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The purpose of this study was to examine the letter-writing ability of preschool children aged 3-5 years and the relationship between early literacy skills (i.e., alphabet knowledge, phonological awareness, and name writing) and letter-writing ability. Thirty-six children were individually assessed on letter writing and early literacy skills thought to be important for letter writing success: letter-name knowledge, letter-sound knowledge, beginning sound awareness, and name writing (i.e., writing names using letters or letter-like forms). Results showed that preschool children demonstrated substantial abilities to write upper-case and lower-case letters and children's age was significantly associated with letter-writing ability. Children's lower-case letter-name knowledge, letter-sound knowledge, and name writing were significantly related to letter writing comprised of upper-case and lower-case letter writing. Letter-sound knowledge and name writing significantly predicted upper-case letter writing and only letter-sound knowledge significantly predicted lower-case letter writing.

Keywords: *letter writing, early literacy, name writing, letter names, letter sound*

The preschool years are a significant period of growth, during which two interrelated but theoretically distinct emergent literacy domains develop: early reading (e.g., alphabet knowledge, phonological awareness) and early writing (e.g., letter writing, spelling) (Diamond, Gerde, & Powell, 2008; Puranik, Lonigan, & Kim, 2011; Storch & Whitehurst, 2002). While great strides have been made in the research regarding the importance of early reading development and the consequences of failure to acquire early reading skills (Lonigan & Shanahan, 2009), far less is known about writing, especially the earliest stages of writing development for preschool children. Early writing refers to the competencies and knowledge that emerge prior to beginning writing acquisition and includes understanding of the specific symbols and conventions involved in the creation of writing (e.g., writing letters, spelling words) and emerging abilities of using early writing to explore and record ideas (Puranik & Lonigan, 2014; U.S. Department of Health and Human Services, 2010). One basic writing skill young children learn is printing individual letters (e.g., upper- and lower-case alphabet letters from dictation) (Puranik et al., 2011; Puranik, Petscher, & Lonigan, 2013; Ritchey, 2008). Children's ability to write alphabet letters represents their emerging orthographic knowledge (Ritchey, 2008) and has been shown to be a strong predictor of writing fluency, spelling, and compositional skills in the primary grades (Graham, Berninger, Abbott, Abbott, & Whitaker, 1997; Puranik & Al Otaiba, 2012). Furthermore, according to the Common Core State Standards for English Language Arts, kindergarten children are expected to print many upper- and lower-case letters, write a letter or letters for most consonant and short-vowel sounds, and spell simple words phonetically (Common Core State Standard Initiative, 2010). Consequently, writing individual letters are targets of curriculum or instruction in the preschool years, potentially to prevent reading and writing problems in the school-age years (Snow, Burns, & Griffin, 1998).

Although researchers and practitioners mutually acknowledge the importance of letter writing in the development of literacy skills, few data-based investigations specifically focus on understanding the development of preschool children's letter writing or identifying which early literacy skills may be associated with letter writing. Therefore, the purpose of this study was to (a) describe preschool children's letter-writing ability and (b) examine the extent to which early literacy skills relate to letter-writing ability. Puranik, Pretscher, and Lonigan (2014) found that child factors (i.e., early literacy skills) played a major role in the acquisition of letter-writing skills, but letter factors (e.g., the first letter of a child's name, letter type) did not influence letter writing in a substantial way. Thus, our study focused on examining child factors thought to be important for letter writing success, including alphabet knowledge, phonological awareness, and name writing. We hypothesized that children would be able to write some letters and their abilities to write letters would increase with age. We also anticipated that early literacy skills would be significantly associated with letter-writing abilities. While our goal in conducting this study was largely descriptive, our findings may serve to emphasize the need for examining letter-writing development in the preschool years, in order to provide possible objectives for early literacy curriculum and instruction.

