to performance in kindergarten, this study provides a more nuanced understanding of child-level contributions to literacy development in this at-risk population.

Evidence from large-scale studies points to the fact that children from low-SES backgrounds cannot simply be considered a homogenous group with regard to oral language and code-related skills. For example, in a comprehensive report of the Head Start program, Zill and Resnick (2006) indicated that the fall receptive vocabulary abilities of three- and four-year-old children ($N = 1801$) entering Head Start demonstrated substantial variability. In particular, there was great disparity when examining the performance of the bottom and top quartiles of students. The mean for children performing in the lowest quartile was 62.6 (i.e., approximately 2nd percentile), while the mean for the top quartile was 101.1 (i.e., approximately 50th percentile). Children also exhibited a wide range in performance on measures of letter-word identification (akin to alphabet knowledge; $N = 833$) and early writing ($N = 799$). The children whose relative performance fell in the bottom quartile of the sample scored approximately 1–2 *SD* below the mean of the normative group on both measures (82.7, 70.9, respectively), whereas children comprising the top quartile scored at or above the 50th percentile (103.9, 100.8, respectively). Other reports also show that children demonstrate substantial heterogeneity in code-related skills (Justice & Ezell, 2001; Welsch et al., 2003), although it is important to note that none of these studies actually investigated this heterogeneity through examination of children's patterns of emergent literacy skills.

This wide range of individual differences in children's performance indicates that there are likely high- and low-performing profiles across emergent literacy domains reflected in the low-SES preschool population. However, empirical research also suggests that there may be at least one other profile in which children demonstrate specific areas of strength or weakness. Why would one expect different levels of skill to manifest within the same child (i.e., intra-individual differences)? Evidence indicates that certain skills are highly dependent upon particular experiences. For example, in homes in which book sharing is emphasized, children may have stronger vocabulary abilities but weaker code-related abilities. Alternatively, in homes featuring an increased focus on direct teaching, children may display greater code-related skills (Sénéchal, LeFevre, Thomas, & Daley, 1998). In addition, some skills may be more intrinsic to children while others may be more responsive to varying environmental influences. The experience of poverty may have differential effects on oral language abilities, with greater environmental effects on children's receptive and expressive vocabulary than syntactical knowledge (i.e., grammar; Whitehurst, 1997). Similarly, some code-related skills (e.g., alphabet knowledge) may be more heavily influenced by environmental factors than others (e.g., phonological awareness) (Lemelin et al., 2007). To sum, it is not necessarily the case that all skills are commensurate with each other within a given child. Consequently, it is likely that children's patterns of performance are characterized by dips and rises across skills. Although this study does not examine experiences of children, it explores whether there are stable patterns of emergent literacy development marked by patterns of performance that are more complex than just "high emergent literacy" and "low emergent literacy" and what this means with regard to children's future performance.

3. Individual differences in emergent literacy skills: person-centered approaches

Given that children may exhibit considerable individual differences in their emergent literacy performance, it seems essential to consider these skills in a multivariate, person-centered context. *Person-centered approaches* seek to identify subgroups within a population who share a specific characteristic or a pattern of characteristics and examine "whether development proceeds differently in these groups" (Hoff, 2006b, p. 636). Inherent in person-centered approaches is the assumption that there are systematic individual differences in the population under study and that this heterogeneity may differentially affect how variables are related to one another (Laursen & Hoff, 2006; von Eye & Bogat, 2006). In the present study, we employed person-centered empirical profiling methodology, namely cluster analysis techniques, to identify patterns of performance in emergent literacy skill.

We identified two studies that utilized person-centered methodology to examine emergent literacy profiles among young children. Our research team (Cabell, Lomax et al., in press) recently examined code-related clusters among preschool-age children with specific language impairment (i.e., impairment of language in the absence of cognitive, neurological, or sensory problems), a group considered at risk for later reading difficulties (e.g., Catts, Fey, Tomblin, & Zhang, 2002). The findings indicated that distinct subgroups of children existed with differential patterns of performance in code-related skills. (The code-related measures utilized in the study were almost identical to the ones used in the present study and pertained to print concepts, alphabet knowledge, name writing, and rhyme.) Although the children who were members of the least desirable of three profiles also exhibited the lowest average language scores, patterns of performance in code-related skills could not be fully determined by maturation (i.e., child age) or oral language skills, highlighting the complexity of the relationship between the domains of emergent literacy.

Speece et al. (1999) explored the clusters of oral language skills among kindergarteners ($N = 88$) across semantic, syntactic, metalinguistic, and narrative abilities. (Note that this analysis included phonological awareness as an index of oral language.) Four reliable clusters emerged that demonstrated a range of language abilities, including two cluster profiles with consistently high or low skills across measures as well as two cluster profiles with varied patterns of dips and rises across skills. Children who showed consistently well-developed oral language performance across skills seemed to experience particular benefits with regard to early literacy one year later (e.g., improved decoding). However, this advantage was not uniform as children who had relatively average language did not outperform those with relatively low language.

Clearly, there is a paucity of person-centered research studies examining children's emergent literacy skills, and we did not identify a single study focusing on describing the individual differences in skills of preschool children from low-SES backgrounds in particular. Given that poverty exerts a substantial influence on reading development (see Snow et al., 1998), it is important to unpack the heterogeneity of emergent literacy skill inherent in this population through examination of person-centered patterns of performance. This study is also based on a comprehensive model of emergent literacy to include both oral language and code-related domains. We build upon research demonstrating the interrelationship of oral language and code-related skills in preschool as well as findings indicating that both domains play a role in early reading (e.g., NICHD ECCRN, 2005; Storch & Whitehurst, 2002).

4. Purpose of this study

In the present study, we employed a person-centered approach (i.e., cluster analysis) with a large sample of preschoolers to identify profiles in emergent literacy skills among children at risk for academic problems. This procedure allowed us to account for the heterogeneous nature of emergent literacy skills and identify homogeneous subgroups that displayed similar patterns of strengths and weaknesses across these variables. Specifically, the aims of the present study were two-fold: (a) to identify reliable profiles of emergent literacy among three- to five-year-old preschoolers, and (b) to determine the predictive validity of the profiles using midyear teacher ratings of emergent literacy as well as end-of-kindergarten literacy performance. Given previous research demonstrating the variability of children's emergent literacy skills (Justice & Ezell, 2001; Speece et al., 1999; Welsch et al., 2003; Zill & Resnick, 2006), we hypothesized that three or more reliable profiles would emerge that would reflect the heterogeneity of children at the beginning of the preschool year. In addition, we predicted that in the event we found reliable profiles, these would be externally validated by midyear teacher ratings of children's skills as well as children's kindergarten literacy performance.

5. Method

5.1. Participants

Participants were 492 preschool-aged children (241 boys, 251 girls) taking part in two larger multiyear studies of emergent literacy development in a single mid-Atlantic state. Data were collected for two sequential cohorts of children (total $N = 646$) over a two-year period. In the larger studies, approximately six to eight children were randomly selected from each of 106 classrooms from among those children for whom parental consent had been received. The 492 children who participated in the present study were selected based on age (between 42 and 60 months) and data availability (had a complete data set for the key emergent literacy measures of interest in this study). Of the 154 children in the larger studies who were excluded from the present study, seven children were outside of the acceptable age range for inclusion in the study, and 18 did not have data on any of the eight measures of emergent literacy. All other children had only partial scores available. In the majority of cases, data were missing due to child absence or dissent.

The 492 children were enrolled in 93 classrooms in publicly-funded preschool programs (e.g., Head Start, state-funded preschool program), all of which were designed to serve children from low-SES backgrounds or who exhibit documentable risk factors for later academic difficulties (e.g., homelessness, parents were school drop-outs, health/developmental issues). The mean age of the children was 53 months ($SD = 4.5$) in the fall of preschool. Table 1 displays the demographic and background information for the children in the sample obtained via parent or teacher questionnaire in the fall of preschool. It is important to note that the sample represented primarily English-speaking children. Halfway through the preschool year, teacher ratings of children's language and code-related skills were available for 421 and 407 children, respectively. At the end of the kindergarten year, literacy assessments were collected for 345 children.

