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ORIGINAL PAPER

Profiles of Emergent Writing Skills Among Preschool Children

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Abstract
Background Research suggests that considerable individual differences may exist among preschool children in terms of emergent writing performance. However, there is no study examining this variability.
Objective This research explored the patterns of within-group individual differences in the emergent writing skills of preschool children.
Method Cluster analysis was employed to identify profiles of emergent writing skills in two independent samples (children from middle-socioeconomic status backgrounds $N = 36$; children from socioeconomically and racial/ethnically diverse backgrounds $N = 367$).
Results Cluster analysis identified three emergent writing profiles: (1) highest emergent writing-strength in letter writing and spelling; (2) average emergent writing-strength in name writing; and (3) lowest emergent writing across skills. Children's letter name

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knowledge and phonological awareness significantly predicted profile membership when controlling for age.

Conclusion These findings provide evidence regarding the heterogeneity of preschool children's emergent writing skills and suggest that different profiles of emergent writing can be explained by children's letter name knowledge, phonological awareness, and age.

Keywords Emergent writing · Letter knowledge · Phonological awareness · Cluster analysis

Introduction

Emergent literacy connotes the knowledge children acquire prior to conventional literacy instruction and includes two distinct, albeit interrelated, domains: emergent reading (e.g., alphabet knowledge, phonological awareness; Storch and Whitehurst 2002) and emergent writing (e.g., letter writing, spelling; Clay 1975; Puranik and Lonigan 2011). For most children, these emergent literacy skills originate and develop during the preschool years (Whitehurst and Lonigan 1998). Emergent writing, similar to emergent reading, is a critical emergent literacy skill that lays the foundation for future literacy development. For instance, according to the National Early Literacy Panel (2008), a young child's name writing is one of six variables demonstrating a "medium to large predictive relationship with later measures of literacy development" (National Early Literacy Panel 2008, p. vii). Furthermore, emergent writing skills serve as the developmental precursors to conventional writing skills (e.g., writing opinion pieces; writing narratives), as indicated by several studies showing that preschool children's name writing predicts conventional writing skills in the primary grades (Blatchford 1991; Dunsmuir and Blatchford 2004; Harvey and Henderson 1997; Hooper et al. 2010; Levin et al. 1996, 2005).

Because of its importance to later writing proficiency, there is an increased interest in the United States in improving the emergent writing skills of preschool children (National Governors Association Center for Best Practices and Council of Chief State School Officers 2010). There are a handful of studies demonstrating that preschool children can be engaged in constructing a series of emergent writing forms and types. For example, preschool children can trace letters (Molfese et al. 2006; Puranik and Lonigan 2011), write names (Diamond and Baroody 2013; Gerde et al. 2012), spell single words (Levin et al. 2006; Puranik et al. 2011), and scribble or draw to convey meaning (Bourke et al. 2014; Levin and Bus 2003).

Although the studies listed above indicate that preschool children are capable of various forms of writing, considerable individual differences may exist among young children in terms of emergent writing performance. Some children may have well-developed skills in some aspects of emergent writing whereas others may have underdeveloped skills (Levin et al. 2005; Puranik and Lonigan 2011; Rowe and Wilson 2015). For example, some children can contribute complete words to a class-written text whereas some children need the teacher to model writing individual letters. Understanding heterogeneity among children in the development of emergent writing has important implications for individualizing writing experiences within the early childhood classrooms. However, we were not able to identify a single study that focused on examining such individual differences in the emergent writing skills of preschool children. Thus, we take an exploratory first step in examining whether there are reliable subgroups of emergent writing skills among preschool children

with the goal of advancing theoretical and applied understandings of the heterogeneity of emergent writing skills in young children.

Emergent Writing Development Among Preschool Children

Emergent writing, competencies and knowledge that emerge prior to beginning writing acquisition, includes the following set of distinct skills: knowledge of the purpose and structure of writing (e.g., the function of print, concepts about writing); knowledge of the specific symbols and conventions involved in the creation of writing (e.g., writing letters, writing names, spelling words); and the ability to convey meaning using drawing, invented spelling, and conventional spelling (Puranik and Lonigan 2014; Rowe and Wilson 2009; US Department of Health and Human Services 2010). In this study, our particular focus is on the knowledge of the specific symbols and conventions involved in translating concepts into symbols for written language using pencil or pen. Specifically, we focus on letter writing, name writing, and spelling, as these skills represent transcription and contribute to proficiency in later reading (Diamond and Baroody 2013; Molfese et al. 2011) and conventional writing skills (Dunsmuir and Blatchford 2004; Molfese et al. 2011).

Letter writing, a commonly used index of emergent writing skill, generally refers to children's abilities to write individual letters. Studies have demonstrated that most young children can write some uppercase and lowercase letters (Molfese et al. 2006; Puranik and Lonigan 2011; Puranik et al. 2011; Worden and Boettcher 1990). For example, Molfese et al. (2006) found that 4-year-old preschool children could accurately write an average of one to three uppercase letters at the beginning of the school year. Another study showed that 77% of 3-year-old children could write some letters of the alphabet (Puranik and Lonigan 2011). Despite preschool children's capability to write individual letters, there is wide variability in children's letter writing skills. For example, in one study of 3–5 year-old preschool children's uppercase letter writing, the standard deviation of letters written by children was nearly as large as the mean score ($M = 10$; $SD = 7$; Puranik and Lonigan 2014). This variability however may be due to age as Puranik and Lonigan (2011) found large differences in means on a letter-writing task across children age 3 ($M = 3.27$), 4 ($M = 9.66$), and 5 ($M = 13.01$) years-old.