Letter-Writing Ability

One important area of preschool writing competency is writing individual letters (Puranik et al., 2011, 2013). Empirical studies have suggested that the majority of young children can write some upper-case and lower-case letters (Molfese, Beswick, Molnar, & Jacobi-Vessels, 2006; Puranik & Lonigan, 2011; Puranik et al., 2011, 2013; Zhang, Diamond, & Powell, 2017). For example, Molfese et al. (2006) asked 79 preschool children to write 15 upper-case letters and found that those children could accurately write an average of one to three upper-case letters at

the beginning of the school year. Zhang et al. (2017) assessed preschool children's letter writing by asking them to write 10 upper case letters (B, D, S, T, O, A, H, K, M, and C). They found that children could accurately write an average of three upper-case letters among these ten. Puranik et al. (2013) asked preschool children to write from memory each of the 26 upper-case letters. This study scored children's responses dichotomously, as correct or incorrect, and found that the mean percent correct across all letters was approximately 40% and 74% for 4- and 5-year-old children, respectively. Finally, Worden and Boettcher (1990) examined the upper- and lower-case letter writing of 188 preschool and elementary school children. In this study, children were asked to print both upper- and lower-case letters from memory and letters were scored as correct or incorrect. They reported that children could write both upper- and lower-case letters and the average percent correct across all letters was 23% for the 4-year-old children and 53% for the 5-year-old children.

Developmental studies of writing in preschool indicate that letter-writing skills develop and change with age (Levin & Bus, 2003; Puranik & Lonigan, 2011; Worden & Boettcher, 1990). For example, Puranik and colleagues have found that the ability to write upper-case letters improves from age 3 years to age 4 years and from age 4 years to age 5 years (Puranik & Lonigan, 2011; Puranik et al., 2013). Worden and Boettcher (1990) also found that the largest gains in writing ability took place in years 3-6, and the ability to write upper- and lower-case letters increased significantly each year.

Alphabet Knowledge and Letter-Writing Ability

Alphabet knowledge, as defined by the National Early Literacy Panel (2008), refers to children's knowledge of the names and corresponding sounds made by letters of the alphabet. It includes the sub-skills of letter-name and letter-sound knowledge. Both of these sub-skills are

essential prerequisites for the development of decoding, spelling, and writing (Blaiklock, 2004; Caravolas, Hulme, & Snowling, 2001). The significant relationship between alphabet knowledge and letter writing may stem from the similarities and parallels between these two domains. Alphabet knowledge and early writing skills, such as letter writing, emerge at about the same time, sometime between birth to age 5 (Mason, 1984). Theoretically, the task of letter writing encompasses the ability to access, retrieve, and produce letter forms (Graham et al., 1997; Graham & Harris, 2000). While the motoric aspect (i.e., producing letter forms) of writing letters is unique to that task, the cognitive aspect of access and retrieval of letters is largely shared with access and retrieval of letter names and letter sounds (Kim, Otaiba, Puranik, Folsom, & Gruelich, 2014; Puranik et al., 2011). Accordingly, it is logical to assume that children need to have some basic knowledge about letter names and letter sounds before they begin writing. Thus, both letter-name and letter-sound knowledge may be important precursors for the development of letter writing.

Empirical work has supported such hypotheses, showing moderate correlations between alphabet knowledge and letter writing (Al Otaiba et al., 2010; Kim et al., 2014; Milburn et al., 2017; Molfese et al., 2006; Puranik et al., 2011). Al Otaiba et al. (2010) found that the correlation between letter-name knowledge and lower-case letter writing was .33 and the correlation between letter-sound knowledge and lower-case letter writing was .39 for kindergarten children. Similarly, Kim et al. (2014) measured kindergartener's letter-writing ability and found that lower-case letter writing was significantly correlated with alphabet knowledge composed of letter-name and letter-sound tasks ($r = .53$). The study of Milburn and colleagues (2017) showed that letter-name knowledge was significantly related to upper-case letter writing in preschool children ($r = 0.60$). Molfese et al. (2006) also found a large correlation

between letter-name knowledge and upper-case letter writing ($r = .71$) in low-income preschool children. Finally, Puranik et al. (2014) considered letter-name and letter-sound knowledge separately as unique contributors of upper-case letter writing and found that letter-name and letter-sound knowledge were uniquely and positively related to upper-case letter writing for preschool children. Overall, these findings provide support for the potential associations between alphabet knowledge and letter writing.