Table 1
Demographic and background information for full sample (N = 492).

Variable	N	Variable	N
Gender		*Year in Preschool*	
Male	241	First year	265
Female	251	Not first year	147
		Unreported	80
Age		*IEP at start of preschool year*	
42–48 months	87	Yes	47
49–54 months	200	No	369
55–60 months	205	Unreported	76
Race/ethnicity		*Language child speaks at home*	
African American	205	English only	391
Caucasian	188	English + another language	27
Hispanic	33	Spanish only	8
Multiracial or Other	30	Neither English nor Spanish	1
Unreported	36	Unreported	65
Annual household income		*Maternal education*	
$10K or less	112	High School No Degree	90
$10K–$25K	126	Completed High School	94
$25K–$50K	111	Some College	98
Over $50K	44	Post-High School Degree	125
Unreported	99	Unreported	85

5.2. Classroom instruction

During children's preschool year, the majority of teachers reported using *The Creative Curriculum for Preschool* (Dodge, Colker, & Heroman, 2002) or *High/Scope* (Hohman & Wikhart, 1995). Some children also took part in either an oral language (N = 122) or code-related (N = 182) classroom-based intervention pertaining to the larger studies in which children were participants (see Cabell, Justice et al., submitted for publication; Justice, Kaderavek, Fan, Sofka, & Hunt, 2009). During the kindergarten year, children were likely exposed to a variety of classroom literacy practices; some uniformity existed however, as all public schools were subject to kindergarten state standards (Virginia Department of Education, 2003).

5.3. General procedures

During the fall of their preschool year, children were individually administered a battery of developmental assessments by trained assessors, the majority of which focused on emergent literacy skills. All assessments were completed within a six-week window, beginning approximately one month after the start of the children's school year. These assessments took place in a quiet space in children's preschool buildings. Prior to working independently with children in the field, assessors completed a comprehensive standardized training to administer each measure; this included (1) viewing an online training module featuring a PowerPoint presentation of key information about the measure with video-based models of implementation, (2) completing a written quiz and receiving a score of 85% or better, (3) observing a skilled assessor implement the measure in the field, and (4) implementing the measure in the field with a child while being directly supervised by research staff or doctoral students. Midway through the preschool year, teachers completed a set of questionnaires about children's skills in different developmental domains. In the spring of their kindergarten year, children were administered a battery of measures to assess language and literacy performance, including reading and spelling ability.

5.4. Measures

Three sets of measures were used in this study: (1) direct measures of preschool emergent literacy skills, (2) teacher ratings of child emergent literacy skills, and (3) direct measures of kindergarten reading and spelling skills.

5.4.1. Preschool direct measures of emergent literacy skills

Direct assessment of children's emergent literacy skills comprised eight measures in total. Four measures of oral language skills were administered: (a) receptive grammar, (b) receptive vocabulary, (c) expressive grammar, and (d) expressive vocabulary. Four measures of code-related literacy skills were also administered: (a) print concepts, (b) alphabet knowledge, (c) name writing, and (d) rhyme awareness.

5.4.1.1. Oral language skills. Children's receptive grammar, or the ability to understand the structure of simple and complex sentences, was measured by the norm-referenced *Clinical Evaluation of Language Fundamentals Preschool—Second Edition* (CELF Preschool-2) Sentence Structure subtest (Wiig, Secord, & Semel, 2004). After a demonstration and two practice items, children point to the picture (from four choices on a test plate) that most closely relates to the verbal stimulus (e.g., "The boy has a ball.") (maximum score = 22). Construct, content, and concurrent validity are deemed adequate for all subtests of the CELF Preschool-2. The Sentence Structure subtest exhibits a test–retest reliability of .78 and internal consistency of .78 and .80 (Cronbach's alpha, split-half reliability, respectively) (Wiig et al., 2004). Internal consistency from the present sample was .80 (Cronbach's alpha). Children's receptive vocabulary was measured by the third edition of the *Peabody Picture Vocabulary Test*, Form A (PPVT-III; Dunn & Dunn, 1997). During administration of this norm-referenced measure, children view a test plate of four black and white illustrations and are asked to point to the picture that most closely represents the verbal stimulus presented (maximum score = 204). The PPVT-III demonstrates test–retest reliability based on different age samples of .91–.94, as well as strong internal consistency of .95 and .94 (Cronbach's alpha, split-half reliability, respectively) (Dunn & Dunn, 1997). Reliability from the study sample was .96 (Cronbach's alpha).The test developers also report information regarding content, construct, and criterion-related validity.

Children's expressive grammar, or the ability to use morphology and pronouns, was measured by the CELF Preschool-2 Word Structure subtest (Wiig et al., 2004). Children view two adjacent pictures on a test plate while listening to a verbal cloze stimulus, such as, "This girl [pointing to picture on left] has two cats. This girl [picture on right] has two .." The stimulus provides children with a verbal model and requires children to provide a word to finish the sentence (i.e., "dogs") (maximum score = 24). This subtest demonstrates test–retest reliability of .86, inter-rater reliability of .97, and internal consistency of .83 and .87 (Cronbach's alpha, split-half reliability, respectively) (Wiig et al., 2004). The study sample exhibited internal consistency of .83 (Cronbach's alpha). Children's expressive vocabulary, or ability to name objects, actions, and people, was measured by the CELF Preschool-2 Expressive Vocabulary subtest (Wiig et al., 2004). Children view a picture on a test plate and are asked a question such as, "What is this?" For most items, children receive two points for semantically correct answers and one point for partially correct answers (maximum score = 20). Wiig et al. (2004) report a test–retest reliability coefficient of .90, inter-rater reliability of .97, and internal consistency of .82 (Cronbach's alpha and split-half reliability). The present sample also demonstrated internal consistency of .82 (Cronbach's alpha).

5.4.1.2. Code-related skills. Children's knowledge of print concepts was measured by the *Preschool Word and Print Awareness* test (PWPA; Justice et al., 2006). The PWPA assesses children's knowledge of book and print organization (e.g., identify the front of the book, identify the title, directionality of text on a page), concept of letter (e.g., identify a capital letter), and print function (e.g., identify speech bubbles as characters talking). Test administrators embed 14 standardized questions into a shared reading of the storybook *Nine Ducks Nine* (Hayes, 1990) (maximum score = 17). The measure exhibits an inter-rater reliability coefficient of .94. In addition, print-concept knowledge represents a single trait (as shown through item response theory) that can be estimated with a reliability of .74 (Justice et al., 2006). The study sample demonstrated an internal consistency of .71 (Cronbach's alpha). Children's knowledge of the 26 letters of the alphabet was measured by the *Phonological Awareness Literacy Screening for Preschool* (PALS-PreK) Upper-Case Alphabet Knowledge task (Invernizzi, Sullivan, Meier, & Swank, 2004). Children are asked to provide the name of each of 26 letters randomly ordered on an 8(1/2) by 11 inch page (maximum = 26 points). The PALS-PreK Teacher's Manual (Invernizzi et al., 2004) reports an inter-rater reliability coefficient of .99, with concurrent validity for the print-related tasks (including this task and name writing) exhibiting correlations of .61 and .71 with similar assessments. Internal consistency (from the study sample) was .97. Children's ability to write their first name was measured by the PALS-PreK Name Writing task (Invernizzi et al., 2004). Children are provided a blank sheet of paper and asked to draw a self-portrait and write their name. Children's signatures are evaluated on a 7-point scale, with higher scores reflecting increasingly sophisticated name-writing abilities. Inter-rater reliability is .99 (Invernizzi et al., 2004).

Children's ability to identify rhyming words was measured by the *Rhyming Individual Growth and Development Indicator* (Early Childhood Research Institute on Measuring Growth and Development, 1998). Children are shown an 8.5″ × 5.5″ test plate and are asked to point or say the picture from three alternatives that rhymes with the target picture at the top of the test plate (no maximum score). Test–retest reliability is .83–.89 and concurrent validity has been established with several other measures of phonological awareness (Missall & McConnell, 2004).

