THE RELATION BETWEEN EARLY WRITING AND SELF-REGULATION IN PRESCHOOL

By

Kyla Z. McRoy

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ABSTRACT

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Writing is a critical early literacy skill. However, the development of early writing is not well understood, and may be affected by children's self-regulation ability. The present study sought to accomplish three goals, 1) provide a rich description of children's skills and growth across four diverse writing tasks, 2) examine how self-regulation is related to writing for each task, and 3) investigate whether self-regulation is related to each task over time. Two hundred and two preschool children were assessed on name writing, letter writing, word writing, and story writing tasks, as well as a self-regulation measure. Children demonstrated growth from fall to spring in each task, and their performance indicated the following rank order of ascending difficulty: letter, name, word, story. Regression models indicated that children who scored higher on self-regulation in the fall were more likely to score higher on each writing task in the fall, and this was also true for fall self-regulation predicting spring word writing when controlling for children's fall writing. However, this relation was not found for spring name, letter, and story writing. These results indicate that a variety of writing tasks are accessible to and appropriate for young children, ordinal data may be the most accurate way to measure writing within these tasks, and while self-regulation is related to writing it may not be as defining for children's growth as their initial writing level.

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Writing skill and development in preschool is a consistent, direct predictor of later reading success (NELP, 2008). Although children's writing skills vary widely at kindergarten entry, they remain highly consistent across time, such that children who begin at a disadvantage are unlikely to catch up to peers who begin with stronger writing skills (Abbott, Berninger, & Fayol, 2010). The National Center for Education Statistics reports that 73% of 4th grade students and 76% of 8th- and 12th-grade students fail to write at a proficient level (NCES, 2002; NCES, 2012). Understanding how writing develops early on and the influence of other skills on writing may help to identify ways to alleviate these poor outcomes. For example, it is possible that early writing development is hindered by deficits in behavioral self-regulation (Puranik, Boss, & Wanless, 2018).

A national sample of over 3,000 kindergarten teachers found that about 46% of teachers reported that at least half of children in their class struggled with following directions, a skill that is rooted in children's ability to self-regulate (Rimm-Kaufman, Pianta, & Cox, 2000). Early development of self-regulation, the ability to control one's own behavior, is critical because it is related to a variety of life outcomes. Children with higher levels of inhibitory control, a critical component of self-regulation, show better physical and mental health in adulthood, obtain higher salaries, and are more likely to remain in school as teenagers (Moffitt et al., 2011). Furthermore, these children are less likely to engage in risky behavior such as smoking, using drugs, or developing a substance dependence. In contrast, children with lower levels of inhibitory control are more likely to make risky decisions such as those leading to credit debt, unplanned teenage pregnancy, or criminal offense conviction (Moffitt et al., 2011). Additionally, research indicates a strong relation between self-regulation and preschool achievement (Blair, 2002; Blair & Razza,

2007; McClelland, Cameron, Connor et al., 2007), as well as achievement in elementary school (Alexander, Entwisle, & Dauber, 1993; McClelland, Morrison, & Holmes, 2000; McClelland, Acock, & Morrison, 2006).

An inability to successfully self-regulate may prevent children from taking advantage of writing opportunities provided in the classroom. However, little is known about the role of this critical executive skill in early writing development. To understand the importance of self-regulation for early writing development, it is essential to investigate the relations between these constructs at school entry and across time. The nature of this relation may inform preschool instruction and intervention and identify whether it is critical to prioritize the teaching of self-regulation in support of literacy development. Thus, the present study examines the possible relations between behavioral self-regulation and early writing in preschool.

Importance of Early Writing

Research indicates that early writing is a key predictor of later reading ability (NELP 2008). In an analysis which combined the results of three meta-analyses and encompassed a total of 450 studies, writing was found to be a strong predictor explaining a large amount of variance in later reading ability, second only to reading itself (Hammill, 2004). In a study of 306 children from Israeli kindergartens, children's performance on several literacy measures including word writing was assessed at the end of the kindergarten year and again at the end of first grade (Shatil, Share, & Levin, 2000). In this study, children's writing in kindergarten predicted their ability to decode and spell in first grade. Aram (2005) found similar results in her study of 38 Israeli children, whose kindergarten word writing was found to be a significant predictor of literacy achievement in 1st and 2nd grade.

Early writing develops alongside multiple other literacy skills. Molfese et al. (2011) examined the name- and letter-writing skills of 286 children from preschool to kindergarten entry and found strong relations between letter-writing and decoding ability (i.e., translating print into sound). In their study of 38 pre-reading children, Blair and Savage (2006) reported relations between name-writing accuracy and phonological awareness. This association persisted even after statistically controlling for children's letter-sound knowledge. Similarly, work by Diamond, Gerde, and Powell (2008) showed a substantial positive association between children's name-writing sophistication and letter knowledge. Positive associations also surfaced between name-writing and print concepts, and name-writing and phonological awareness. In a particularly large study of 3,546 preschool children, Welsch and colleagues (2003) found that print-related skills and age accounted for 34% of the variance in children's name-writing. The relations between writing and other concurrent literacy skills show the interconnected nature of these skills, further highlighting the role of writing in children's overall literacy development.

While these studies demonstrate how early writing is critical for concurrent and later literacy development, test results from the National Center for Education Statistics reveal that about three-fourths of children in grades 4, 8, and 12 are unable to write at a level referred to as proficient (NCES, 2002; NCES, 2012). That is, they do not write such that they are "clearly demonstrating the ability to accomplish the communicative purpose of their writing" (NCES Executive Summary, 2012, p. 1). While about half of these children were able to achieve the lower, basic level of writing, the National Commission on Writing (2003) argues that proficient is the new basic; that is, our current society demands an ability to "systematically produce writing at the high levels of skill, maturity, and sophistication required in a complex, modern economy" (NCW, 2003, p. 16).

Given that writing is crucial to literacy development and that children struggle to develop writing, it is unsurprising that poor writing skills in preschool and kindergarten have a lasting impact on writing performance (Aram, 2005; Shatil et al., 2000). A longitudinal study of children's writing performance across grades 1 to 7 showed considerable consistency of children's writing ability over time, particularly in spelling, suggesting that early deficits in writing skills are dangerously defining of later development (Abbott et al., 2010). These long-term poor outcomes identify a pressing need to understand how early skills contribute to or suppress children's writing development.