Another important component of emergent writing is children's ability to write their own names. Name writing has induced considerable interest by the research community, because names are among the first words that children attempt to write and names provide a source of letters for children to practice writing (Bloodgood 1999; Clay 1975; Gerde et al. 2012). Evidence suggests that preschool children can produce sophisticated name-writing representations (Cabell et al. 2009; Diamond and Baroody 2013; Gerde et al. 2012; Puranik and Lonigan 2012). Close examination of these studies suggests that children show substantial differences in their development of name writing skills. For instance, work by Gerde et al. (2012) showed that the name-writing abilities of 3–5 year-old preschool children in the fall of the preschool year demonstrate substantial variability; 25% of children wrote their names using all letters, 26% of them used scribbles without any feature of letters, 2% used drawing, 2% used scribble writing with some of the features of letters, and 8% used letter-like shapes that resemble letters such as separated cursive letters. Puranik and Lonigan (2012) examined 3–5 year-old children's name writing skills at the beginning of their preschool year. They found that children could be divided into three groups based on their performance of name writing assessment: no-name writers (name writing was unsymbolic), partial-name writers (name written with several letters in their names),

and full-name writers (name written correctly). Unexplored in these studies, however, were differences in name writing abilities according to children's age.

Proficiency in spelling words is the other critical component of emergent writing that can serve as a window to children's developing understanding of the alphabetic principle (Shatil et al. 2000; Tangel and Blachman 1992). Theories of spelling development indicate that spelling tends to progress in the following phases: (1) pre-alphabetic phase (children use letters, but do not recognize that letters represent sound), (2) partial alphabetic phase (children use the letters to represent some of the sounds in the word, but not all the sounds), (3) full alphabetic phase (children begin to represent each sound in a word with a letter), and (4) consolidated alphabetic phase (children begin to consolidate orthographic and morphological patterns along with sound patterns in their spelling; Ehri 1997; Gentry 1982; Henderson and Templeton 1986). Many preschool children are just beginning to understand the alphabetic principle while others possess more advanced understanding of spelling (Gunning 2015). For instance, some children in the pre-alphabetic phase may use strings of letters to create words. However, some children in the partial alphabetic phase are able to write initial or final letters of words. One recent study examining variation in spelling among preschool children (Puranik and Lonigan 2011), asked preschool children to write six consonant–vowel–consonant (CVC) words. Findings from this study indicated significant age-group differences on the CVC spelling task. At 3 years of age, 3–10% of preschool children could write the correct initial or final letters of the words they were asked to spell. At 4 years of age, 23–30% of preschool children and 30–50% of children at 5 years of age included the correct initial or final letters of the words in their spelling. A small number of 5 year-old children spelled the CVC words correctly.

Individual Differences in Emergent Literacy Skills

Much of the prior work investigating emergent writing skills among preschool children has included descriptive work focused on examining differences specifically in children's writing skills according to their ages (Molfese et al. 2006; Puranik and Lonigan 2011, 2014). This work has described the variability in children's emergent writing skills within the same age group and across age groups. Of particular use beyond descriptive work, however, are empirical profiling methods which can be used to identify specific profiles of children across an array of emergent literacy skills (Cabell et al. 2011; Cabell et al. 2010; Justice et al. 2015). These methods (e.g., cluster analysis) typically seek to empirically identify profiles (also subgroups) that may display similar patterns of strengths and weaknesses across the classification variables (Jung and Wickrama 2008). Therefore, studies using these methods may have the potential to provide a more comprehensive understanding in individual differences in emergent literacy development.

In an initial effort to profile emergent literacy skills of preschool-age children with language impairment, Cabell et al. (2010) explored profiles of 62 children with language impairment across alphabet knowledge, print concepts, name writing, and rhyme awareness skills. Results showed three emergent literacy profiles: (1) highest emergent literacy, strength in alphabet knowledge, (2) average emergent literacy, strength in print concepts, and (3) lowest emergent literacy across skills. In another study, Cabell et al. (2011) identified profiles of emergent literacy skills of preschool children from low socioeconomic backgrounds. This study was based on a comprehensive model of emergent literacy and included oral language (i.e., grammar, vocabulary) and code-related skills (i.e., print concepts, alphabet knowledge, name writing, rhyme awareness). Five reliable clusters emerged that demonstrated a range

of emergent literacy skills including one profile with highest emergent literacy, three profiles with average oral language and differential code-related skills, and one profile with lowest oral language with broad code-related weaknesses. Collectively, these studies provide valuable insights into the systematic heterogeneity prevalent in the emergent literacy skills of preschool children.

Despite these findings pertaining to profiles of children in emergent literacy skills, no prior studies have aimed to identify profiles of children particularly in emergent writing skills. The early work of Sulzby (1985, 1990) however supports the notion and existence of heterogeneity exclusively in emergent writing skills. This work identifies seven broad categories of emergent writing observed in preschool-age children: drawing as writing, scribble writing, letter-like units, nonphonetic letter strings, copying from environment print, invented spelling, and conventional writing. Thus, it is logical to surmise that there is systematic heterogeneity of emergent writing skills inherent in the preschool population and that such heterogeneity can be unpacked through the use of empirical profiling methodology.

Purpose of this Study

The present study used cluster analysis to describe the emergent writing skills of preschool-age children across the following variables: letter writing, name writing, and spelling. The identification of clusters or profiles in this study would represent a meaningful view of heterogeneity of emergent writing skills among young children. In particular, our study through the identification of profiles may have the potential to impact classroom practices in that children in different profiles may benefit from instruction tailored to their emergent writing profiles.

Two specific aims guided this research: (a) to identify reliable profiles of emergent writing skills among 3–5 year-old preschoolers, and (b) to examine whether children's letter name knowledge and phonological awareness distinguish the profiles after accounting for children's age. With respect to the first aim, drawing from prior research (Cabell et al. 2010, 2011; Justice et al. 2015), we hypothesized that two or more reliable profiles would emerge from the data, differentiating children with relatively higher emergent writing scores from those with relatively lower emergent writing scores. With respect to the second aim, previous studies have shown positive moderate correlations between children's letter name knowledge and emergent writing (Gerde et al. 2012; Kim et al. 2011; Molfese et al. 2006; Puranik et al. 2011; Worden and Boettcher 1990). Research studies have also demonstrated significant relations between children's phonological awareness skills and emergent writing (Al Otaiba et al. 2010; Diamond et al. 2008). Thus, we predicted that letter name knowledge and phonological awareness would explain some of the differences among profiles. In this study, we conducted two independent tests of our hypothesis using two distinct samples of preschool children; in Study 1 which is a pilot study, we conducted an initial test of the hypothesis in a sample of 36 children from middle-socioeconomic status (SES) backgrounds and in Study 2, we conducted a replication of the hypothesis test utilizing a larger sample and a more general population of children (367 children who are socioeconomically and racial/ethnically diverse).