5.4.2. Teacher ratings

Two rating scales of the CELF Preschool-2 (Wiig et al., 2004) were administered: the *Descriptive Pragmatics Profile* (DPP) and an abbreviated version of the *Pre-Literacy Rating Scale* (PLRS). The 26 items of the DPP focus on children's oral language abilities across three categories: (1) nonverbal communication skills, (2) conversational routines and skills, and (3) asking for, giving, and responding to information. Within these categories, teachers rate how often children display appropriate language abilities on a 4-point scale (i.e., 1-*never*, 2-*sometimes*, 3-*often*, 4-*always*). Ratings are summed to create an overall descriptive score (possible range = 26–104). Test–retest reliability (.87) and internal consistency (Cronbach's alpha = .95) for this measure are reported in the CELF Preschool-2 Examiner's Manual (Wiig et al., 2004). Our sample demonstrated a similar internal consistency of .97 (Cronbach's alpha). The 12 items of the abbreviated PLRS focus on children's code-related literacy skills across three categories: print concepts, alphabet knowledge, and emergent writing. As in the DPP, teachers rate children's performance on a 4-point scale. Ratings are summed to arrive at a score per category (possible range = 4–16). Research supports the reliability (Cronbach's alpha = .94) and validity of the abbreviated version of the PLRS (Cabell, Justice, Zucker, & Kilday, 2009). Using our sample, we obtained a similar overall internal consistency of .95 (Cronbach's alpha). Internal consistency was also measured with items pertaining to print concepts (.83), alphabet knowledge (.91), and emergent writing (.87).

5.4.3. Kindergarten direct measures of reading and spelling skills

To measure literacy at the end of kindergarten, three subtests of the *Woodcock-Johnson III Tests of Achievement* (WJ III ACH) were administered: Letter-Word Identification, Passage Comprehension, and Spelling (Woodcock, McGrew, & Mather, 2001). Letter-Word Identification is a test of decoding that measures children's ability to name letters and words increasing in difficulty (maximum score = 76). Reading comprehension was measured using the Passage Comprehension subtest. This subtest requires children to point to a rebus picture that most closely matches a target picture, to read a phrase and choose a corresponding illustration, and to silently read a cloze passage and fill in the missing word, with passages increasing in complexity (maximum score = 47). The Spelling subtest first asks children to reproduce, trace, and write letters based on a model. The items progress to printing letters of the alphabet (without models) and writing words (maximum score = 59). For the three subtests, the test developers report test–retest reliability coefficients of .92, .89, and .91, respectively. Internal consistency (i.e., split-half reliability) is greater than .90, .83, and .89, respectively. We found similar internal consistency values for the present sample (Cronbach's alpha = .92, .83, .77, respectively). Content and construct validity were also examined and found to be adequate (McGrew & Woodcock, 2001). Based on age norms, raw scores are transformed into standard scores, with a mean of 100 and standard deviation of 15.

Table 2
Descriptive statistics for full sample on key emergent literacy variables (N = 492).

Variables	*M*	*SD*	Actual range	Percentile
Oral language				
Receptive grammar	8.07	2.93	1–18	32.3
Receptive vocabulary	89.16	17.03	20–138	32.2
Expressive grammar	7.21	2.96	0–16	25.8
Expressive vocabulary	8.01	3.06	0–15	32.9
Code-related skills				
Print concepts	95.14	16.83	46–161	–
Alphabet knowledge	8.16	8.93	0–26	–
Name writing	3.80	2.10	0–7	–
Rhyme awareness	2.85	3.78	0–17	–

Note. Receptive grammar, expressive grammar, and expressive vocabulary from the *Clinical Evaluation of Language Fundamentals Preschool—Second Edition* (M = 10, SD = 3); receptive vocabulary from *Peabody Picture Vocabulary Test, 3rd Edition* (M = 100; SD = 15); print concepts from the *Preschool Word and Print Awareness* test (M = 100, SD = 15); alphabet knowledge (maximum score = 26) and name writing (maximum score = 7) from *Phonological Awareness Literacy Screening for Preschool*; rhyme awareness from the *Rhyming Individual Growth and Development Indicator*, no maximum score. All measures were standardized to T-scores (M = 50; SD = 10) prior to analyses.

6. Results

Table 2 displays the key variables of emergent literacy for the full sample in both domains of oral language and code-related skills. (It is important to note that standard scores and percentile ranks are presented where possible to allow comparison to a norm-referenced sample. However, raw scores converted to T-scores were used in the analyses.) As a group, the children performed between the 25th and 33rd percentiles on measures of oral language and just below the standardized mean in print concepts. On average, children could identify eight alphabet letters and write their names with some correct letters, random letters, and letter-like forms. Table 3 presents the intercorrelations among these key skills, as well as those among teacher ratings and end-of-kindergarten literacy performance. Children's oral language skills were highly inter-correlated (r = .60–.77) and code-related skills were moderately to highly intercorrelated (r = .30–.61). These domains were moderately correlated with one another (r = .29–.52). Midyear teacher ratings of skills (r = .56–.87) as well as kindergarten literacy measures were also highly inter-correlated (r = .63–.80). Finally, teacher ratings were moderately to highly correlated with

Table 3
Bivariate correlations among key study variables.

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. RG	–	.64	.60	.60	.49	.33	.39	.34	.36	.37	.33	.34	.22	.19	.22
2. RV		–	.65	.77	.52	.40	.36	.34	.42	.46	.37	.38	.23	.20	.23
3. EG			–	.71	.47	.29	.30	.37	.43	.40	.30	.31	.26	.24	.29
4. EV				–	.51	.37	.33	.33	.43	.46	.38	.35	.26	.17	.27
5. PC					–	.47	.48	.35	.39	.47	.45	.46	.34	.21	.35
6. AK						–	.61	.31	.40	.52	.62	.57	.38	.31	.36
7. NW							–	.30	.34	.52	.58	.59	.24	.16	.27
8. RA								–	.28	.28	.26	.26	.23	.17	.23
9. TR: OL									–	.66	.56	.60	.30	.19	.36
10. TR: PC										–	.82	.80	.29	.22	.38
11. TR: AK											–	.87	.37	.28	.40
12. TR: EW												–	.33	.25	.41
13. K LWI													–	.73	.80
14. K PC														–	.63
15. K S															–

All *ps* < .01.
Note. RG = receptive grammar; RV = receptive vocabulary; EG = expressive grammar; EV = expressive vocabulary; PC = print concepts; AK = alphabet knowledge; NW = name writing; RA = rhyme awareness; TR OL = teacher ratings of oral language; TR PC = teacher ratings of print concepts; TR AK = teacher ratings of alphabet knowledge; TR EW = teacher ratings of emergent writing; K LWI = kindergarten letter-word identification; K PC = kindergarten passage comprehension; K S = kindergarten spelling.

emergent literacy skills (excluding rhyme) (r = .30–.62). Kindergarten measures exhibited low to moderate correlations with preschool skills (r = .16–.38).

In the next section, we first present a description of the analytic strategy used to derive profiles. We then report the results for these analyses and description of the profiles obtained, along with their prevalence rates and associated demographic features.

6.1. Clustering strategy

Eight preschool direct measures of emergent literacy, representing skills in both oral language and code-related domains, were used to identify profiles through cluster analysis. Given the different metrics of these instruments, all measures were standardized (M = 50, SD = 10) within the total sample by age grouping (42–48 months, N = 82; 49–54 months, N = 200; and 55–60 months, N = 205) prior to analysis. It is widely recognized that failure to place variables on a common scale prior to analysis will result in variables with larger variances having a disproportionate influence on the solution by dominating characteristics of other variables with smaller variances (Everitt, Landau, & Leese, 2001; Hair, Anderson, Tatham, & Black, 1998; Pastor, 2010; Xu & Wunsch, 2009). Although our approach to variable transformation, which involved age based *T*-score standardization, has been advocated by some researchers for the purpose of obtaining common scale units across variables (Aldenderfer & Blashfield, 1984; Izenman, 2008; McDermott, 1998), we recognize that others advocate for the use of alternative approaches for this purpose. For example, Milligan and Cooper (1988) simulation work revealed that range standardization of variables generally provided better recovery of known cluster structure than more traditional standardization methods similar to those employed in the current study. However, more recently, Schaffer and Green (1996) revealed little difference between the two standardization methods when the focus was on the external validity of the resulting solution.