Underlying all domains, from physical to literacy skills, is the ability to regulate one's own behavior (McClelland et al., 2018). Self-regulatory skills such as inhibitory control, working memory, and cognitive flexibility, seem to be important for children's writing development. Understanding the relations between self-regulation and writing may be one way to alleviate these poor writing outcomes described above. To examine this relationship, it is important to understand what early writing looks like, how it develops, and which skills underlie writing development.

Defining Early Writing

There are multiple ways in which writing is currently being conceptualized. One framework views early writing as encompassing three main skills: composing, spelling, and handwriting (Berninger, 2000; Kaderavek, Cabell, & Justice, 2009). Composing refers to the process of generating ideas and planning content for writing. Children are composing when they dictate a list of ingredients to a teacher as the teacher writes, voice what they will write in a letter to a peer, or discuss what should happen next in a story they are writing. Spelling reflects an understanding of the alphabetic principle (Bear, Invernizzi, Templeton, & Johnston, 2008), and

that the letters representing sounds can be combined into meaningful words. This skill is evident as children sound out the letters in words they plan to write, such as identifying the first sound in "pizza" as /p/ when they write a menu, and ultimately recognizing middle sounds as they progress toward conventional spelling. Handwriting refers to physical text generation, in which children produce writing with a writing utensil based on their knowledge of letter forms. Children practice handwriting as they create letter shapes with paint or in sand, or refer to a word card as they write a label for the strawberries in the garden. The ultimate, synthesized purpose of these skills is communication, as young children recognize the value of writing to transfer and preserve information.

More recently, Puranik and Lonigan (2014) identified a three-factor model of early writing skills, consisting of generative knowledge, procedural knowledge, and conceptual knowledge. Within this model, the composing, spelling, and handwriting components from the previous model are represented, but differ slightly in organization. Specifically, the generative knowledge piece corresponds to composing, and encompasses children's meaningful expression of ideas in phrases and sentences they plan to write. Procedural knowledge combines the aspects of spelling and handwriting, including skills such as letter- and name-writing. The third piece is conceptual knowledge, which separates print concepts from the other components by highlighting children's need to comprehend the purpose and spatial process of writing. While this model touches upon the role of cognitive and executive abilities in the process of writing, these fundamental skills are understated.

In contrast, Berninger's model of writing for older children (2009) highlights self-regulation as one of the essential components of writing. This model was based on a synthesis of 25 years of interdisciplinary, programmatic research into the writing development and skills of

elementary school children. The model includes supports for both storage and processing of phonology, orthography, and morphology for words, along with the integration of these skills, and executive functioning abilities such as working memory and inhibitory control. Berninger notes that the importance of executive skills in her model is emphasized by brain imaging studies. Five brain regions associated with cognitive, metacognitive, and working memory functions showed robust activation in good writers, but not poor writers (Richards, Berninger, & Fayol, 2009). In accordance with these findings, activation in these same five regions was significantly correlated with children's composing, handwriting, and spelling abilities. Given the demonstrated relevance of executive function to older children's writing, it is likely that younger, emergent writers rely even more heavily upon self-regulatory support to focus and persist through the challenge of early writing. Considering this range of frameworks, this study focuses on four writing behaviors that are represented within each framework: name writing, letter writing, word writing, and story writing.

Early Writing Development

Early work examining young children's writing has established a foundation demonstrating that writing develops across several phases (Bloodgood, 1999; Hildreth, 1938; Liberman, 1985; Schickedanz & Casbergue, 2009; Sulzby & Teale, 1985). Children advance through these phases as they understand more about how their oral language can be represented in print and how letters and sounds function to create meaning (Bissex, 1980; Clay, 2001). Early writing begins with drawing and scribbles, which children use to convey a message that holds meaning for them. This is the earliest form of their symbolic representation, and a reflection of their nascent print awareness skills (Bloodgood, 1999; Sulzby & Teale, 1985). Children also develop universal skills at this time, such as the fact that writing is linear and has a direction

(Puranik & Lonigan, 2011), though we recognize the direction differs by language. Children then progress to producing letter-like forms and fully formed letters, but lack the corresponding sound knowledge to form words. During this phase, the most accurate and frequently used letters and letter combinations are often first reflected in children's name-writing (Bloodgood, 1999). Letters from children's names also tend to be the first to appear in writing attempts outside of name-writing contexts (Treiman, Kessler, & Bourassa, 2001). In the next phase of early writing, children use invented spelling, that is writing any sounds they hear in words, in their writing as they begin to master letter-sound correspondence. At first, children use invented spelling to identify and write the letters representing salient sounds at the beginning and ending of words. As children progress to the final stage of writing, they represent in writing the less salient sounds present in the middle of words, culminating in the production of conventional spelling. It is important to note that, while children may be able to use writing in one kind of task such as name- or letter-writing at a high level of sophistication, they may approach more challenging tasks such as story-writing with scribbles or letter-like forms (Bialystok, 1995; Sulzby & Teale, 1985).

Importantly, there is significant variation in the rate at which children progress through these phases. Puranik and Lonigan (2011) assessed preschool children on name-writing, letter-writing, and spelling of consonant-vowel-consonant words. Results showed that 3-year-olds scored significantly lower than 4-year-olds and 5-year-olds on every task, and 4-year-olds scored significantly lower than 5-year-olds on every task. In addition, longitudinal data identifies variation in growth trajectories across ages and across the preschool period (Diamond et al., 2008). It is important to note that, even for Diamond et al.'s narrow sample of low-income 4-year-old children, writing abilities varied widely. Variations have also been observed in

preschoolers with language impairment. In their sample of 59 preschool children (ages 48-60 months) with language impairment, Cabell and colleagues found that about half of the children produced relatively sophisticated representations of their names, while the other half produced relatively immature representations (Cabell, Justice, Zucker, & McGinty, 2009). These results indicate that language impairment itself may not be the only contributor for early writing ability; other skills, such as self-regulation, may also play a role. Similarly, Puranik and Lonigan (2012) found that children with deficits in oral language as well as cognition struggled more with writing than those with only oral language deficits. As such, it would appear that cognitive abilities, such as those required to self-regulate, play an important role in young children's writing.