Phonological Awareness and Letter-Writing Ability

Phonological awareness is defined as the ability to pay attention to, identify, and manipulate sounds within spoken words within a range of linguistic complexity (Phillips & Piasta, 2013). Accordingly, this construct may be assessed by a variety of tasks asking children to identify, segment, blend, and delete sounds within spoken words (Anthony, Lonigan, Driscoll, Phillips, & Burgess, 2003; Wagner, Torgesen, & Rashotte, 1994). The role of phonological awareness in writing has gained increased research attention, because writing skills (e.g., letter writing) are associated with children's growing awareness of how orthography reflects phonology (Ehri, 1992). As described previously, letter writing represents a child's attempt at retrieving the names and sounds of letters (Kim et al., 2014; Puranik et al., 2011) and as such should be facilitated by a child's phonological awareness (e.g., sensitivity to sounds), particularly for preschool children, as young children may use the letters that represent the most distinctive sounds (Gunning, 2013).

Several empirical studies have examined the links between phonological awareness and letter writing. For example, Al Otaiba et al. (2010) found a significant, but weak correlation between phonological awareness tasks, specifically blending and elision, and upper-case letter writing in a sample of 288 kindergarten children ($r = .18$ to .27). Kim et al. (2014) used the same

phonological awareness measures as Al Otaiba et al. (2010), but measured letter writing by asking children to write lower-case letters and observed a moderate correlation of $r = .48$. However, one recent study that examined preschool children's early writing found tests of phonological awareness (i.e., blending and elision) did not significantly predict upper-case letter writing (Zhang et al., 2017). All of these previous studies examined phonological awareness by assessing blending and elision. Indeed, there are a range of phonological awareness sub-skills (i.e., beginning sound awareness, segmentation, blending, manipulation [deletion, substitution]), which may predict early writing skills, but are not frequently used as measures in studies exploring phonological awareness and early writing. For example, beginning and ending sound awareness may be especially important in promoting preschool children's early writing skills because preschool children may reach a critical point in writing development when they begin to represent beginning and ending sounds of words in their writing (Cabell, Tortorelli, & Gerde, 2013). For example, Diamond et al. (2008) found a significant association between children's use of letters in writing and their sensitivity to beginning sounds; therefore, children's awareness of beginning sounds was assessed to indicate phonological awareness in this study.

Name Writing and Letter-Writing Ability

Writing one's name often represents children's first attempt at writing letters and provides children practice in writing familiar letters (Gerde, Skibbe, Bowles, & Martoccio, 2012). Thus, it is reasonable to hypothesize that individual differences in children's name writing skills may be related to children's letter writing abilities. Despite the evident and assumed importance of name writing to letter writing, to date only a few studies have examined the associations between name writing and letter writing skills (Milburn et al., 2017; Molfese et al., 2006, 2011; Puranik et al., 2011; Zhang et al., 2017). Milburn et al. (2017), for example, showed

that name writing skills were significantly related to upper-case letter writing for children in preschool ($r = .56$). Molfese et al. (2006) also found that name writing had moderate correlations with letter writing ($r = .57$) in preschoolers.