Study 1

The sample for Study 1 was drawn from an early writing intervention project designed to improve the emergent writing skills of 3–5 year-old preschool children. Children and their families were recruited from a university preschool and a child care center in a local children's

hospital. Eligible children included those (1) who were 3- to 5-year old, (2) whose primary home language was English, and (3) who were not identified for cognitive disability or other learning disabilities. The early writing intervention included shared book reading, interactive writing, and alphabet activities and was implemented in small groups by a trained researcher. The data used in the present study were collected prior to beginning the intervention; thus, the experimental design of the intervention study does not have any bearing on the research reported here.

Method

Participants

Participants for Study 1 were 36 preschool children (19 boys, 17 girls). The mean age of the children were 52.9 months (SD = 8.08; range 38–65). The sample's ethnic/racial composition included Caucasian (80.6%; n = 29), African American (8.3%; n = 3), Hispanic/Latino (2.8%, n = 1), multiracial (5.5%; n = 2), and Asian (2.8%; n = 1). The educational attainment of children's mothers in the sample included 25% with a bachelor's degree, 19% with a master's degree, and 50% with a doctoral degree; thus, the sample comprised a majority of mothers who were well-educated. 78% of children's families had an annual household income above $85,000 per year, 9% between $55,000 and $85,000 per year, 6% between $30,000 and $55,000 per year, and 7% less than $30,000 per year. The median family income of the United States in 2011 was $49,445 (US Census Bureau 2011), therefore the majority of families in the present sample were above the median US income. Taken together, the SES of the Study 1 sample can be described as predominantly middle-class.

Procedures and Measures

The procedures involved collecting a parent-completed questionnaire and direct assessment data on children. Parents of participating children completed a questionnaire on general demographic information including child's age, maternal education level, and family income. Subsequently, children were individually administered a battery of reading and writing assessments by trained research assistants. These assessments took place in the children's schools. Prior to working independently with children, research assistants were trained using protocols involving (1) a PowerPoint training module with video demonstrating assessment administration, (2) a written quiz (90% accuracy on quiz questions), and (3) three supervised practice administrations (90% accuracy per practice on observer's checklist). The quiz included true/false questions and open-ended questions which measured research assistants' understanding of the administration and scoring of assessments and ceiling rules. Data regarding the children's emergent writing skills (letter writing, name writing, and spelling) and emergent reading skills (letter name knowledge and phonological awareness) before the intervention was implemented are discussed in the current study. These data were collected during the winter of the preschool year.

Emergent Writing Skills

Letter Writing

Letter-writing skills were measured using the updated version of the *Write Letter Task* (Puranik et al. 2011). In this task, children were asked to write five upper-case (B, O, H, L, and M) and five lower-case (b, i, n, d, and a) letters named by research assistants. Children's responses were scored according to a 3-point scale (0, 1, and 2), depending on if, and how well or poorly, the letters were formed. Specifically, children are given a score of 0 if they did not respond or wrote a letter that could not be recognized; 1 if they wrote a letter that was reversed or poorly formed; and 2 if they wrote a letter that was correct. Internal consistency for this measure was .91. The average inter-rater reliability was 98% ranging from 95 to 99%.

Name Writing

The Name Writing subtest of the *Phonological Awareness Literacy Screening for Preschool* (PALS; Invernizzi et al. 2004) was used as a measure of children's name-writing skills. In this subtest, children were asked to draw a self-portrait and write their name. Name-writing representations were scored on a 7-point scale, with higher scores reflecting increasingly sophisticated name-writing performance. The average inter-rater reliability for the Name Writing subtest was .95 ranging from 90 to 99%.

Spelling

Spelling skills were assessed using the *Spelling Task* (Puranik et al. 2011). This measure required children to write common consonant–vowel–consonant (CVC) words (i.e., mat, bed, duck, cat, fell, hen). Each word was scored on a scale of 1 (random letter string) to 7 (conventional spelling). We found that this task had high internal consistency (.97). The average inter-rater reliability for the Spelling Task was 97% ranging from 95 to 99%.

Emergent Reading Skills

Letter Name Knowledge

The lower-case letter identification subtest of the PALS (Invernizzi et al. 2004) was administered to assess letter name knowledge. In this subtest, children were shown a sheet with all 26 lower-case letters on it in random order and asked to go through and name all the letters they know. Inter-rater reliability of this measure was .99 and validity showed correlations of .61 and .71 with similar assessments (Invernizzi et al. 2004).

Phonological Awareness

Phonological awareness was assessed using the beginning sound awareness subtest of the PALS (Invernizzi et al. 2004). This subtest includes 10 items, all of which are at an appropriate difficulty level for preschool children. For each item, children were shown a picture of a target word, asked to repeat the word, and produce the first sound of the target word

aloud. A correct response could be either the letter sound or the letter name, but the letter sound was preferable. If the child gave the correct letter name, the examiner modeled the letter sound. The internal consistency of this subtest was reported to be .93 (Invernizzi et al. 2004).

Data Analysis

To identify reliable profiles of emergent writing skills (Aim 1), letter writing, name writing, and spelling were standardized (i.e., transformed to *z*-scores) and then entered for cluster analysis. Cluster analysis is a statistical technique for identifying subgroups who share a specific characteristic or a pattern of characteristics (Everitt et al. 2011). In the current study, children within the same profile have similar values on three indicators of emergent writing skills than children in different profiles. Consistent with the recommended practices for cluster analysis (Pastor 2010), both hierarchical cluster analysis and *K*-means cluster analysis were used to identify the proper number of clusters. Children's profile membership was obtained from the final cluster solution. To examine whether children's letter name knowledge and phonological awareness distinguished the profiles while controlling for age (Aim 2), multinomial logistic regression was conducted to predict profile membership from age, alphabet knowledge, and phonological awareness. IBM SPSS Statistics 22 (IBM Corp. 2013) was used to conduct all analyses.