Skills that Children Need to Write

Writing is a uniquely complex process requiring skills from multiple developmental domains, including physical, cognitive, and socioemotional areas. At a basic level, children need fine motor skills to hold and manipulate writing utensils when forming letters, and early visual motor skills have been identified as one of the strongest predictors of early name-writing skills (Gerde, Skibbe, Bowles, & Martoccio, 2012). Cognitive skills, particularly those relating to literacy, are essential for writing as well. These include print concepts, which children depend on to comprehend the layout and purpose of text, differentiate text from pictures, and differentiate letters from words (Clay, 2001). Print concepts, which are related to writing in preschool (Diamond et al., 2008), are considered universal and develop early, providing a critical foundation for children to build upon as they learn how to use and generate writing themselves (Puranik & Lonigan, 2011). To engage in writing, children must also be able to identify letter names and sounds. Writing the word "dog," for example, requires children to separate the initial

/d/ sound from the rest of the word, match it to the corresponding letter formation, and repeat this process for the remaining two letters. These decoding and letter knowledge skills have been established as moderate and strong predictors, respectively, of preschool name-writing ability (Diamond et al., 2008; Gerde et al., 2012).

Defining Self-Regulation

Behavioral self-regulation is a domain-general skill that develops markedly between the ages of 3 and 7 years (Diamond, 2002; Gerstadt, Hong, & Diamond, 1994; Rothbart, Posner, & Kieras, 2006; Rueda, Posner, & Rothbart, 2004; Zelazo, Müller, Frye, & Marcovitch, 2003). Self-regulation consists of three components: working memory, inhibitory control, and cognitive flexibility (McClelland et al., 2007). Working memory involves the short-term storage and management of information, such as remembering classroom rules. Although the developmental trajectories of each component overlap across childhood, working memory is perhaps the first component to manifest, as even infants can hold one or two pieces of information in mind for a long period of time (Diamond, 1995). Inhibitory control refers to the ability to inhibit a prepotent response in favor of a more adaptable one, such as attending to a teacher's voice instead of a peer's or asking to take turns instead of grabbing another child's toy. Cognitive flexibility, the third component of self-regulation, is the ability to adapt to changing rules or information. It is said to build on inhibitory control and working memory, and as such it develops later (Davidson, Amso, Anderson, & Diamond, 2006; Garon, Bryson, & Smith, 2008).

Self-Regulation Development

While the development of self-regulation begins in infancy, these skills develop rapidly after age three, with exponential trajectories across the preschool period. Importantly, children appear to develop self-regulation at different rates, which may subsequently affect their

academic development. In a recent study of the developmental trajectories of behavioral self-regulation, Montroy et al. (2016) followed a diverse sample of 1,386 children from preschool through first grade. While the majority of these children showed rapid development of self-regulation during this period, three distinct trajectories emerged. Early developers showed a marked increase in self-regulation preceding that of intermediate developers, and this increase was further delayed for later developers. Each trajectory was defined not only by differential timing of rapid gains, but also by early language skills. Early developers tended to have higher levels of expressive language at preschool entry, while later developers had the lowest levels. As such, it appears that higher levels of self-regulation in earlier stages of development may relate to children's development of language skills. On average, later developers lagged six months to a full year behind their intermediate developing peers, and at least a year and a half behind the early developers. Based on these trajectories, many children may struggle to develop other critical academic skills, including writing skills because they are working with underdeveloped self-regulation skills vital for execution of a broad range of skills. Furthermore, children who are later to develop self-regulation may be unable to successfully engage in the learning opportunities, including those for early writing, and interactions provided in the classroom.

Self-Regulation in Preschool Classrooms

Preschool is an important time to consider children's development of self-regulation because these skills are essential for successfully engaging in the learning environment of preschool classrooms (Dennis, Brotman, Huang, & Gouley, 2007). Working memory is required for children to remember the rules of a game, follow a teacher's instructions to wash their hands before eating a snack, and recall the details of a storybook while drawing an illustration. In addition, children use inhibitory control to raise their hand instead of shouting out a response,

persist at completing a block tower when adjacent children are knocking down their towers, and ask to share instead of grabbing another child's marker. Children depend on cognitive flexibility to cease play when clean-up time is announced, adjust when a game is missing a piece, and discuss how the /k/ sound can represent the letter K and the letter C.

Several curricula exist to support the development of these skills in preschool. *Tools of the Mind* (Bodrova & Leong, 2007) is one such curriculum, approved by state funded preschool programs (e.g., the Great Start Readiness Program in Michigan) and used in pre-kindergarten and kindergarten classrooms across the US. Based on Vygotskian theory, *Tools of the Mind* highlights strategies that support children's self-regulation through which to promote their learning and achievement (Bodrova & Leong, 2007). Self-regulation forms the core of this curriculum, which emphasizes that "paying attention, remembering on purpose, and being able to flexibly move from one aspect of a learning task to another have a direct effect on how much children learn and how quickly they learn it" (p. 2). In particular, the *Tools of the Mind* curriculum includes literacy activities that deliberately integrate self-regulation, such as Scaffolded Writing. In this activity, children are supported to use self-regulatory skills such as planning and monitoring through the process of writing. That is, children must prepare their message by drawing a line where each word will be, identify sounds and produce letter forms at a developmentally appropriate level, expand their writing based on ongoing learning in other domains such as science, and reread their writing to peers. Another curriculum designed to promote self-regulation is Promoting Alternative Thinking Strategies (Kusché & Greenberg, 1994). PATHS focuses on discussion of emotions to support behavioral regulation, which in turn is thought to affect achievement. While these kinds of curricula exist and are implemented in

many US classrooms (GSRP Curriculum Manual, 2017; Hulsey et al., 2011), how teachers support self-regulation varies widely across classrooms (Cameron, Connor, & Morrison, 2005).