The Present Study

Despite these promising findings, there are several gaps in the literature regarding letter-writing ability. First, the majority of scholarly work has investigated upper-case letter-writing skills in preschool children (e.g., Puranik et al., 2011; 2013), except the study conducted by Worden and Boettcher (1990), which examined both upper- and lower-case letter writing. However, Worden and Boettcher (1990) did not identify the important literacy skills that may predict letter writing. Second, there is a small body of work examining the relationship between emergent literacy skills such as alphabet knowledge and phonological awareness and letter-writing ability in preschool children (Milburn et al., 2017; Puranik et al., 2011, 2014; Zhang et al., 2017). All of these studies focused on upper-case letter writing, not lower-case letter writing. As lower-case letters are more difficult than upper-case letters (Bowles, Pentimonti, Gerde, & Montroy, 2013), the precursors to these two sub-skills of letter writing may be slightly different. Little information is available on the potential precursors to lower-case letter writing. However, lower-case letters make up the majority of print children are exposed to and learning lower-case letters is one of the main learning goals of preschool children (Treiman, Cohen, Mulqueeny, Kessler, & Schechtman, 2007; Treiman & Kessler, 2004; Turnbull, Bowles, Skibbe, Justice, & Wiggins, 2010). Thus, increased understanding of how young children learn to write lower-case letters has salient implication for advancing basic developmental theories as well as for improving educational practices focused on improving children's early writing skills. Taken

together, there remains a clear need for additional applied research to empirically examine letter writing and what skills contribute to letter writing for preschool children specifically.

To contribute to the sparse research base on the letter-writing skills of preschool children, we addressed two primary research aims in the current study. The first aim was to describe preschool children's letter-writing ability, comprised of both upper- and lower-case letter writing. We hypothesized that most children in our sample would write some upper-and lower-case letters correctly or nearly correctly, and that children's abilities to write letters would improve with age. The second research aim was to examine the unique and independent contributions of letter-name and letter-sound knowledge (alphabet knowledge), beginning sound awareness (phonological awareness), and name writing to letter-writing ability in preschool-age children. We hypothesized that letter-name and letter-sound knowledge, beginning sound awareness, and name writing would significantly predict letter-writing ability combining both upper- and lower-case letter writing. In addition, we examined the potential predictors of upper- and lower-case letter writing separately. In this study, the assessment of lower-case letter-name knowledge was used to represent letter-name knowledge, because preschool children in our sample were at or near ceiling on an assessment of upper-case letter-name knowledge and did not have such a ceiling effect on lower-case letter-name knowledge. If a child hits the ceiling of an assessment, it indicates that the items of assessment are insufficiently difficult to measure true ability. Thus, it is important to reduce the chances of children scoring at ceiling levels.

Methods

Participants

Researchers provided a written project description to administrators of child care centers in southwestern Ohio and obtained approval from two child care centers to recruit children and their parents. Information flyers and child consent forms were sent home to the primary

caregiver via children's backpacks. As a result, thirty-six parents and their preschool children across these two child care centers volunteered to participate in a study examining the effects of an early writing intervention on children's early writing skills. The data used in the present study were collected before the early writing intervention was implemented; thus, the experimental design of the larger study does not have any bearing on the research reported here. Only the data regarding the children's alphabet knowledge, phonological awareness, name writing, and letter-writing skills implemented before the intervention are discussed in this study. These data were collected during the winter of the preschool year.

The 36 participating children were preschool age with a mean age of 52.9 months (SD = 8.08; range = 38-65). Half of the children were recruited from a university preschool and the other half were recruited from the child care center at a local children's hospital. There were 19 males and 17 females. Based on self-reported information from parents, the majority of children were identified as Caucasian (80.6%; n = 29). Other races/ethnicities were also represented: African American (8.3%; n = 3), Hispanic/Latino (2.8%, n = 1), multiracial (5.5%; n = 2), and Asian (2.8%; n = 1). The mothers' reported highest education levels indicated that 50% of children's mothers had a doctoral degree as their highest level of education. For the remainder of the children, 19% held a master's degree and 25% had a bachelor's degree. Six percent had an associate's or two-year degree as their highest level of education. The majority of children's families (78%) had an annual household income above $85,000, 9% of families between $55,000 - $85,000, 6% between $30,000 - $55,000, and 7% less than $30,000.