The use of six-month intervals in our standardization process was guided by both theoretical and practical considerations. Theoretically, our use of six-month intervals is consistent with the reported strategies of many test publishers that provide normative standard scores in six or twelve month age bands. Practically, we wanted to ensure that each age band captured a reasonable number of children within our sample. The use of age-based standard scores had the added advantage of controlling for raw score age differences within this sample. Standard scores provide a means by which the relative position of children can be determined in relation to similarly aged peers, so that children in different age blocks with the same standard scores can be said to be the same distance from their respective age-based group means (Katz & Slomka, 2000), rendering between group comparisons meaningless (Clarizio & Phillips, 1986). The drawback to controlling for age in this way, as a potentially contributing factor to cluster identification, is that the control is limited to three age groups.

The clustering strategy we adopted was similar to the one used elsewhere for identifying normative profiles (Glutting & McDermott, 1990; Glutting, McDermott, & Konold, 1997; Konold, Glutting, & McDermott, 1997), as described in McDermott (1998). This procedure involved three steps. In the first step, Ward's (1963) hierarchical-agglomerative procedure was performed on a Euclidean distance matrix that is sensitive to level, shape, and scatter. Ward's method has been shown to outperform alternative methods in terms of minimizing profile overlap (Bayne, Beauchamp, Begovich, & Kane, 1980) and to be the most efficient means by which to recover known taxonomic structure in a population exhibiting variation (Kuiper & Fisher, 1975). In this first step, the total sample (N = 492) was randomly divided into three equal samples (N = 164) and Ward's method was applied to each of the three sub-samples. Decisions regarding the number of clusters to retain within each of the three samples were based on a number of indices: pseudo-F (Calinski & Harabasz, 1985), pseudo t^2 (Duda & Hart, 1973), R^2, inspection of the agglomeration index for each subgroup as well as the agglomeration history within each subgroup, the coherence of the resulting clusters, and the degree of replicability of clusters across subgroups (Crockett, Moilanen, Raffaelli, & Randall, 2006). This step also utilized a "trim" procedure that removed a maximum of 2% of the outlier cases from consideration in the analysis (McDermott, 1998).

Information from the clusters identified in step one was pooled to form an overall similarity matrix that was used for step two. Thus, step two clustering began with a proximity matrix whose diagonal elements held error sums of squares (ESS) statistic values for respective step one clusters, with off-diagonal elements corresponding to potential ESSs for merging each pair of first-stage clusters. Ward's method was employed on the resulting similarity matrix from step one to assess the extent to which cluster profiles from subsamples of the data matched those found for the total sample (i.e., replication). Each of the aforementioned statistical indices was again considered when determining how many clusters to retain at step two. Steps one and two led to the identification of five clusters. Where pseudo F = 107.0 revealed good separation among the clusters, pseudo t^2 = 21.1 reflected separation between the two

Table 4
Emergent literacy mean score patterns (standard deviations), psychometric properties, and demographic variables of core clusters.

	Cluster types				
	Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5
Emergent literacy variables					
Receptive grammar	61.8	50.6	55.7	46.3	40.1
Receptive vocabulary	62.2	51.9	54.6	47.6	38.5
Expressive grammar	61.9	50.0	54.8	49.3	38.1
Expressive vocabulary	62.4	51.6	54.9	48.6	37.6
Print concepts	61.5	54.9	52.1	43.9	43.0
Alphabet knowledge	58.2	64.1	45.6	44.0	44.4
Name writing	56.9	59.1	49.7	43.0	45.7
Rhyme awareness	61.4	51.7	49.0	46.8	45.2
Psychometric properties					
Prevalence	14%	16%	24%	23%	23%
Independent replication across four blocks	67%	67%	100%	67%	67%
Internal profile cohesion (H)	.68	.70	.74	.78	.77
External isolation (Rp)	.23	.38	.52	.45	.30
Demographic variables[a]					
Child gender					
Boys	51.5%	41.8%	45.3%	56.9%	48.6%
Girls	48.5%	58.2%	54.7%	43.1%	51.4%
Maternal education					
High school, no degree	11.1%	20.6%	19.2%	23.8%	33.7%
Completed high school	17.5%	16.2%	19.2%	28.8%	31.4%
Some college	36.5%	29.4%	23.1%	17.5%	16.3%
Degree	34.9%	33.8%	38.5%	30.0%	18.6%
Race/ethnicity					
Caucasian	65.1%[b]	16.0%[c]	61.6%[b]	44.9%	17.2%[c]
African American	25.8%	72.0%[b]	31.3%	44.9%	53.5%
Hispanic	0%	2.7%	2.7%	7.1%	21.2%[b]
Other	9.1%	9.3%	4.5%	3.1%	8.1%
Years in preschool					
First year	56.9%	50.7%	72.4%	57.3%	74.7%
Not first year	43.1%	49.3%	27.6%	42.7%	25.3%
Child age (in months)	54 (4)	53 (5)	52 (4)	53 (5)	52 (5)

[a] All demographic variables are reported as percentages within a given cluster, with the exception of age, for which we report the mean and standard deviation per cluster.
[b] Statistically more membership than expected in the cluster.
[c] Statistically less membership than expected in the cluster.

clusters joined to yield a five-cluster solution, and the resulting five-cluster solution accounted for an appreciable portion of variance as indicated by R^2 = 47%. Step one of the clustering design allowed for an examination of the number of clusters that would be obtained within each of three subsamples. Results of these analyses were combined and step two clustering was performed on these combined results in order to evaluate the internal replication of the emergent clusters at step two. Cluster three yielded a replication rate of 100%, whereas the remaining four clusters demonstrated replication rates of 67% (see Table 4). Replication rates of 67% indicate that these profiles were also identified in two of the three subsamples, whereas, the profile demonstrating a 100% replication rate was found to emerge in all three sub-samples of step one.

Group centroids from the step two solution served as starting seeds for the stage three iterative partitioning analysis conducted using *K*-means passes. *K*-means cluster analysis makes use of an iterative procedure where individuals are assigned to core subgroup membership based upon their smallest Euclidean distance to each subsequent cluster centroid (Eng, Heimberg, Coles, Schneier, & Liebowitz, 2000; Jones, Laufgraben, & Morris, 2006). This third step was necessary because hierarchical-agglomerative procedures (steps one and two) do not allow subjects to shift clusters after their original assignment, despite the fact that they may fit better in a different profile later in the solution. By contrast, iterative partitioning procedures allow subjects to migrate to neighboring clusters, following identification of the number of suspected clusters (steps one and two), and generally result in tighter solutions.

Mean profile configurations (*T*-scores) for the resulting five-cluster solution are presented in Table 4 and illustrated in Fig. 1. The five clusters represent the natural variation of individual emergent literacy development among children identified as potentially at risk for academic difficulties. Table 4 also provides additional psychometric properties for each cluster. The final cluster solution from step three was required to retain the dual properties of internal cohesion and external isolation (Aldenderfer & Blashfield, 1984). Both internal cohesion and external isolation address the issue of internal validity. Internal cohesion refers to the tightness of a cluster, or the closeness of objects around the cluster centroid. External isolation refers to the distance between clusters in multivariate space. Thus, subjects within a given cluster should be similar to one another, whereas clusters composed of homogeneous individuals should be distinct from one another. The average H coefficient (Tryon & Bailey, 1970) across clusters satisfied a-priori expectations for internal cluster cohesion >.60 (Average H = .73), thereby, providing evidence in support of homogeneous within-cluster representation. In addition, the average Rp (Cattell, 1949) across clusters also satisfied a priori expectation in support of external isolation <.40 (Average Rp = .38).