Importance of Self-Regulation

Self-regulation plays a key role in children's academic development. Behavioral regulation in preschool has been shown to significantly and positively predict fall and spring math, vocabulary, and emergent literacy skills (McClelland et al., 2007). Intervention research shows similar findings. A 16-week intervention study by Aram and Levin (2013) found that kindergarten children with higher self-regulation showed greater improvements in letter knowledge and spelling skills at the end of the intervention than children with lower self-regulation. More recent work has found that children's self-regulation at the beginning of the preschool year was significantly related to children's growth in letter name and sound knowledge across the year (Zhang, Bingham, & Quinn, 2017; Puranik et al., 2018). Similarly, Blair and Razza (2007) found that self-regulatory skills including inhibitory control and attention shifting each accounted for unique variance in mathematics and letter knowledge in both preschool and kindergarten.

Despite the notion that children who are simply compliant and cooperative might perform better academically, these socioemotional traits may not be as important for achievement as those relating to attention (Alexander et al., 1993). Results from a study following first-grade children through fourth grade found traits such as concentration, focus, enthusiasm, and creativity to affect math and literacy test score gains in first, second, and fourth grade. This relationship was longitudinal as well, with teacher ratings of behavior from year one relating to performance at years two and four. Compliance and cooperation, however, did not affect

academic performance or behavior ratings. Achievement appears to be more related to behavioral self-regulation skills, such as sustained attention (Alexander et al., 1993).

Self-regulatory skills acquired by children in preschool may be particularly defining of children's later academic achievement. Self-regulatory or "work-related" skills such as self-control and attention have been found to predict achievement in reading, mathematics, vocabulary, and letter knowledge at school entry (McClelland et al., 2000). These work-related skills also predicted achievement in each academic area except vocabulary at the end of second grade. Over the course of elementary school, from kindergarten to sixth grade, these same self-regulatory skills uniquely predicted reading and math skills (McClelland et al., 2006). Self-regulatory skills also predicted growth in reading and math achievement between school entry and second grade, but not between third and sixth grade, highlighting the early influence of self-regulation on academic outcomes. Further emphasizing this influence, children who entered school with low levels of self-regulation and social competence scored significantly lower on reading and math than their higher-rated peers between kindergarten and sixth grade. Specifically, children entering school with low self-regulatory and social competency skills fell further behind their higher-rated peers between kindergarten and second grade, and were still unable to catch up between third and sixth grade. As such, self-regulation appears to play an important role in achievement early in development.

It is clear that self-regulation is important for literacy skills such as letter name and sound knowledge in preschool, and letter knowledge, spelling, reading, and vocabulary at school entry. However, little is known about how self-regulation is related to early writing, though writing is a critical early literacy skill.

Theoretical and Empirical Support for the Relation Between Self-Regulation and Early Writing

What remains minimally defined, and is the target of this study, is how self-regulatory skills are used to support early writing. Theoretically, self-regulation may be valuable for supporting academic achievement. To successfully engage in writing, children must be able to attend to the task and inhibit the urge to attend to the multitude of classroom distractions. As children write, they must retrieve letter sounds and shapes from memory, and track their use of these letter sounds and shapes to form words. In addition, children must be able to move flexibly between the components of the writing process, including idea generation, spelling, and forming letters by hand. Thus, the three components of self-regulation would be theoretically represented throughout the process of writing. Vygotskian theory emphasizes this link between language and self-regulation (Bodrova & Leong, 2007). Vygotsky posits that adults and peers use language to support children to develop other abilities. As children learn and use verbal language with others, they develop an internal dialogue. This inner speech allows children to problem-solve more effectively and independently, as they can use planning and attentional control to support them to think through a problem. This psychological tool, self-regulation, then allows children to access more advanced technical tools such as writing. Self-regulation becomes important both for engaging in the process of writing, and engaging in teacher instruction and support. For older children, conceptual models of writing include self-regulation (Berninger, 2009). However, little is known about its relation to writing for young children remains.

The role of behavioral self-regulation in early writing may appear difficult to identify in previous research for two main reasons, 1) because it may differ as a function of the target writing task, and 2) it may fluctuate as children develop. The writing process can be reflected in

four common preschool writing tasks, including name writing, letter writing, word writing, and story writing. The strength of the relation between self-regulation and early writing may be different for each task because each task may rely differently upon self-regulation. In addition, the degree to which each component of self-regulation relates to each task may change over time as children master certain skills and begin to acquire new skills (Puranik et al., 2018). Self-regulation may be critical as children are learning the basic elements underlying a particular writing task, and then it may become less critical as writing becomes automatized and children master the task. As children advance and begin learning the next developmentally appropriate writing task, self-regulation may resurface as an important factor to support the application of foundational knowledge. As children advance to learning letter-sound correspondence, they may depend on self-regulation to support word-writing. Finally, as children learn to organize their ideas, their ability to express and record these ideas in written stories may require self-regulatory skills.

While self-regulation has been identified as a significant predictor of name-writing ability in preschool children (Gerde et al., 2012), self-regulation explained only a small amount of variance in children's name-writing. These results follow logically, as name writing involves basic memorization of a single, constant sample of letter formation and sequence, and this task is typically mastered by the end of preschool. Furthermore, when learning to write their name, children typically do not use letter-sound correspondence, and often don't recognize the letters or the sounds of the letters they've written (Bialystock, 1995; Bus et al., 2001; Cabell et al., 2009; Drouin & Harmon, 2009; Levin et al., 2005; Welsch et al., 2003). Rather, children appear to view their names as logograms, unrelated to phonological production. This suggests that they are not using advanced spelling skills when engaging in name-writing, and are instead more focused

on letter formation. Similarly, Puranik, Lonigan, and Kim (2011) found that, when considering letter-writing and name-writing ability in relation to spelling, only letter-writing ability significantly contributed to the prediction of spelling. These findings further indicate that name-writing may reflect a narrow set of writing skills, and thus is not a good indicator of children's invented spelling skills. As such, name writing may not tax children's self-regulatory abilities as much as other tasks (e.g., word writing) might, and thus this task alone may fail to capture the role of self-regulation within the entire writing process. However, this task is often children's first exposure to writing (Treiman et al., 2001), so self-regulation may serve a more critical role as the initial skills involved in name-writing are developing. Gerde et al. (2012) found self-regulation to be a significant predictor of name-writing ability in preschool children when they examined data from the fall of preschool, at which time children's name-writing skill is particularly challenging. While some studies have shown significant relations in the spring (Zhang et al., 2017), most children are writing their names with greater ease and accuracy at that time (Diamond et al., 2008), so spring data from that population might have revealed a lesser relation between self-regulation and name-writing. In fact, Puranik and colleagues (2018) found no relation between self-regulation and preschool name writing in the spring, suggesting there exists some conflict in the literature on this potential relation.