Results

Descriptive statistics of the key variables for the sample of Study 1 and correlations between these variables are presented in Table 1. As shown, children's letter writing mean was 9.47 (SD = 6.57), their name writing mean was 4.97 (SD = 2.12), and their spelling mean was 20.39 (SD = 16.83). Given the large standard deviation and wide range of performance in the measures of emergent writing, there were substantial individual differences among children. Correlations among emergent writing skills, letter name knowledge, phonological awareness, and child age were all significant (rs = .42–.81).

Research Aim 1: To Identify Reliable Profiles of Emergent Writing Skills

Hierarchical cluster analysis with Wald's method was first conducted to classify participants into clusters based on squared Euclidean distance. Wald's method was chosen because it outperforms alternative methods (Bayne et al. 1980; Hand and Everitt 1987). The optimal number of clusters was determined by jumps in fusion coefficients (Milligan and Cooper 1985) and visual inspection of the dendogram (Aldenderfer and Blashfield 1984). Large jumps in fusion coefficients indicate greater dissimilarity when clusters are merged. The agglomeration schedule showed that the jumps in fusion coefficients were small (range 0–6.31) except when three clusters were merged into two (16.96) and when two clusters were merged into one (65.71). Visual inspection of the dendrogram also suggests the existence of two or three clusters. Additional hierarchical cluster analyses were conducted based on different methods (i.e., between-groups linkage, within-groups linkage, nearest neighbor, furthest neighbor, centroid clustering, and median clustering) and they consistently suggested the presence of two or three clusters.

Table 1 Descriptive statistics for key variables and their correlations (full sample)

	Study 1 ($N = 36$)		Study 2 ($N = 367$)		Bivariate correlations					
	Range	*M* (SD)	Range	*M* (SD)	(1)	(2)	(3)	(4)	(5)	(6)
(1) Letter writing	0–19	9.47 (6.57)	0–18	6.79 (5.89)	–	.75**	.86**	.67**	.62**	.69**
(2) Name writing	0–7	4.97 (2.12)	0–9	6.56 (2.99)	.77**	–	.67**	.61**	.59**	.73**
(3) Spelling	0–53	20.39 (16.83)	0–70	26.72 (20.11)	.81**	.54**	–	.57**	.62**	.65**
(4) Letter name knowledge	0–26	17.22 (8.56)	0–26	14.81 (9.81)	.74**	.60**	.68**	–	.49**	.49**
(5) Phonological awareness	0–10	7.83 (3.41)	0–27	13.61 (6.87)	.65**	.61**	.52**	.49**	–	.54**
(6) Age	38–65	52.94 (8.08)	36–70	53.44 (8.95)	.74**	.61**	.49**	.45**	.42*	–

Correlations for Study 1 were shown in the lower triangle and correlations for Study 2 were shown in the upper triangle

**$p < .01$; *$p < .05$

Based on the results from hierarchical cluster analysis, K-means cluster analyses were conducted with the number of clusters specified to be two and three, respectively and results are summarized in Table 2. In the solution with two clusters, children were classified into either high on all skills (Cluster 1, $n = 20$) or low on all skills (Cluster 1, $n = 16$). The Euclidean distance 2.72 suggests that the two clusters were well separated. The two clusters were significantly different across all emergent writing skills, as indicated by the significant F tests. In the solution with three clusters, children were classified into three profiles (i.e., clusters, see Table 2a). Euclidean distances (1.95–3.37) suggest that the three profiles were well separated, with the greatest dissimilarity existed between Profiles 1 and 3 (distance = 3.37). Significant differences exist between three profiles, as indicated by the F tests. Comparison between solutions indicates that the three-cluster solution better captures the heterogeneity of emergent writing skills than the two-cluster solution and thus was retained as the final solution in this study. Three profiles are depicted in Fig. 1a.

Profile 1: *Highest emergent writing, strength in spelling and letter writing* (*prevalence = 39%, n = 14*). Children in Profile 1 demonstrated the highest emergent writing with strength in spelling and letter writing. On average, they performed near or above + .7 SD of the mean, with strength in letter writing (+ 1.05 SD) and spelling (+ 1.08 SD). On average, children in this profile could write letters and CVC words correctly. They also could write their names using recognizable letters.

Profile 2: *Average emergent writing, strength in name writing* (*prevalence = 25%, n = 9*). Children in Profile 2 demonstrated average emergent writing with strength in name writing. Name writing was a relative strength at + .64 SD above the mean, indicating that

Table 2 A summary of final cluster centers and distances between clusters

	Study 1			Study 2		
	Cluster 1 ($n = 20$)	Cluster 2 ($n = 16$)		Cluster 1 ($n = 178$)	Cluster 2 ($n = 189$)	
Final cluster centers for the two-cluster solution						
Letter writing	.75	− .94		.91	− .86	
Name writing	.67	− .84		.75	− .71	
Spelling	.67	− .83		.88	− .83	
Distance between clusters	2.72			2.86		
	Profile 1 ($n = 14$)	Profile 2 ($n = 9$)	Profile 3 ($n = 13$)	Profile 1 ($n = 154$)	Profile 2 ($n = 94$)	Profile 3 ($n = 119$)
Final cluster centers for the two-cluster solution						
Letter writing	1.05	− .04	− 1.10	1.01	− .36	− 1.03
Name writing	.65	.64	− 1.15	.77	.40	− 1.31
Spelling	1.08	− .54	− .78	1.03	− .59	− .87
	Profile 1	Profile 2		Profile 1	Profile 2	
Distances between clusters						
Profile 2	1.95		Profile 2	2.16		
Profile 3	3.37	2.10	Profile 3	3.48	1.86	

Analysis of variance indicated that the differences between clusters were statistically significant ($p < .001$) level for all variables in both studies