6.2. Patterns of emergent literacy skills

An overview of the five clusters that emerged is provided below. Cluster names are provided to highlight relative strengths and weaknesses that were found through empirical methods as a way of differentiating among children that are known to be at risk. Recall

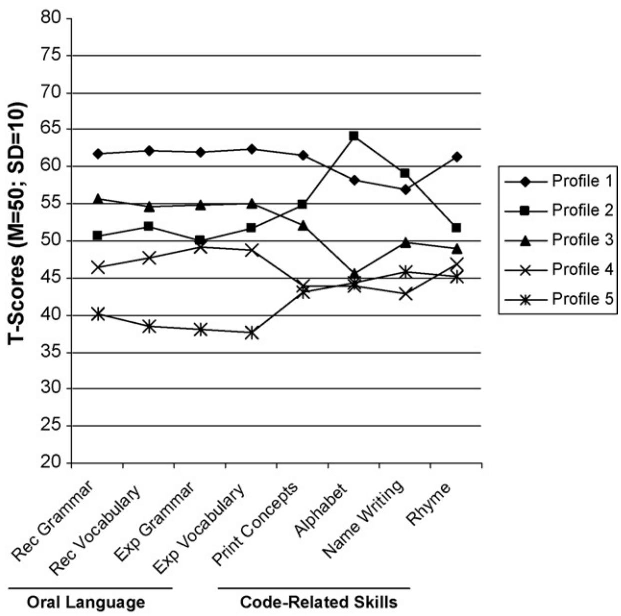

Fig. 1. Profiles of emergent literacy skills.
Profile 1: Highest emergent literacy (14%).
Profile 2: Average oral language, strength in alphabet knowledge (16.3%).
Profile 3: High average oral language, weakness in alphabet knowledge (24.2%).
Profile 4: Low average oral language, broad code-related weaknesses (22.5%).
Profile 5: Lowest oral language, broad code-related weaknesses (22.9%).

that raw scores were transformed to *T*-scores by age categories ($M=50$, $SD=10$) within this sample prior to analysis in order to control for age as a contributing factor in cluster formation. As a result, the summaries below reflect *relative* strengths and weaknesses within this sample.

The summaries below also consider the demographic factors of child gender, maternal education level, race/ethnicity, and years in preschool. (Note that these variables were not entered into the cluster analysis.) Observed demographic proportions within each cluster were compared to what would be expected if these characteristics were proportionately distributed across the five clusters according to their representation in the total sample. For example, the total sample following the trim procedure used in the clustering algorithm ($N=484$) was comprised of 49.0% males and 51.0% females. Cluster one contained 14% of the total sample ($N=68$). Thus, we would expect 49.0% of this number to be male and 51.0% of this sub-sample to be female. This procedure tested for violations of this hypothesis within each cluster. Type I error rates were controlled through the use of Bonferroni adjustments. Results demonstrated that child gender, mothers' education level, or years in preschool were not statistically different from population expectancy within any of the five clusters.

In the descriptions that follow, we present a synthesis of information reported in Table 4 pertaining to the group averages in emergent literacy skills demonstrated by the within-cluster profiles and associated demographic features. Prevailing demographic descriptions of each cluster type considers only instances in which statistically significant race/ethnicity differences were obtained ($p<$ family-wise .05). Each profile is also depicted as a line graph in Fig. 1. Clusters are ordered from the most to least desirable based on extant literature.

6.2.1. Cluster 1: highest emergent literacy

Cluster 1 demonstrated the most desirable profile and was characterized by strong oral language and code-related performance that was consistent across all variables. The prevalence of this cluster in the sample was 14% ($N=68$). Children in this cluster exhibited relative language performance of at least one standard deviation above the sample mean on both receptive and expressive language measures. There were statistically more Caucasian children in this cluster. Relative performance on two emergent literacy measures, rhyme and print concepts, was greater than one standard deviation, with alphabet knowledge and name writing dipping just below that level. On the average, children in this cluster could recognize 16 upper-case letters of the alphabet and could write many letters in their names.

6.2.2. Cluster 2: average oral language, strength in alphabet knowledge

Cluster 2 was characterized by average oral language and high average code-related skills. Prevalence in the sample was 16.3% ($N=79$). There were statistically fewer Caucasian and more African American children in this cluster. Relative performance on language measures was slightly above the mean, while performance on three of the four literacy measures was within one standard deviation above the mean. Children exhibited relatively high alphabet knowledge, with a mean above one standard deviation, corresponding to about 20 letters; they could write many if not all of the letters in their names.

6.2.3. Cluster 3: high average oral language, weakness in alphabet knowledge

Cluster 3 was characterized by average performance across all emergent literacy measures. This cluster had the highest prevalence rate of 24.2% of the sample ($N=117$), with statistically more Caucasian members. Performance on all language measures was one-half standard deviation above the sample mean and approximately at the mean on print concepts, name writing, and rhyme awareness. Alphabet knowledge fell about one-half standard deviation below the mean. This cluster's profile pattern of relative performance is similar to that of cluster 1, with a difference in the overall level of ability. Children in this cluster identified about four letters and wrote their names with letter-like forms or a combination of these forms and correct letters.

6.2.4. Cluster 4: low average oral language, broad code-related weaknesses

Children in cluster 4 displayed relatively weak oral language skills and broad code-related weaknesses. Prevalence in the sample was 22.5% ($N=109$). All language measures were within one-half standard deviation below the mean of the sample. Code-related emergent literacy performance was comparable ($(-1/2)$ *SD*), with rhyme ability slightly above a *T*-score of 45 and name writing ability just below that level. On average, children recognized approximately three upper-case letters and wrote their names with scribbles or letter-like forms.

6.2.5. Cluster 5: lowest oral language, broad code-related weaknesses

Cluster 5 represents the least desirable score profile. However, it had the second highest prevalence rate in the sample, including 22.9% of children ($N=111$). There were statistically fewer Caucasian children and greater numbers of Hispanic children than expected. Children in this cluster displayed the lowest levels of oral language abilities, with relative performance at or below one standard deviation of the mean. Code-related measures were at or close to one-half standard deviation below the mean. Children identified between three and four letters and were primarily using letter-like forms to write their names.

Table 5
Means (standard deviations) per cluster profile for teacher report of oral language and code-related abilities.

	Oral language	Code-related skills		
		Print concepts	Alphabet knowledge	Emergent writing
Cluster profile				
1. Highest emergent literacy	89.52 (11.49)	13.78 (2.38)	12.10 (3.45)	12.81 (2.37)
2. Average oral language, strength in alphabet knowledge	87.37 (14.77)	13.83 (2.24)	13.07 (3.42)	13.40 (2.87)
3. High average oral language, weakness in alphabet knowledge	82.26 (14.77)	12.19 (2.56)	9.27 (3.83)	10.85 (2.93)
4. Low average oral language, broad code-related weaknesses	75.59 (14.23)	11.02 (2.76)	7.69 (3.35)	9.16 (2.91)
5. Lowest oral language, broad code-related weaknesses	68.94 (15.50)	10.03 (2.95)	7.51 (3.78)	9.21 (3.48)

Note. Oral language scores from the *Descriptive Pragmatics Profile* (possible range = 26–104) and code-related scores from an abbreviated version of the *Pre-Literacy Rating Scale* (possible range = 4–16 per category) of the *Clinical Evaluation of Language Fundamentals Preschool—Second Edition*.

6.3. Predictive validity of clusters

The predictive validity of the emergent literacy clusters was ascertained through the examination of (1) midyear teacher ratings of emergent literacy measured three months later and (2) children's end-of-kindergarten conventional literacy performance measured nearly two academic years later. A series of one-way analyses of variance (ANOVAs) was utilized to examine differences among clusters. Missing data were substantial at each time point. To ensure that the profiles compared in the predictive validity analyses were similar to the original profiles, we examined the differences in the eight measures of emergent literacy skills between those for whom we had scores available and those for whom scores were not available based on original cluster membership ($N = 484$). To account for age differences, we used the T-scores for our between-group analyses. Results of the predictive validation and missing data analyses are reported below.

6.3.1. Midyear teacher ratings

To externally validate our five-cluster solution, we examined teacher ratings of children's emergent literacy skills administered approximately three months after children's fall emergent literacy performance was measured with direct assessments. After examining the cluster profiles, we made a priori hypotheses regarding comparisons among clusters. We anticipated that teacher ratings of language would reflect our ordering. We predicted a distinction in the highest (1) and lowest (5) clusters, in that ratings of cluster 1 would be significantly higher and those of cluster 5 would be significantly lower than ratings of other clusters. However, in teacher ratings of language ability, we anticipated no distinction between the clusters exhibiting average oral language (clusters 2, 3, 4). Similarly, we anticipated that teacher ratings of code-related skills would reflect our cluster ordering and favor children in clusters 1 (highest emergent literacy) and 2 (average oral language, strength in alphabet knowledge). We expected no differences between clusters 4 and 5, which were characterized by broad code-related weaknesses.