Procedures and Measures

After consent was obtained, parents of participating children were given a questionnaire adapted from the Early Childhood Longitudinal Study to obtain demographic information such

as family structure and parent educational level (Saçkes, Trundle, Bell, & O'Connell, 2011).

Child's age, maternal education level, and family income were collected from the demographic

questionnaire. Next, trained research assistants individually assessed children in a quiet space in

each child's center on a number of outcomes including letter-writing ability, alphabet

knowledge, phonological awareness, and name writing. Research assistants were trained using

protocols involving (1) a PowerPoint training module, (2) a written quiz (90% accuracy per test

on quiz), and (3) three supervised practice administrations.

   Child letter-writing ability. Letter-writing ability was assessed using the updated

version of *Write Letter Task* (Puranik et al., 2011). Children were asked to write each of 5 upper-

case (B, O, H, L, and M) and 5 lower-case (b, i, n, d, and a) letters named by research assistants.

These selected letters are based on previous research suggesting these letters are recognized most

frequently by preschool children (Justice, Pence, Bowles, & Wiggins, 2006). Children's

responses were scored on a 3-point scale (0, 1, and 2), depending on if, and how well or poorly,

the letters were formed. Specifically, children were 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 recognized only in context; and 2 if they wrote a letter that was correct and

recognized out of context. Our study showed that this measure had high internal consistency

(coefficient alpha = .91) and correlation (range from .60 to .68) with other assessments (i.e.,

alphabet knowledge, name writing). We found the inter-rater reliability for this measure as .98.

Raw scores from the *Write Letter Task* were used for analysis in this study. Table 1 presents

children's raw scores on this measure.

Table 1.
Descriptive Statistics for Child Letter Writing Measure (Full Sample)

Letter	Mean	*SD*	Range	Child Response (%)		
				Rating (0)	Rating (1)	Rating (2)
B	0.89	0.95	0-2	50%	11.1%	38.9%
O	1.61	0.73	0-2	13.9%	11.1%	75.0%
H	1.08	0.99	0-2	44.4%	2.8%	52.8%
L	1.14	0.90	0-2	33.3.%	19.4%	47.3%
M	0.92	0.94	0-2	47.2%	13.9%	38.9%
b	0.72	0.88	0-2	55.5%	16.7%	27.8%
i	0.92	0.94	0-2	47.2%	13.9%	38.9%
n	0.75	0.87	0-2	52.8%	19.4%	27.8%
d	0.67	0.83	0-2	55.6%	22.2%	22.2%
a	0.72	0.82	0-2	50.0%	27.8%	22.2%
Letter writing scores (the average of 10 items)	0.94	0.66	0-2			

Child alphabet knowledge: letter-name knowledge. The lower-case letter identification subtest of the *Phonological Awareness Literacy Screening for Preschool* (PALS) (Invernizzi, Sullivan, Meier, & Swank, 2004) was used as a measure of children's letter-name knowledge. In this subtest, the children were shown a sheet with all of the 26 lower-case letters on it in random order. The children were asked to go through and name all the letters that they knew. Inter-rater reliability of this task is .99 and validity shows correlations of .61 and .71 with similar assessments (Invernizzi et al., 2004). Table 2 shows children's raw scores on this subtest. For the purposes of the present study, the raw scores were used in the analysis.

Table 2.

Descriptive Statistics for Child Alphabet Knowledge Measures

	M	*SD*	Range
Lower-Case Letter-Name Knowledge	16.67	9.01	0-26
Letter-Sound Knowledge	3.47	2.49	0-6
Beginning Sound Awareness	7.83	3.41	0-10
Name Writing	4.97	2.12	0-7

Child alphabet knowledge: letter-sound knowledge. The *Letter-Sound Short Form Assessments* (Piasta, Anthony, Phillips, Williams, & Bowles, 2016) were used to assess letter-sound knowledge. This measure includes four parallel forms of 6 letters each. Item response theory analyses indicate that these forms are equivalent in difficulty. In this study, one short form was randomly selected for administration and given to each child. In this measure, the children were shown letter cards (e.g., letter C as in city) and asked to tell the sounds that letters make when they are in words. There are several letters that make more than one sound such as letter C (/k/ as in cat or /s/ as in city). For this type of letter, either was considered as an acceptable response. Piasta et al. (2016) found that the reliability for this measure was high ($\rho = .93$). Table 2 presents children's raw scores on this measure; the raw scores were used for analysis.