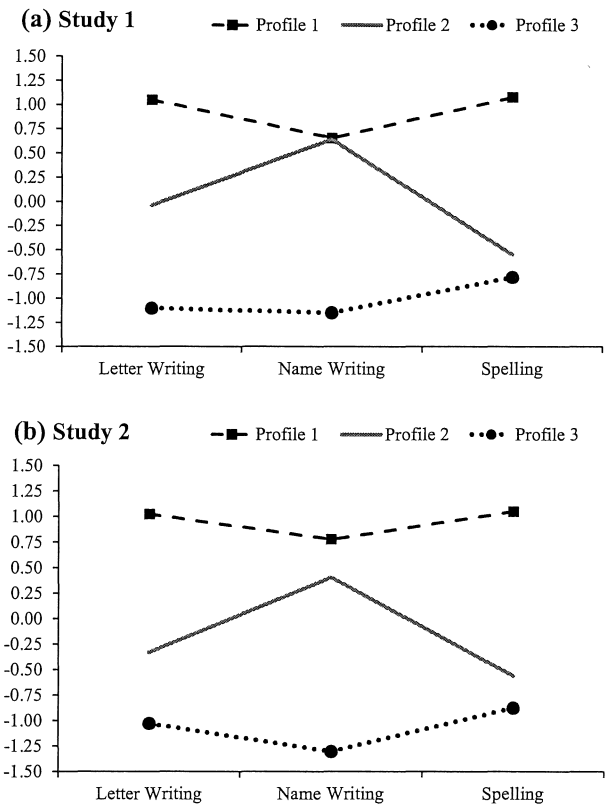

Fig. 1 Profile plots based on the final solution obtained from the *K*-means cluster analysis. Profile 1: highest emergent writing, strength in spelling and letter writing. Profile 2: average emergent writing, strength in name writing. Profile 3: lowest emergent writing across skills

they could write their names with many correct letters. However, spelling was relatively low, indicating that for children in this profile, spelling is an area of specific weakness.

Profile 3: *Lowest emergent writing across skills* (*prevalence* = 36%, $n = 13$). Children in this profile demonstrated the lowest emergent writing across skills. Scores on all three emergent writing measures (i.e., letter writing, name writing, spelling) fell below − .75 SD of the mean. On average, children within this profile, wrote using unrecognizable letters, wrote their names with scribbles, and wrote CVC words using random letter strings.

The three profiles significantly differed across writing skills, letter writing, $F(2, 33) = 134.53$, $p < .001$, $\eta^2 = .89$, name writing, $F(2, 33) = 54.57$, $p < .001$, $\eta^2 = .77$, and spelling $F(2, 33) = 54.11$, $p < .001$, $\eta^2 = .77$. Given the significant differences on all emergent writing skills between three clusters, post hoc tests with Bonferroni correction were further conducted to examine the source of differences. For letter writing skill, Profile 1 had a significantly higher mean than Profile 2 ($t = 16.40$, $df = 33$, $p < .001$), which in turn had significantly higher mean than Profile 3 ($t = 7.47$, $df = 33$, $p < .001$). For name writing, the means of Profiles 1 and 2 did not significantly differ ($t = .05$, $df = 33$, $p = 1.00$), but they were significantly higher than the mean of Profile 3 (Profiles 1 vs. 3: $t = 9.43$, $df = 33$, $p < .001$; Profiles 2 vs. 3: $t = 8.33$, $df = 33$, $p < .001$). For spelling, Profile 1 had a higher mean than the other two profiles (Profile 1 vs. 2: $t = 7.62$, $df = 33$, $p < .001$; Profile 1 vs. 3: $t = 9.69$, $df = 33$, $p < .001$), but the means of Profiles 2 and 3 did not differ ($t = 1.10$, $df = 33$, $p = .84$). See Table 3.

Table 3 Emergent writing, alphabet knowledge, phonological awareness, and child age by profile

	Study 1 ($N = 36$)					
	Profile 1 ($n = 14$)		Profile 2 ($n = 9$)		Profile 3 ($n = 13$)	
	Range	*M* (*SD*)	Range	*M* (*SD*)	Range	*M* (*SD*)
Letter writing	11–19	16.36 (2.02)	3–12	9.22 (2.86)	0–5	2.23 (1.96)
Name writing	4–7	6.36 (.84)	6–7	6.33 (.50)	0–4	2.54 (1.45)
Spelling	23–53	38.50 (7.70)	0–28	11.22 (10.00)	0–23	7.23 (7.89)
Letter name knowledge	12–26	23.79 (3.51)	5–26	16.67 (7.05)	0–24	10.54 (8.27)
Phonological awareness	8–10	9.79 (.58)	0–10	8.11 (3.41)	0–10	5.54 (3.95)
Age	47–65	58.36 (4.72)	42–65	55.89 (7.59)	38–53	45.08 (4.50)
	Study 2 ($N = 367$)					
	Profile 1 ($n = 151$)		Profile 2 ($n = 96$)		Profile 3 ($n = 120$)	
	Range	*M* (*SD*)	Range	*M* (*SD*)	Range	*M* (*SD*)
Letter writing	4–18	12.82 (2.71)	0–15	4.86 (3.52)	0–6	.74 (1.25)
Name writing	7–9	8.88 (.42)	4–9	7.77 (1.20)	0–6	2.67 (1.67)
Spelling	21–70	47.83 (11.22)	0–37	15.50 (9.53)	0–37	9.12 (5.68)
Letter name knowledge	7–26	21.50 (6.46)	1–26	14.83 (8.47)	0–26	6.36 (7.56)
Phonological awareness	0–27	18.23 (5.93)	0–26	12.74 (5.47)	0–22	8.49 (4.77)
Age	45–68	60.11 (4.61)	38–70	54.28 (8.01)	36–66	44.38 (5.35)

Research Aim 2: To Examine Whether Children's Age, Letter Name Knowledge, and Phonological Awareness Distinguish the Profiles

A multinomial logistic regression was conducted to examine whether age, letter name knowledge, and phonological awareness predict profile membership obtained from the three-cluster solution. The model was statistically significant, $\chi^2 = 44.97$, $df = 6$, $p < .001$, Cox and Snell $R^2 = .71$, Nagelkerke $R^2 = .81$, and McFadden $R^2 = .58$. Child age significantly predicted profile membership, $\chi^2 = 17.63$, $df = 2$, $p < .001$. Letter name knowledge was a significant predictor of profile membership, $\chi^2 = 12.71$, $df = 2$, $p = .002$. As letter name knowledge increased by one unit, the chance of being in Profile 1 instead of Profile 3 was 1.51 times greater, $b = .42$, $SE = .16$, Wald = 6.35, $df = 1$, $p = .01$, odds ratio = 1.51. However, letter name knowledge did not distinguish between Profiles 2 and 3, $b = .19$, $SE = .12$, Wald = 2.36, $df = 1$, $p = .13$, odds ratio = 1.20. Phonological awareness did not predict profile membership, $\chi 2 = 4.37$, $df = 2$, $p = .11$. Parameter estimates are summarized in Table 4.