Of the 484 children assigned to a cluster, scores on the DPP were available for 421 of the children, with 14.5% ($N = 61$) in cluster 1; 16.2% ($N = 68$) in cluster 2; 24.9% ($N = 105$) in cluster 3; 21.6% ($N = 91$) in cluster 4; and 22.8% ($N = 96$) in cluster 5. Thus, the distribution of children to cluster membership within this subsample roughly reflects that of the total sample. With regard to missing data analyses, differences were not significant for six of the eight emergent literacy measures. The group for whom DPP scores were available exhibited significantly higher scores in fall of preschool receptive grammar [$F(1,482) = 4.87$, $p = .03$] and rhyme awareness [$F(1,482) = 4.02$, $p = .05$]. At a mean level, children in this group performed 2.66 standard points higher on receptive grammar than children with missing DPP data and 2.91 points higher in rhyme awareness.

Table 5 displays the means and standard deviations of oral language teacher ratings per cluster. (Recall that teacher ratings of language using the DPP do not precisely align with the fall of preschool oral language constructs.) Teachers rated children's behaviors on a 4-point scale (i.e., 1—never, 2—sometimes, 3—often, 4—always). At the mean level, teachers rated children in clusters 1, 2, and 3 as often or always demonstrating a behavior. Teachers rated children in clusters 4 and 5 as sometimes or often demonstrating a behavior. Teacher ratings of oral language were compared among profiles with ANOVA, revealing significant differences among clusters, $F(4,416) = 28.00$, $p < .001$. Post hoc Tukey tests indicated that teachers reported significantly higher abilities for children in cluster 1 than children in clusters 3, 4, or 5 ($p < .001$, $d = .53$; $p = .02$, $d = 1.05$; $p < .001$, $d = 1.45$, respectively); cluster 2 than 4 or 5 ($p < .001$, $d = .81$; $p < .001$, $d = 1.21$); cluster 3 than 4 or 5 ($p = .01$, $d = .46$; $p < .001$, $d = .88$); and cluster 4 than 5 ($p = .02$; $d = .44$). Differences in teacher ratings of oral language were not significant between clusters 1 and 2 or between clusters 2 and 3.

Scores on the abbreviated PLRS were available for 407 of the children; proportions in this reduced sample reflected the distribution of children in the overall sample (14.5%, $N = 59$; 17.2%, $N = 70$; 23.6%, $N = 96$; 22.4%, $N = 91$; and 22.4%, $N = 91$; in clusters 1–5, respectively). With regard to missing data, differences were not significant for any of the eight emergent literacy measures between children for whom PLRS scores were available and those for whom data were unavailable. Table 5 summarizes teacher-reported code-related skills across categories. (Recall that the constructs reflected by the teacher ratings are similar to but do not align exactly with the original code-related constructs, with writing more broadly conceptualized and phonological awareness not reflected.) At a mean level, teachers rated children in clusters 1 and 2 as often or always exhibiting a code-related skill, while children's skills in clusters 3, 4, and 5 were generally rated as sometimes or often present. Exceptions included alphabet knowledge in clusters 4 and 5, in which teachers reported the skill as never or sometimes present. Clusters were compared with regard to teacher ratings of code-related skills (i.e., abbreviated PLRS) utilizing a series of one-way ANOVAs. Results indicated that there were significant differences between clusters in each of the three categories of code-related skills: print concepts [$F(4,402) = 31.37$, $p < .001$], alphabet knowledge [$F(4,402) = 37.85$, $p < .001$], and emergent writing [$F(4,402) = 33.53$, $p < .001$]. Post hoc Tukey tests revealed the same patterns of cluster performance for each of the three categories. Teachers reported significantly advanced abilities for children in cluster 1 compared with children in cluster 3, 4, or 5 (all p's $< .01$), with medium to very large effect sizes for all categories ($d = .63–1.36$). Likewise, children in cluster 2 were reported as more frequently exhibiting code-related literacy abilities than children in clusters 3, 4, and 5 (all p's $= < .001$; $d = .67–1.58$). Finally, children in cluster 3 significantly outperformed children in clusters 4 or 5 (all p's $= < .02$; $d = .44–.78$). Differences in teacher ratings of code-related skills were not significant between clusters 1 and 2 or between clusters 4 and 5.

Table 6
End-of-kindergarten reading and spelling means (standard deviations) per cluster and results of post hoc tests.

	Cluster 1 (*N* = 56) *M* (*SD*)	Cluster 2 (*N* = 58) *M* (*SD*)	Cluster 3 (*N* = 87) *M* (*SD*)	Cluster 4 (*N* = 74) *M* (*SD*)	Cluster 5 (*N* = 70) *M* (*SD*)	Post hoc	Effect sizes (*d*)
Letter-word identification	116.77 (11.26)	114.78 (12.58)	109.01 (8.28)	103.24 (10.54)	102.81 (9.00)	1 > 3,4,5 2 > 3,4,5 3 > 4,5	0.81, 1.24, 1.38 0.56, 1.00, 1.10 0.61, 0.72
Passage comprehension[a]	108.16 (13.02)	104.59 (14.34)	100.70 (11.09)	95.41 (12.03)	94.71 (11.52)	1 > 3,4,5 2 > 4,5 3 > 5	0.63, 1.02, 1.10 0.70, 0.76 0.53
Spelling	115.07 (9.21)	113.97 (11.80)	109.32 (9.83)	101.61 (12.36)	100.80 (10.95)	1 > 3,4,5 2 > 4,5 3 > 4,5	0.60, 1.20, 1.39 1.01, 1.15 0.69, 0.82

Note. All subtests from the Woodcock-Johnson III Tests of Achievement (M = 100; SD = 15).
[a] For Passage Comprehension analyses, Cluster 1 has 55 children and Cluster 5 has 68 children.

6.3.2. *End-of-year kindergarten outcomes*

We compared clusters on children's reading and spelling performance approximately two academic years after collecting the measures of emergent literacy skills. Because emergent literacy skills are theoretical precursors to reading and have been shown to be predictive of later literacy ability, we predicted that children in different clusters would display differential performance on end-of-year kindergarten outcomes, while maintaining the rank ordering reflected in the profiles.

Table 6 displays the means and standard deviations of end-of-kindergarten performance by cluster type. We employed a series of ANOVAs with follow-up Tukey tests to examine differences among profile mean performance at the end of kindergarten on measures of letter-word identification, passage comprehension, and spelling. Letter-word identification and spelling scores were available for 345 children: (16.2%, N = 56; 16.8%, N = 58; 25.2%, N = 87; 21.4%, N = 74; and 20.3%, N = 70; in clusters 1–5, respectively). Scores for passage comprehension were available for 344 children. With regard to missing data, fall of preschool differences were not significant for four of the eight emergent literacy variables (i.e., expressive grammar, alphabet knowledge, name writing, and rhyme awareness). The group for whom kindergarten literacy scores were available demonstrated significantly higher original T-scores than the group whose data were missing on measures of receptive grammar [$F(1,482) = 4.85$, $p = .03$], expressive vocabulary [$F(1,482) = 4.36$, $p = .04$], receptive vocabulary [$F(1,482) = 4.62$, $p = .03$], and print concepts [$F(1,482) = 4.42$, $p = .04$]. Mean T-scores of these children were approximately two points higher for these measures than those for whom kindergarten scores were not available.