Letter writing is another commonly used task for assessing early writing. Assessing this skill often involves prompting children to write a series of dictated letters (e.g., Puranik, Lonigan, & Kim, 2011; Puranik & Lonigan, 2012). Preschool letter writing ability has been shown to be a better predictor of children's spelling than name-writing (Puranik et al., 2011) noting its capacity to capture nuance not available in name-writing measures. Recent work has found significant correlations between self-regulation and writing fluency, defined as the number

of legible letters children could produce in one minute, in the fall of preschool, and a positive correlation between self-regulation and name-writing in both the fall (r = .34, p < .01) and spring (r = .24, p < .01) (Zhang et al., 2017). However, this speed-based approach for assessing letter-writing is commonly used in older children (e.g., Graham, Berninger, R. Abbot, S. Abbot, & Whitaker, 1997), and may be less appropriate for young children because it examines both letter knowledge and production speed. Recognizing this, Puranik and colleagues (2018) recently used a letter-writing task without a speed component, and still found a significant positive relation between self-regulation and letter writing.

Within the writing process, spelling serves as a critical bridge between composing and handwriting. To write a word, children must identify the first sound, identify the letter that represents that sound, retrieve its form from a memory bank of 52 capital and lower-case letters, handwrite the letter, and then repeat the entire process for middle and ending sounds until the word is complete (Bear et al., 2008). Zhang and colleagues (2017) identified a significant correlation between self-regulation and invented spelling skills at both fall and spring of the preschool year. Even more recently, self-regulation was found to be significantly and positively related to spelling (Puranik et al., 2018). This relation is understandable, as word-writing requires the flexibility to move through identification of letter sounds, identification of letter forms, and production of those forms on paper. Word-writing also requires significant focus to bring the task to completion. In the fall, children likely depend on self-regulation as they learn to identify and write various letters. By spring, self-regulatory skills may support children as they begin to recognize and write the letters that represent the beginning and ending sounds of words. As they progress, children may depend on self-regulation as they begin to identify and write the letters reflecting sounds in the middle of words. As such, word-writing skills continue to remain

challenging at the end of preschool, and thus, children likely need self-regulation skills to be successful in the task. While the Zhang et al. (2017) study is a critical addition to the literature recognizing the importance of self-regulation for name-writing and invented spelling, the study did not address story-writing, a more advanced writing task.

With the literature predominantly occupied by studies examining children's name, letter, and word writing, little is known about the role of self-regulation in children's story-writing ability, a task that requires children to generate the ideas and produce the text. However, research on older children has indicated relations between these constructs. Bourdin and Fayol (2000) found that poor working memory, an aspect of self-regulation, may restrict writing production in second- and fourth-graders. It seems that children's cognitive resources are so taxed by the processes of spelling and handwriting that they are less able to engage in higher-level conceptual planning, a critical part of composing. Additionally, second-grade students with poor writing abilities showed strong improvement in story-writing following an intervention focused on improving self-regulation skills (Lane et al., 2010). For many of these students, improvements in the quality and length of their stories were also lasting, with gains maintained at least 3 weeks post-intervention. Research on first-grade children has also demonstrated that sustained attention, another aspect of self-regulation, is predictive of composition quality and fluency (Kent, Wanzek, Petscher, Al Otaiba, & Kim, 2014). This indicates that self-regulation is important for composing-type skills in older children, and as such it may be important for emergent writers whose composing skills are less developed and thus more dependent upon attention, inhibition, and cognitive flexibility. This is further indicated by work by Puranik and colleagues (2018), who found a significant relation between kindergarten self-regulation and composition.

Composing requires young children to mentally generate and integrate ideas prior to undertaking the process of transcription, that is, spelling and handwriting (Kissel, 2009). As such, composing may be the most challenging of the three writing tasks, and may thus be most dependent on self-regulation. This task is so challenging that children with skills in name-writing and conventional spelling may still compose a story in scribbles, because they are focused more on the message than the transcription skills. For example, a child may write her name as the author of her story and write "THE END" on the last page with a high level of sophistication, while the contents of her story appear as a series of scribbles (Sulzby & Teale, 1985). The process of story-writing is also the most time-consuming, demanding sustained attention and powerful working memory abilities as children focus on recording the details of their story. The act of composing, being entirely rooted in thought, may be more taxing to a child's self-regulatory system than both the memorization skills of name-writing and the letter-sound matching skills of spelling. Given these likely differences in the role of self-regulation across the writing process, it is a goal of this study to investigate the relation between self-regulation and name writing, letter writing, spelling, and early story-writing ability.

Measuring Writing and Self-Regulation

Typical measurement of writing.

Coding writing. Despite the importance of writing assessment, there is little agreement regarding ideal measures and scoring systems tend to differ greatly across studies (NELP; Lonigan, Schatschneider, & Westberg, 2008). Assessing children's writing requires identifying the features of writing and the levels that these features reflect. This is typically approached with either dichotomous coding or continuous coding. Dichotomous coding awards a 1 for the presence of a feature and a 0 for its absence. Common features for dichotomous coding of name-

writing include linearity, segmentation, simple characters (e.g., dots, circles), left-to-right orientation, first letter of child's name, letter-like forms, random letters, more than half of the letters in child's name, and correct spelling of name (e.g., Puranik & Lonigan, 2011).