Discussion

Results of Study 1 confirmed our hypothesis, showing that three distinct emergent writing profiles for preschool children were identified: (1) highest emergent writing, strength in spelling and letter writing (prevalence rate = 39%); (2) average emergent writing, strength

Table 4 Parameter estimates from multinomial logistic regression with Profile 3 as reference

	b	*SE*	*Wald*	*df*	*p*	Odds ratio	95% CI	
							Lower bound	Upper bound
Study 1								
Profile 1								
Intercept	− 42.16	14.38	8.59	1	.003			
Age	.49	.20	6.31	1	.01	1.63	1.11	2.39
Letter name knowledge	.41	.16	6.35	1	.01	1.51	1.10	2.09
Phonological awareness	1.06	.67	2.55	1	.11	2.90	.78	10.69
Profile 2								
Intercept	− 21.39	9.16	5.45	1	.02			
Age	.37	.17	4.87	1	.03	1.45	1.04	2.01
Letter name knowledge	.19	.12	2.36	1	.13	1.20	.95	1.52
Phonological awareness	.04	.16	.07	1	.79	1.04	.76	1.44
Study 2								
Profile 1								
Intercept	− 23.66	2.38	98.61	1	< .001			
Age	.34	.04	70.82	1	< .001	1.41	1.30	1.53
Letter name knowledge	.22	.03	52.38	1	< .001	1.25	1.18	1.33
Phonological awareness	.21	.05	19.10	1	< .001	1.24	1.12	1.36
Profile 2								
Intercept	− 13.13	1.77	54.98	1	< .001			
Age	.22	.03	42.84	1	< .001	1.25	1.17	1.33
Letter name knowledge	.11	.02	22.32	1	< .001	1.12	1.07	1.17
Phonological awareness	.10	.04	4.91	1	.03	1.10	1.01	1.20

in name writing (prevalence rate = 25%); and (3) lowest emergent writing across skills (prevalence rate = 36%). This finding suggests that there are reliable profiles of preschool children that allow us to differentiate groups on emergent writing skills.

We also found that children's age and letter name knowledge had some predictive value for children's group members, but children's phonological awareness did not. As shown, children in Profile 3 (lowest emergent writing across skills) were younger than those in Profiles 1 and 2 (highest emergent writing, strength in spelling and letter writing; average emergent writing, strength in name writing). This finding suggests a developmental progression in the performance of emergent writing skills across time. Specifically, the ability to write letters and names and spell words significantly increased with age. Children's letter name knowledge was a significant predictor of profile membership, after accounting for children's age, underscoring the importance of letter name knowledge in facilitating early writing development.

Study 2

The sample of Study 2 was drawn from a large-scale study examining emergent writing development in 3–5 year-old preschool children. Different from Study 1, participants for

Study 2 were recruited from a wide range of preschools/daycare centers ($N = 54$) at two sites, one in northwestern Pennsylvania and the other in North Central Florida.

Method

Participants

Participants included 367 preschool children (172 boys, 195 girls) with a mean age of 53.4 months ($SD = 8.95$; range 36–70). The sample's ethnic/racial composition included Caucasian (62.1%; $n = 228$), African American (28.1%; $n = 103$), Hispanic/Latino (2.2%, $n = 8$), multiracial (3.4%; $n = 14$), and Asian (3.8%; $n = 14$). Of the 367 participants, data on income and parental education are available for only 231 participants whose parents returned surveys. Approximately 7% had a high school diploma, 11% had some college or vocational training, 25% had a bachelor's degree, and 19% had a graduate degree. In terms of household incomes, approximately 19% of children's families had an annual household income below $50,000 per year, 7% between $51,000 and 75,000, 14% between $76,000 and $100,000, and 27% reported an income of greater than $101,000.

Procedures and Measures

Similar to Study 1, the procedures involved collecting a parent-completed questionnaire and direct assessment data on children. Children were tested individually at their preschool centers by trained research assistants. These assessments were generally conducted in a quiet room and completed in two to three sessions as needed. The research assistants were graduate or undergraduate students and field staff who were trained in the assessment protocol which includes review of assessment manual and practice administration. The staff and students were provided multiple opportunities for practice. After practice, they had to pass a mock session where they administered the assessment to one of the authors. Each assessor was observed at least once (and more if needed) in the preschool assessing a participant by a senior project member to ensure fidelity of test administrations. Assessors had to obtain a minimum score of 90% on fidelity checklist to pass fidelity. Data were collected in the fall of the preschool year.

Emergent Writing Skills

Letter Writing

For this task, children were asked to write all 26 uppercase letters of the alphabet. The examiner presented the letters in a predetermined random order. Children's written productions were scored on a scale of 0–2. A score of 0 was given to responses that were unrecognizable or an incorrect letter. A score of 1 was given to responses that were poorly formed or written in lowercase. A score of 2 was given to well-formed uppercase letters. The maximum score was 52. Internal consistency reliability for the letter-writing task was .98. Inter-rater reliability for this task was 93%.

Name Writing

Children were asked to write their first name on a blank sheet using a pencil provided to the child. Name writing was scored on a developmental scale of zero to nine in line with previous research (e.g., Puranik et al. 2014; Puranik and Lonigan 2011). The scoring rubric takes into consideration developmental features of writing including linearity, directionality, phonetic representation, first letter of name, many letters of name, and correct spelling of name. The final score was the sum of all the features; so the maximum score possible was nine. Internal consistency reliability for name writing was .87 for preschool children. Inter-rater reliability for the name writing task was 97%.