Differences among clusters were significant for all three measures: letter-word identification [$F(4,340) = 24.91$, $p < .001$], passage comprehension [$F(4,337) = 13.87$, $p < .001$], and spelling [$F(4,340) = 24.50$, $p < .001$]. Post hoc Tukey tests indicated that for letter-word identification, children in cluster 1 outperformed those in clusters 3, 4, and 5; children in cluster 2 outperformed those in clusters 3, 4, and 5; children in cluster 3 outperformed those in clusters 4 and 5 (all p's < . 01). Effect sizes (Cohen's d) ranged from 0.61 (medium) to 1.38 (very large), with clusters 1 and 2 exhibiting performance over a standard deviation greater than clusters 4 and 5. Pair-wise differences between clusters 1 and 2 as well as clusters 4 and 5 were not significant. For passage comprehension, patterns of performance were identical (all p's < .01, except 3 > 5 at $p = .02$), with two exceptions: differences between clusters 2 and 3 as well as between clusters 3 and 4 were not significant. Effect sizes ranged from 0.53 to 1.10. With regard to spelling outcomes, patterns of performance were again identical to letter-word identification (all p's < .01 except 1 > 3 at $p = .02$), with the exception of no significant difference between clusters 2 and 3. Effect sizes ranged from 0.60 to 1.39. To summarize, end-of-kindergarten literacy skills reflected the desirability rank ordering of preschool clusters, with effect sizes increasing as profile ranking became more disparate (e.g., differences between profiles 1 and 5 had the largest effect sizes).

7. Discussion

The purpose of the present study was to identify and validate profiles of emergent literacy skills among English-speaking preschoolers from low-SES backgrounds. The five internally and externally validated clusters showed there to be systematic individual differences among groups of children in their emergent literacy skills. Importantly, our findings indicate that early patterns of performance appear to be meaningful to subsequent reading achievement and, in turn, may have the potential to inform preschool educational practices.

7.1. *Systematic heterogeneity of children's emergent literacy skills*

Our foremost finding was that systematic individual differences characterized the emergent literacy skills of children in the fall of their preschool year, as evidenced by distinct subgroups. Five psychometrically sound clusters were obtained: (1) Highest Emergent Literacy (prevalence = 14%), (2) Average Oral Language, Strength in Alphabet Knowledge (prevalence = 16.3%), (3) High Average Oral Language, Weakness in Alphabet Knowledge (prevalence = 24.2%); (4) Low Average Oral Language, Broad Code-Related Weaknesses (prevalence = 22.5%), and (5) Lowest Oral Language, Broad Code-Related Weaknesses (prevalence = 22.9%). The prevalence rates show that membership was well-distributed across the five clusters, although the lowest prevalence was seen for the highest-performing group. Children in the lowest profile comprised nearly one-fourth of the sample. In addition, comparison of profiles on variables external to the solution, including both midyear teacher ratings and end-of-year kindergarten performance, provided evidence of external validity.

Consequently, the results show there to be systematic heterogeneity of children who are considered "at risk" for later academic difficulties, namely children from low-SES backgrounds, and build upon previous reports of heterogeneity among this population (Justice & Ezell, 2001; Welsch et al., 2003; Zill & Resnick, 2006). Prior reports have not aimed to describe children's individual patterns of performance across skills and rather have regarded this variability as random error. By utilizing cluster analysis, we attended to the notion of variability to create subgroups within the larger group; in these subgroups, individual members were more similar in performance to those in their same subgroup than to those in other subgroups across emergent literacy skills (Speece & Cooper, 2004). This classification of individuals into subgroups may provide important insights into individual differences within the larger population of children from low-SES backgrounds (see Speece, 1993). Importantly, the variables used for analyses represent those which are highly important to emergent literacy and are predictive of later reading achievement (NELP, 2008). Of greater significance, however, is that many of these variables are also amenable to change through intervention (e.g., Justice & Ezell, 2000; Justice & Ezell, 2002; Justice et al., 2009; NELP, 2008) and are influenced by contexts in which children develop (both home and school; e.g., Crone & Whitehurst, 1999; Sénéchal et al., 1998). Thus, understanding heterogeneity among children in the development of these important predictors of later reading skill has important implications to individualizing literacy experiences within the early childhood classroom, a matter we attend to shortly.

7.2. Concurrent relationship between preschool oral language and code-related skills

A theoretically interesting finding from this study concerned the concurrent relations between oral language and code-related skills within clusters. Specifically, these relationships varied by cluster, as seen in the dips and rises within each of the profiles. If the connection between domains were uniform for all children, the results of our analyses would have revealed only one meaningful cluster, or perhaps clusters that demonstrated similar patterns of oral language and code-related skills at different levels of performance. In contrast, the resulting clusters suggest that the two domains of emergent literacy may develop unevenly across different children.

Considering this issue in more detail, we found that two clusters, the highest (cluster 1) and the lowest (cluster 5), were characterized by fairly commensurate oral language skills and code-related skills, whereas in the other three clusters, the two skill areas were not commensurate. The pattern of performance for children in cluster 5 suggests that some degree of oral language ability may be necessary for growth in code-related skills (see NICHD ECCRN, 2005), although it is unclear as to the level of ability required. As evidenced by cluster 5, children with particularly low language skills may be at a disadvantage for code-related learning, perhaps because children's language inhibits engagement with and full participation in literacy activities. Indeed, research involving children with specific language impairment indicates that children's engagement in literacy may be compromised by concurrent low language ability (Kaderavek & Sulzby, 1998). At the other end of the continuum, as evidenced by cluster 1, we might speculate that particularly high language ability may be an enabling influence for code-related development. Children who are able to readily understand linguistic concepts and who can actively participate in conversations surrounding literacy may consequently be able to attend to and learn from literacy activities with higher engagement than their peers. In addition, these children, due to their advantaged language, may routinely elicit more information from adults (e.g., Chouinard, 2007) and capitalize on learning opportunities across both domains (e.g., Connor, Morrison, & Slominski, 2006).

Most notably, however, children with language performance in the average range (clusters 2, 3, and 4) exhibited distinctly different profiles of code-related strengths and weaknesses, despite having similar levels of language abilities. Explicit and frequent code-related emergent literacy experiences may be associated with skills in these areas, and consequently this variation in code-related skills apparent among profiles likely reflects differential literacy experiences at home and school. Thus, findings suggest that for children with relatively average language, concurrent code-related skills cannot be accurately discerned from language ability alone in the fall of their preschool year. Moreover, results also suggest that the relationship between oral language and concurrent code-related skills may not be a linear one. Drawing from a recent study of children with specific language impairment (Cabell, Lomax et al., in press), which identified three clusters of children, we found that there was no distinction in mean language ability for the top two clusters, noting that "there are distinct patterns of [code-related] emergent literacy performance that cannot be fully determined from children's age or language abilities" (p. 9). Thus, our findings qualify the evidence indicating a strong interdependence between code-related emergent literacy skills and oral language abilities in young children (Burgess & Lonigan, 1998; Dickinson et al., 2003; Dickinson & Snow, 1987; NICHD ECCRN, 2005; Scarborough, 2001; Sénéchal et al., 1998; Storch & Whitehurst, 2002; Whitehurst & Lonigan, 1998); indeed, we can speculate that this relationship may be marked by complex individual variability, as there are stable clusters of substantial numbers of children in which emergent literacy skills do not track predictably to oral language abilities.

7.3. The longitudinal relationship of preschool emergent literacy skills and kindergarten reading achievement

Previous studies have utilized variable-centered analytic approaches to provide valuable insights into the relationships between preschool children's emergent literacy skills and later reading outcomes (e.g., Kendeou et al., 2009; Storch & Whitehurst, 2002; see NELP, 2008). The present study extends this literature in its effort to show how different patterns of emergent literacy skills revealed subgroups of children which demonstrated differential levels of success in school.

In fact, the results revealed potential reasons why children's early patterns of performance may provide an important complement to existing approaches in the prediction of later skills. The two key emergent literacy variables that are repeatedly emphasized as the most powerful predictors of later reading are phonological awareness and alphabet knowledge (e.g., NELP, 2008). In the present study, if we examined these skills in isolation, rather than in connection with other skills, we would likely predict that children exhibiting higher levels of each skill at the start of preschool would have stronger decoding skills at the end of kindergarten. However, in looking across an individual's pattern of skills, we begin to see that the relationship between emergent skills and later reading is likely more complex. For example, we may expect children in cluster 1 to collectively outperform those in cluster 2 on kindergarten literacy measures, which rely heavily on decoding abilities, because of the approximately 1 *SD* difference in phonological awareness (i.e., rhyme) performance. But children in these clusters did not exhibit differential performance at the end of kindergarten. Conversely, we may expect children in cluster 3 to perform the same as those in clusters 4 and 5 had we examined only alphabet knowledge. But the differential patterns across skills of these clusters, when all skills were considered collectively within a child, resulted in differential end-of-kindergarten achievement. Consequently, consideration of subgroups could potentially lead to increased precision with regard to identifying preschool children who would benefit from additional supports.