In continuous coding, scribbles are generally coded as the lowest level, followed by drawing as writing, then letter-like shapes, the combination of letters and letter-like shapes, and finally conventional letters (Cabell et al., 2009; Diamond et al., 2008; Invernizzi, Sullivan, & Meier, 2001; Puranik & Lonigan, 2011; Rowe & Wilson, 2015). For example, one widely used measure of writing is the Phonological Awareness Literacy Screening (PALS), which offers preschool (Invernizzi et al., 2001) and kindergarten (Invernizzi, Juel, Swank, & Meier, 2009) versions. Both versions of PALS evaluate only transcription skills, not composing ability; the preschool version includes only name writing as an assessment of writing ability, and the kindergarten version uses only CVC word writing. Scoring for the kindergarten word writing is continuous, with zero points given for a string of random letters, one point added for each correct letter, and four points for all three correct letters written in order. Studies investigating preschool name-writing, word-writing, and story-writing use similar scales, but expand them to acknowledge lower-level abilities such as drawing (Cabell et al., 2009), scribbling (Puranik & Lonigan, 2011), and letter-like shapes (Rowe & Wilson, 2015).

Continuous coding has been used because it seems to reflect development. Forms of writing are coded dichotomously to acknowledge that the relative importance of certain features is still unknown, and thus continuous coding would be inappropriate as it assumes increasing value and equal distance between levels. As such, based on what we know about children's writing, this study uses ordinal coding in an attempt to reflect more accuracy in measurement.

Writing tasks. The most common measure of child writing is name-writing (Puranik, Schreiber, Estabrook, & O'Donnell, 2014), in which children are simply instructed to write their first name on a piece of paper. This task was originally considered the gold standard for assessing children's early writing ability because a child's own name is typically the first word they learn to write (Martens, 1999), and this process often serves as their first exposure to the connection between oral and written language (Villaume & Wilson, 1989). As such, this study uses name-writing as one of the measures for early writing.

More recently, however, research has questioned the role of name-writing as fully representative of children's writing competence, as it does not require spelling or composing. In letter-writing tasks, children are often asked to write a set of capital letters known to be especially familiar to preschool children. The task of letter-writing may capture more of children's writing ability than name-writing. Puranik, Lonigan, and Kim (2011) showed that letter-writing predicted children's spelling in preschool, while name-writing did not. Letter-writing clearly represents some emergent skills, and as such this study includes this task.

To measure invented spelling, children are asked to write consonant-vowel-consonant words, such as "job" (Zhang et al., 2017). To write these words, children must undertake the process of sound-letter matching, the core element of spelling. Thus, this study uses word-writing as a measure of early writing. To address children's composing ability, tasks have been designed to encourage children to write a sentence. These include describing a picture (Rowe & Wilson, 2015), and writing a sentence that was provided orally by the administrator (Puranik & Lonigan, 2014). Importantly however, the latter does not require idea generation, which is central to composing. This study uses a story-writing measure adapted for younger children, where children are shown an illustration of animal characters and prompted to write what the

characters might be saying to each other (Gerde & Bingham, 2013). This requires the child to generate the ideas and record their own text.

While the above scoring approaches have been used for name-writing and word-writing, scoring for early composing has been less defined. Assessment of children's early story-writing ability is not only a more recent endeavor, but also less-studied. Older children's composing is commonly scored for number of words (writing fluency), number of clauses, and content and organization (writing quality) (Berninger & Fuller, 1992; Graham et al., 1997), as well as number of ideas and grammar elements (Graham & Harris, 1989).

Studies also differ in the number and type of writing tasks they use, mostly focusing on only one or two skills, such as name-writing and letter-writing (e.g., Gerde et al., 2012). A major issue with focusing on a select few skills is that children use different forms of writing when engaging in different tasks, such as using conventional letters in their names but scribbling a story (Sulzby & Teale, 1985). As such, this study uses a broad range of tasks that capture the full spectrum of a child's writing ability.

Typical measurement of self-regulation. Historically, children's self-regulation skills have been assessed through parent or teacher report along with a range of socioemotional abilities. The Child Behavior Checklist (CBCL; Achenbach & Rescorla, 2000) is one such assessment, a caregiver report form widely used to identify problem behaviors in children (e.g., upset by changes in routine, inattentive, unable to inhibit desires). Another is the Social Skills Improvement System (SSIS) Rating Scales (Gresham & Elliot, 2008), for which parents and teachers rate children's social skills (e.g., self-control, cooperation), competing problem behaviors (e.g., inattention, externalizing), and academic competence (e.g., reading and math achievement). While such parent and teacher reports are commonly used, there are concerns

regarding the ability of these second-person accounts to capture the actual self-regulatory abilities of children.

Studies have shown discrepancies between reports from teachers and teaching assistants (Wolcott & Williford, 2015), as well as between parents and teachers (Ladd & Burgess, 2001). Some of these discrepancies may arise from social desirability bias in parents (Fowler, 2002), or the quality of the child-teacher relationship for teachers (Hughes, Bullock, & Coplan, 2013). These differences raise concerns regarding reporter bias. The time at which teacher reports are taken during preschool may also affect accuracy, as teachers may not know children well enough at the beginning of the year to provide a comprehensive report on the child's behavior. Furthermore, inventories such as the CBCL (Achenbach & Rescorla, 2000) and SSIS (Gresham & Elliot, 2008) assess a great number of skills and deficits, many of which are not directly related to self-regulation such as somatic and sleep issues. In these measures, self-regulation is integrated into multiple subscales, and as such the measures do not represent pure assessments of self-regulation.

Fortunately, self-regulation can be measured through direct child assessment, and recent measures have been developed to do just that. However, the nature of behavioral self-regulation as a composite of working memory, inhibitory control, and cognitive flexibility yields challenges in accurate measurement of the construct as a whole. Several tasks have been designed to represent a single component of self-regulation, such as the Dimensional Change Card Sort Task (Frye, Zelazo, & Palfai, 1995; Zelazo, Frye, & Rapus, 1996; Zelazo et al., 2003) which claims to be a test of cognitive flexibility where children sort cards by one dimension (e.g., shape) and then must switch to another (e.g., color). The NIH Toolbox Flanker test (Slotkin, Nowinski, Hays, Beaumont, Griffith, Magasi et al., 2012) is designed to test inhibitory control as children

must indicate the direction a central fish is swimming while ignoring the multiple adjacent fish. The child-adapted Missing Scan Task, in which children must name a stuffed animal that is missing from the original set shown to them, targets working memory (Roman, Pisoni, & Kronenberger, 2014). However, debate ensues over the existence of such a "pure" assessment as at least two of the three components are likely at work to some degree in any given task (e.g., Miyake et al., 2000). For example, the DCCS requires rule-switching (i.e., cognitive flexibility), but children must also encode the first and second rules (i.e., working memory) prior to applying them.