Spelling

For the spelling task, children were asked to spell eight simple consonant–vowel–consonant words. Responses were scored on a 0–9 scale to account for levels of development from scribbling to phonetic representations to invented spelling and finally, conventional spelling. The maximum score possible on this task was 72. Internal consistency reliability for the spelling task was (Cronbach's $\alpha = .98$). Inter-rater reliability for the spelling task was 91%.

Emergent Reading Skills

Letter Name Knowledge

To assess letter name knowledge, children were shown a card with an uppercase letter printed on it and were asked to name the letter. All 26 letters were presented to the children in a fixed random (non-alphabetic) order. The maximum score was 26. Internal consistency reliability for the letter-naming task was .97.

Phonological Awareness

Children's phonological awareness (PA) skills were assessed using the PA subtest from the *Test of Preschool Early Literacy* (TOPEL; Lonigan et al. 2007). The subtest includes 27 multiple-choice and free-response items along the developmental continuum of PA from word awareness to phonemic awareness. Children are required to perform both blending (putting sounds together to form a new word) and elision (removing sounds from a word to form a new word). The test begins with training items to ensure that the child understands the task. Test developers reported that internal consistency reliability was above .90.

Data Analysis

The analysis paralleled the analysis of Study 1 in order to replicate our initial findings concerning the identification of profiles of emergent writing skills and examination of whether

children's letter name knowledge and phonological awareness may distinguish the profiles. Specifically, hierarchical cluster analysis and multinomial logistic regression were utilized.

Results

In the sample of Study 2, children's letter writing mean was 6.79 (SD = 5.89), their name writing mean was 6.56 (SD = 2.99), and their spelling mean was 26.72 (SD = 20.11), showing within-group individual differences among children (see Table 1). Correlations among emergent writing skills, emergent reading skills, and child age were all significant (rs = .49–.86).

Research Aim 1: To Identify Reliable Profiles of Emergent Writing Skills

Hierarchical cluster analysis with Wald's method was first conducted to classify participants into clusters based on squared Euclidean distance. The agglomeration schedule showed that the jumps in fusion coefficients were small (range 0–48.34) except when three clusters were merged into two (211.28) and when two clusters were merged into one (659.42). Visual inspection of the dendrogram also suggests the existence of two or three clusters. K-means cluster analysis was then conducted with the number of clusters specified to two and three, respectively. The solution with three clusters captured the heterogeneity of emergent writing skills than the two-cluster solution (see Table 2) and thus was retained as the final solution. Euclidean distances (1.86–3.48) suggest that the three profiles were well separated, with the greatest dissimilarity existed between Profiles 1 and 3 (distance = 3.48).

As shown in Fig. 1b, the three profiles were consistent with what was found in Study 1. Children in Profile 1: *Highest emergent writing, strength in spelling and letter writing* (*prevalence* = 41%, n = 151) demonstrated the highest emergent writing with strength in letter writing (+ 1.10 SD) and spelling (+ 1.03 SD). Children in Profile 2: *Average emergent writing, strength in name writing* (*prevalence* = 26%, n = 94) demonstrated the average emergent writing with strength in name writing (+ .40 SD). Children in Profile 3: *Lowest emergent writing across skills* (*prevalence* = 32%, n = 94) demonstrated the lowest emergent writing across skills.

The three profiles significantly differed across the three writing skills, letter writing, $F(2, 364) = 754.90$, $p < .001$, $\eta^2 = .81$, name writing, $F(2, 364) = 1022.71$, $p < .001$, $\eta^2 = .85$, and spelling $F(2, 364) = 676.74$, $p < .001$, $\eta^2 = .79$. Post hoc tests with Bonferroni correction showed that children in Profile 1 scored significantly higher than children in Profile 2, who scored significantly higher than those in Profile 3 ($ps < .001$). See Table 3 for descriptive statistics.

Research Aim 2: To Examine Whether Children's Age, Letter Name Knowledge and Phonological Awareness Distinguish the Profiles

A multinomial logistic regression was conducted to examine whether age, letter name knowledge, and phonological awareness predict profile membership obtained from the three-cluster solution. The multinomial logistic regression model was statistically significant, $\chi^2 = 389.17$, $df = 6$, $p < .001$, Cox and Snell $R^2 = .65$, Nagelkerke $R^2 = .74$, and McFadden $R^2 = .49$. All the predictors were statistically significant, child age $\chi^2 = 124.58$,

$df = 2$, $p < .001$, letter name knowledge $\chi^2 = 124.58$, $df = 2$, $p < .001$, and phonological awareness $\chi^2 = 429.720$, $df = 2$, $p < .001$. Parameter estimates are summarized in Table 4. After controlling for age, letter name knowledge and phonological awareness uniquely distinguished Profiles 1 and 2 from Profile 3.

General Discussion

In the present study, we determined the extent to which preschool children exhibited reliable profiles of emergent writing skills in two independent research samples. Results demonstrated several important findings. First, the same three distinct emergent writing profiles for preschool children were identified in both studies. Second, children's age and letter name knowledge in both studies explained profile membership. Phonological awareness made a unique contribution to explaining profile membership in the sample of Study 2, but did not predict profile membership in the sample of Study 1. These findings and possible explanations for these results are discussed below.

A first major finding of the present study was that three distinct profiles existed: (1) highest emergent writing, strength in spelling and letter writing (prevalence rate = 39% in Study 1, 41% in Study 2); (2) average emergent writing, strength in name writing (prevalence rate = 25% in Study 1; 26% in Study 2); and (3) lowest emergent writing across skills (prevalence rate = 36% in Study 1; 32% in Study 2). Results thus showed that there are reliable profiles of emergent writing skills in preschool-age children. Children in Profiles 1 and 2 demonstrated particular writing strengths. On average, children within Profile 1 could write letters, write their names using correct letters, and spell single words correctly, suggesting that this group of preschool children was starting to understand the alphabetic principle, use letters to represent sounds, and be involved in a higher level of emergent writing (Ehri 1997; Gunning 2015) compared to the other two groups. Children in Profile 2 had high scores on name writing, but low scores on letter writing and spelling. The pattern of performance for children in Profile 2 aligns with other research studies suggesting that name writing is the starting point for phonetic writing (Both-de Vries and Bus 2008; Levin et al. 2005). Although these children could write their names, they appear to lack skills for phonetic writing such as letter writing and spelling. Once again, this finding is consistent with the explanation that name writing reflects procedural knowledge rather than the conceptual knowledge necessary for spelling and writing in novel ways (e.g., Puranik and Lonigan 2014).