Child phonological awareness: beginning sound awareness. The beginning sound awareness subtest of the PALS (Invernizzi et al., 2004) was administered to assess phonological awareness. This subtest includes 10 items, all of which are at an appropriate difficulty level for young children. For each item, children are shown the picture of a target word, then are asked to repeat the word and to produce the first sound of the target word aloud. A correct response can be either the letter sound or the letter name, but the letter sound is preferable. If the child gives the correct letter name, the examiner models the letter sound. The coefficient alpha of this

subtest is .93 (Invernizzi et al., 2004). The total number of correct responses was used in the analysis. Table 2 shows children's raw scores on this subtest.

Child name writing. Children's name writing skills were assessed using the Name Writing subtest of the PALS (Invernizzi et al., 2004). Children were required to draw their portrait and write their names. Their writings were scored on a 7-point scale ranging from score of 1 (1 = name indistinguishable from picture) to 7 (7 = legible and orthographically complete name). The inter-rater reliability for this subtest is .99. Table 2 presents children's raw scores on this subtest, which were used in the analysis.

Results
Research Aim 1: To describe preschool children's letter-writing ability.

To address the first research aim, we documented trends and patterns of children's performance on the letter-writing measure (i.e., *Write Letter Task*). Table 1 presents the means, standard deviations, and ranges for each letter and letter-writing scores (the average scores of 10 letters), as well as the percentage of children receiving each rating (i.e., a score of 0, 1 or 2) for individual letters. Descriptive data show that the mean of letter-writing scores (upper- and lower-case letter writing) was 0.94 (SD = .66, Range = 0-2) on a 3-point scale (0: unrecognizable letter; 1: poorly formed letter or reversals; 2: correctly written letter). Examination of individual letters revealed that the majority of preschool children (75%) were able to write correctly the upper-case letter O. About half of the children could correctly write the upper-case letters H (52.8%) and L (47.8%). By contrast, approximately one-third of preschoolers were able to write the upper-case letters B (38.9%) and M (38.9%). Approximately 39% of young children could correctly write lower-case letter i. About one-fourth of preschool children were able to correctly write lower-case letters b (27.8%), n (27.8%), d (22.2%), and a (22.2%). In addition, there was a significant correlation between children's age and their letter -writing scores (r = .74, p < .001).

Research Aim 2: To examine the unique and independent contribution of alphabet knowledge, phonological awareness, and name writing to letter-writing ability.

To address the second research aim, we first computed the correlations to examine the interrelationships among these skills (see Table 3). As shown, the correlation among these skills were all significant. Next, we conducted several multiple regression models. We first examined several parsimonious models for the purpose of saving degrees of freedom in the final model. As age, maternal education, and family income may be associated with preschoolers' letter-writing skills, we tested each variable as a predictor in the model separately. Only predictors that reached statistical significance ($p < .05$) stayed in the model as covariate variables. Children's age, maternal education level, and family income were entered in the model and only children's age was a significant predictor of letter-writing skills. As indicated in Table 4, after controlling for the effects of age, lower-case letter-name knowledge ($ß = .20$, $p = .030$), letter-sound knowledge ($ß = .31$, $p = .001$), and name writing ($ß = .26$, $p = .016$) were significant predictors of letter-writing skills. However, beginning sound awareness was not a significant predictor of letter-writing abilities. Approximately 84% of the total variance in the letter-writing skills was explained by these early literacy skills.