Perhaps the most comprehensive, direct measure of child self-regulation is the Head Toes Knees Shoulders Task (Ponitz, McClelland, Matthews, & Morrison, 2009). In this task, children are required to perform physical responses that have been deemed the "opposite" of what the assessor prompts (e.g., "touch your head" requires the child to touch their toes). The HTKS task was designed to tap each of the components of self-regulation: working memory to remember the rules of the game, inhibitory control to perform the opposite behavior, and cognitive flexibility to change rules. The inclusion of each component of self-regulation within this task allows for a more comprehensive assessment of children's self-regulatory abilities than previously developed measures.

The Present Study

The present study first seeks to expand the literature by describing children's skills and growth in four widely used writing tasks. The field would benefit from a deeper understanding of how children write across commonly used writing tasks in preschool, and so the description of these various skills and their growth across the year is valuable. Second, this study seeks to examine the possible relations between those tasks and preschool self-regulation. While the

literature highlights the criticality of self-regulation for academic success (Blair, 2002; Blair & Razza, 2007; McClelland et al., 2007), and young children's writing development for literacy success (Hammill, 2004; NELP, 2008), few studies have investigated the effects of preschool self-regulation on writing development, though theoretically one is needed to execute the other.

To accomplish these aims, this study asks three main questions, 1) what are the characteristics of early writing across four widely-used tasks in fall and spring of the preschool year, 2) how is self-regulation related to writing for each task, and 3) how is self-regulation related to writing for each task over time? For the first question, we expected findings to show that children used predominantly scribbling and letter-like shapes in the fall, especially for word- and story-writing, and that by spring children had progressed to using letters and accurate forms for name- and letter-writing, but mostly letter-like shapes and letters for word- and story-writing. For the second question, study findings were expected to show that self-regulation is more related to story-writing than to word-writing or name-writing tasks, and more related to word-writing than name-writing due to the increasing complexity of the task and subsequent increase of cognitive load. For the third question, study findings were expected to show that this relation may change over time and is potentially strongest as the child is developing the specific skills needed.

Methods

Participants

This study used archival data taken from a larger study of 298 children, which used a planned missingness design with a lengthy battery of language, literacy, math, and executive function measures. In order to obtain a sample in which a sufficient number of children received all measures but to avoid overburdening children with testing, a percentage of children received executive function measures, a percentage received writing measures, and a percentage received both. This decision was made by center and was equally distributed across programs. Participating programs include Head Start, state-funded Pre-K, and university laboratory schools. These programs serve large populations of children in the U.S. and contribute ethnic and cultural diversity to the sample. Children were eligible for participation in the study if they met the following inclusion criteria: 1) age 3-5, 2) have no identified disability or delay, and 3) attend the respective program regularly to ensure successful data collection.

The present study included a sample size of 202 preschool children ages 3-5 attending early childhood programming in one U.S. state, representing children who were assessed on both writing and self-regulation. Participating children were between 34 to 70 months (M = 48.88, SD = 6.95), 50% male (n = 101). They were somewhat diverse with 52.5% Caucasian, 9.4% multiracial, 5.9% Asian, 2.5% African American, and 1% Hispanic or Latino (missing data 28%). Home languages included 60.4% English, and 1% or less of Arabic, Chinese, Korean, Spanish, Tamil, Telugu, and Urdu (missing data 33%). Education level of mother was considered an indication of socioeconomic status, with the majority holding a Bachelor's (22.7%), 14.9% Master's or Doctoral, 6.9% AA, AS, or 2-year degree, 16.3% some post-high school education (no degree), 5% high school diploma, 1% some high school but no diploma, and 1% other.

Procedures

This study used archival data gathered by a team of researchers during the 2011-2012 school year. Children/families were recruited through preschool programs. Directors provided researchers access to invite family participation. Families were recruited in one of two ways, 1) at a parent open house event at the start of school, or 2) through an informational letter sent home from school.

Research assistants, trained in the child assessment protocol, individually assessed children on their writing and self-regulation skills. Assessments occurred during the school day in a quiet space at the children's preschools (e.g., small office, hallway). Typically, research assistants entered classrooms during free choice, introduced themselves to children with consent, and engaged briefly in child-led play before inviting children to participate in the assessments. Assessment sessions lasted about 10-15 minutes per child. Assessments occurred in September/October reflecting the beginning of the school year and again in April/May at the end of the year. Data collection visits were pre-scheduled by phone or email.

Measures

Early writing. Young children's writing was examined using four writing tasks based on previous work by Diamond and colleagues (2008), and Gerde, Bingham, and Pendergast (2015). The tasks proceed in the following order: name writing, letter writing, word writing, and story writing.

***Name writing*.** Children were provided with a booklet of 8.5x11 blank sheets of paper. The assessor instructed the child to write their name. The assessor then labeled the page with "name," noted the direction of the top of the page when the child was writing, and noted the direction of the writing from the first letter or shape to the last. If letters/shapes were written all

around the page, the assessor marked each with a number indicating their order. If a child indicated that they made a mistake, they were permitted to begin again on the same page or on the back of that page. The highest form of name writing was coded as 1 = drawing/scribbling, 2 = letter-like shapes, 3 = incomplete name or inaccurate letters, 4 = accurate spelling of name.

Letter-writing. Children were instructed to write 10 letters one at a time as the assessor dictated the letters: T, B, H, M, S, A, D, C, J, and P. Letter writing was coded the same as name writing: 1 = drawing/scribbling, 2 = letter-like shape, 3 = incomplete or inaccurate letter, 4 = accurate letter. The highest form that each child produced across all ten letters was used in analyses.

Word writing. Children were instructed to write 5 CVC words one at a time as the administrator dictated the words: sad, hug, lip, net, and job. The highest form that each child produced across all five words was used in analyses, and was coded as 1 = drawing/scribbling, 2 = letter-like shapes, 3 = incomplete or inaccurate letters (no accurate sounds), 4 = initial or advanced sounds, 5 = accurate.