Approximately one-third of children exhibited a profile of emergent writing skills consistent with relatively poor performance across all three writing indices (letter writing, name writing, spelling) in relation to their peers. As compared to their peers, these children in Profile 3 could not write letters, their own names, or single words. On average, children within this profile were beginning to distinguish between writing and drawing through the use of scribble writing (Sulzby 1985, 1990). Taken together, these findings are consistent with previous research suggesting that preschool children are a heterogeneous group and that within-group differences may exist with respect to their emergent writing skills (e.g., Puranik and Lonigan 2012, 2014). Thus, it is important for early childhood educators to provide individualized support to facilitate young children's emergent writing development. Matching instructional activities to these profiles may facilitate children's transition from lower to higher developmental literacy stages. Children in Profile 1 have a solid foundation on basic writing skills and are able to participate in writing activities targeting more advanced writing skills (e.g., idea generation and text construction; Gunning 2015). As

such, higher-level writing activities such as independent writing and using writing beyond the word level (i.e., spelling) to communicate messages and tell stories with the appropriate scaffolding would help these children to move toward more conventional writing (Tolchinsky 2014). Children in Profile 2 are able to write their names but lack competence of phonetic writing (e.g., letter writing), so they need support to understand the alphabetic principle. It may be fruitful to engage them in shared writing activities to attend to letter-sound correspondence within words and practice writing letters (Tomasello 1999). By contrast, children in Profile 3 are at the scribbling phase and are just beginning to notice print. Accordingly, teaching the letters of alphabet and basic writing features and providing scaffolds such as verbal prompts and modeling through writing might be especially beneficial for them (Bus and Out 2009).

A second major finding from the present work was that children's age and letter name knowledge predicted group membership. As shown, children in Profile 3 (lowest emergent writing across skills) were younger than those in Profiles 1 and 2 (highest emergent writing, strength in spelling and letter writing; Average emergent writing, strength in name writing). This finding further supports previous research showing developmental changes in emergent writing skills (Puranik and Lonigan 2011; Rowe and Wilson 2015). Likewise, children's letter name knowledge was a significant predictor of profile membership, after accounting for children's age. This finding is a logical extension of research showing positive links between emergent reading skills such as letter name knowledge and early writing skills (Gerde et al. 2012; Molfese et al. 2006; Worden and Boettcher 1990; Kim et al. 2011; Puranik et al. 2011). It is important to note that lower-case letter name knowledge was measured in Study 1 and upper-case letter name knowledge was assessed in Study 2. Thus, to improve emergent writing, instructional attention is needed in both lower- and upper-case letter name knowledge (Justice et al. 2006). In addition, this finding further highlights the need to teach reading and writing in tandem as opposed to discrete skills.

We found that phonological awareness did not explain some of the differences among profiles in the sample of Study 1, but it was found to be a significant predictor of profile membership in the sample of Study 2. One potential explanation for these discrepancies may be related to the measure of phonological awareness used across the two studies. In Study 1, we assessed one subskill of phonological awareness, namely beginning sound awareness. In contrast, blending and manipulation (i.e., elision), two other subskills of phonological awareness, were measured in Study 2. The inconsistent findings across the two studies suggest that phonological awareness subskills may differentially predict emergent writing skills and that blending and manipulation may be more sensitive phonological awareness skills than beginning sound awareness for differentiating profile membership.

Limitations and Future Directions

Several important limitations of the present investigation warrant mention, as well as some directions for future research. First, children's profiles are only partially explained by age, letter name knowledge, and phonological awareness. Future studies should further examine other potential factors that may underlie the formation of profiles. For example, it is likely that children's fine motor and oral language skills as well as classroom instruction and home literacy environment may help to explain the strengths and weaknesses evident in the identified profiles (Gerde et al. 2012; Guo et al. 2012; Skibbe et al. 2013). Second, not all emergent writing domains were included in the assessment battery, such as those capturing emerging abilities to compose text beyond single-word

level and conceptual knowledge of the conventions and functions of writing (Puranik and Lonigan 2014; Rowe and Wilson 2015). It is possible that additional or different types of profiles may have emerged with the inclusion of such writing tasks. Therefore, future studies may consider more closely replicating our current work, with respect to more emergent writing domains. Finally, we examined children's emergent writing skills at a single point in time. Recent work by Cabell et al. (2013) found that children's patterns across emergent literacy skills change and that children shift profiles over time. Thus, future work may consider examining emergent writing profiles in a longitudinal context.

Conclusion

In summary, this study examined profiles of emergent literacy skills among preschool children using empirical profiling methodology. Results showed that three meaningful profiles of emergent writing skills existed among preschool children. Such profiles identified in the present work could be used to develop individualized writing instruction. Although no studies have examined the effects of individualized instruction on children's writing outcomes, the reading literature indicates that the impact of a particular reading instruction may depend on children's reading, oral language, and attention skills. For instance, observational work by Connor et al. (2006) showed that explicit reading instruction was better suited for preschool children with weak reading or language skills than it was for children with average or above average skills in these areas. McGinty et al. (2012) found that reading instruction particularly supported print knowledge of children with vulnerabilities in the area of attention. Given the heterogeneity of the emergent writing skills of children presented here, preschool children may benefit from the design of individualized writing instruction. More explicit, individualized instruction can better identify specific profiles of the emergent writing skills of children and can thus be used a basis to address the particular weaknesses of individual children, potentially resulting in more substantial growth in writing skills.

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Compliance with Ethical Standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethical Approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed Consent Informed written consent was obtained from all participating children's parents in the study.

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