7.3.1. Preschool language and later literacy

One salient longitudinal finding pertains to children's differences in language ability at the start of the preschool year and how this may relate to subsequent literacy achievement in kindergarten. There was no apparent advantage by the end of kindergarten in reading or spelling skill for children who began the preschool year with slightly higher language abilities (i.e., +(1/2) to +1 *SD* relative to peers), as shown by a consistent lack of differences in longitudinal comparisons between clusters 1/2 and clusters 4/5. For both of these comparisons, children demonstrated similar code-related skills and thus the primary distinction in the profiles was in the level of language performance.

This finding may be in keeping with research suggesting that oral language ability is more strongly related to reading achievement at a later point in development (e.g., NELP, 2008; Roth, Speece, & Cooper, 2002). Measures taken at the end-of-kindergarten time point generally represent beginning reading for typically developing children, when children are devoting their cognitive energy to learning to decode words. Storch and Whitehurst (2002) provide convincing evidence that preschool oral language skills are not directly related to decoding in kindergarten, but exert an indirect influence via preschool code-related skills (but see NICHD ECCRN, 2005). Given that trajectories of oral language ability exhibit stability from the end-of-preschool forward (Kendeou et al., 2009; Storch & Whitehurst, 2002), slight language differences early in preschool, as demonstrated by these cluster comparisons, may have been differentiated had we compared clusters on reading comprehension in 3rd or 4th grade.

This finding may also be supported by previous person-centered work. Speece et al. (1999) investigated the relationship of oral language and beginning reading in a heterogeneous sample of kindergarten children and found that the strength of the relationship differed for children of varying oral language profiles. Specifically, they found that very strong oral language skills provided an advantage to children's early literacy skills, but that children with average or low language skills were not clearly differentiated in their literacy skills one year later. This must be interpreted with caution, however, as phonological awareness was included in the clusters and thus its effect cannot be separated from that of oral language.

The present findings do not imply that schooling does not matter for preschool children or that children's literacy outcomes remain fixed upon preschool entry. Studies have indeed shown that preschool attendance, classroom quality, teacher training, and emergent literacy interventions positively influence children's skills and potentially help to narrow the gap between those deemed at risk and not at risk (e.g., Abbott-Shim, Lambert, & McCarty, 2003; Landry, Swank, Smith, Assel, & Gunnewig, 2006; Mashburn et al., 2008; NELP, 2008). It is even the case that the specific oral language and code-related interventions to which our participants were exposed had significant positive effects on their skills (Cabell, Justice et al., submitted for publication; Justice et al., 2009). However, our results point to the idea that there is some degree of stability in children's literacy trajectories over time, despite diverse influences. While we cannot say from the present study whether *patterns* of performance remain stable—that is, we don't know whether the same high/low patterns persist throughout preschool and into kindergarten—we can surmise that early patterns of performance are meaningful to later literacy.

7.4. Educational implications

The findings of this study show that children from low-SES backgrounds who are commonly grouped as being at risk for emergent literacy difficulties (and by consequence at risk for later reading problems; e.g., Snow et al., 1998) do not represent a homogenous group, and that there are psychometrically sound subtypes among these children at the start of the preschool year. We found that there is a great deal of complexity in children's emergent literacy development that cannot be reduced to "high emergent literacy" and "low emergent literacy" performance. The current movement towards providing differentiated instruction with preschool settings is important and apparently desirable, based on the findings presented here (e.g., Connor et al., 2006). The present study highlights the value of considering children's skills in combination across domains, with the implication that different subgroups have differential relations to later reading. This could affect how interventions are designed, potentially leading to increasingly refined individualized instruction models.

An empirical profiling approach, through its consideration of within-child patterns of performance, has the potential to impact classroom practices through the identification of subgroups that may have varying risk for reading failure and that may respond differentially to intervention. An important extension of the current findings is to consider whether any of the profiles actually represent children's differential ability to learn emergent literacy skills when provided high quality and consistent opportunities to do so. As the present study represents an early step in the direction of person-centered emergent literacy skills, we do not yet recommend that practitioners use these specific patterns of performance as a basis of decision-making. However, our findings have implications for *where teachers focus their attention* in assessment; rather than focusing solely on variables in isolation, such as alphabet knowledge and phonological awareness, it is imperative that teachers examine student performance across a broader array of skills to determine children's needs.

8. Limitations and future directions

A few salient limitations of this study warrant note. The first pertains to the generalizability of the resulting clusters. The extent to which our sample represents the more general low-SES preschool population is unclear. Although children from the larger studies were randomly selected from classrooms across one mid-Atlantic state, only those with complete data sets of key emergent literacy skills participated in the present study. The sample comprised largely native speakers of English, and it is unclear whether results generalize to children who are learning English as a second language. A second way generalizability was limited was in the measures chosen for the study. Since the measures did not have established norms and were therefore on different scales, we first transformed scores into a common metric (i.e., *T*-scores) prior to analyses. Therefore, the within-cluster profiles obtained are relative to the sample and cannot generalize to the population. Replication should use subtests of one norm-referenced measure to be able to meaningfully compare results to the population at large rather than simply relative patterns.

A related concern centers on our choice of method for standardizing variables prior to submitting them to cluster analysis. As previously described above, some simulation work suggests that the range method of standardization provides better recovery of known cluster structure, while others found little difference between this method and our *T*-score method of standardization. Given this controversy, we ran a parallel set of analyses for our data using the range approach advocated by Milligan and Cooper (1988). Results of this analysis also indicated the presence of five clusters. However, not surprisingly, there were some differences across solutions with respect to the shapes of the emergent literacy profiles and groupings of individuals. One likely reason for this discrepancy may lie in the fact that when employing range standardization, "the transformed mean or variance will not be constant across variables" (Milligan & Cooper (1988), p. 185). By contrast, our *T*-score based approach to standardization overcomes the problems associated with differing variable variances and the disproportionate influence that larger variances have on the resulting solution (Everitt et al., 2001; Hair et al., 1998; Pastor, 2010; Xu & Wunsch, 2009). It is also worth noting that the unstandardized variances of the variables we worked with ranged from a low of 2.1 to a high of 18.6. However, until influence of the type of standardization is fully resolved in the methodological literature, readers should be aware that other plausible patterns of children's emergent literacy skills may exist within this sample.

Another limitation concerns predictors of clusters, in that we did not attempt to explore the ecological factors influencing the formation of profile patterns or membership. Rather, our goal was to simply identify robust clusters across emergent literacy variables. It is likely that the shapes of profiles as well as cluster membership were affected by environmental influences. For example, the differences in children's home literacy environments certainly may account for the relative strength and weakness of alphabet knowledge found in clusters 2 and 3, given the evidence that points to this skill as being heavily influenced by extrinsic factors (Lemelin et al., 2007). School factors may play a role as well, as many of the children in our study attended a 3-year-old program.

Overall, this study suggests that children's emergent literacy development is not marked by random, idiosyncratic variability but that children's strengths and weaknesses reflect consistent profiles of performance. Indeed, children who are generally deemed at risk show considerable individual differences in their emergent literacy development. An important outstanding question, then, is whether and how the profiles from this study are useful longitudinally and whether understanding children's emergent literacy profiles in preschool may assist in the detection and prevention of reading difficulties.

Acknowledgements

The authors thank the many teachers, children, and research staff who made this study possible, with special mention to Amy Sofka, Alice Wiggins, Elizabeth Cottone, Khara Pence Turnbull, and Sarah Friel. This research project was supported by Grants R305G050057 and R305F050124 from the U.S. Department of Education, Institute of Education Sciences.

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