Story writing. The assessor turned to a picture showing two raccoons, with a speech bubble projecting from the larger of the two. Children were reminded, “In books text bubbles include words characters say or think,” then prompted to “write what you think Mama Raccoon might be saying or thinking in the picture.” When the child finished, the assessor noted the direction of the writing with an arrow or numbers. The assessor then asked, “Can you tell me what you wrote so I can remember?” and noted the child’s response. The story was coded for the highest form of writing present with the same coding as word writing: 1 = drawing/scribbling, 2 = letter-like shapes, 3 = incomplete or inaccurate letters (no accurate sounds), 4 = initial or advanced sounds, 5 = accurate.

Reliability for all coding. Consistent with previous work, research assistants coding writing tasks were trained to reliability by reading the definitions of all codes and coding practice items and then test sets with master codes. To achieve reliability, coders were required to achieve 95% reliability on two consecutive sets of 10 writing samples with the master codes. In addition, 20% of writing samples were double-coded and reliability for these samples exceeded 90%.

Behavioral self-regulation. The Head Toes Knees Shoulders task (Ponitz et al., 2009) was used to assess behavioral self-regulation for children. Evidence for the construct validity, predictive validity, reliability, and inter-rater reliability of the HTKS is strong (McClelland, Cameron, & Duncan et al., 2014). Reflecting construct validity, relations between HTKS and Dimensional Change Card Sort task (reflecting cognitive flexibility), WJ-III Working Memory subtest, Day-Night Stroop (reflecting inhibitory control), and Simon Says (reflecting inhibitory control) all correlated both fall and spring with HTKS between *r*s = .27 and .60 ($p = .001$). For predictive validity, HTKS predicted academic outcomes in preK ($\beta = .4$, $p = .007$). In terms of reliability, inter-rater agreement on HTKS is 92.29% and test-retest reliability on HTKS is .6 ($p < .001$) in preschool, .74 ($p < .001$) in kindergarten (McClelland et al., 2014).

To administer this measure, the assessor indicates that they will play a game in which the child will do the opposite of what the assessor prompts (e.g., “touch your head” requires the child to touch their toes and vice versa). In the second portion of the task, children are taught another two prompts (shoulders and knees), and are finally required to perform both pairs of opposites together. The HTKS task was designed to tap each of the components of self-regulation: working memory to remember the rules of the game, inhibitory control to perform the opposite behavior, and cognitive flexibility to change rules. The task includes 20 test items, with the first 10 testing performance on the initial pair of opposites, and the second 10 testing

performance on both pairs of opposites together. Child responses for each training, practice, and testing section are coded as 0 – incorrect, 1 – self-correct, and 2 – correct, with higher scores indicating greater self-regulation (range 0-60). Two parallel forms (A and B) ensure that commands are counter-balanced. Form A begins with head and toes, Form B with shoulders and knees. The task takes between 5 and 7 minutes to administer. RAs served as assessors.

Data Analysis

To address the first research question, "What are the characteristics of early writing across four widely-used tasks in fall and spring of the preschool year?", writing was examined through descriptive statistics, frequencies, and histograms. Then, due to the ordinal nature of the data, Spearman correlations and a series of ordinal logistic regressions were used to answer research questions two and three regarding the relation of self-regulation to each writing task and this relation over time, respectively. Analyses were performed using SPSS.

Results

Characteristics of Early Writing

The data for children's name, letter, word, and story writing are ordinal, therefore I describe the distributions using frequencies and histograms. Table 1 shows descriptive statistics for each writing variable in the fall and spring. Children had an average of five letters in their name, however they ranged from three to nine (M = 5.52, SD = 1.40), such as Eli and DariJuana (pseudonyms). For name writing in the fall, 22.3% of children were scribbling their names, 23.3% of children wrote their names with letter-like shapes, the majority of children (42.5%) wrote their names with incomplete or inaccurate letters, and far fewer, 11.9%, spelled their names correctly (Figure 1). On average, about half of children (48%) correctly wrote the first letter of their names, 49% of children wrote their names horizontally, and 65% of children wrote from left to right.

By spring, the trend in name writing shifted to reveal growth, with only 4.5% of children scribbling their names (Figure 2). Some children (14.5%) wrote their names with letter-like shapes, most children (44.1%) were now writing their names with incomplete or inaccurate letters, and 36.9% of children were writing their names accurately. On average, 72.6% of children correctly wrote the first letter of their name. In terms of linearity, 75.4% of children wrote their names horizontally, and most children wrote their names from left to write.

For letter writing in the fall, 13% of children were scribbling letters, some children (23.4%) were writing with letter-like shapes, only 6.8% of children wrote inaccurate letters, and over half (56.8%) of children were writing the correct letter forms for at least one letter (Figure 3). By spring, only 2.2% of children were scribbling letters, and only 11.7% of children were using letter-like shapes (Figure 4). Even fewer children (2.8%) were writing inaccurate letters,

and the vast majority of children (83.2%) were writing accurate letter forms for at least one letter.

In terms of fall word writing, 27.1% of children were scribbling words, the majority of children (42%) were using letter-like shapes, only 16.6% of children used at least some letters (but no accurate sounds), and even fewer (13.8%) represented sounds in their writing (Figure 5). Almost none of the children (0.6%) spelled words accurately. On average, most of these children did not write words horizontally or linearly (for example, 29% wrote "sad" horizontally, 27% wrote "sad" linearly), and almost no children reproduced the first letter of each word (e.g., 5% wrote the first letter of "sad"). By spring, word-writing was more balanced across categories, with 13.7% of children scribbling words and 17.1% of children using letter-like forms (Figure 6). Slightly more children (25.7%) wrote words with letters (but no accurate sounds), the majority of children (39.4%) included sounds in their writing, and very few children (4%) produced accurate spelling of words. On average, about half of children wrote words horizontally and over half wrote words linearly (e.g., 57% wrote "sad" horizontally, and 61% wrote "sad" linearly). As in the fall, very few children on average reproduced the first letter of each word (e.g., 19% wrote the first letter of "sad").

Children struggled with story-writing in the fall. About half the children (52.7%) scribbled their stories, 20% of children wrote stories with letter-like shapes, 22.7% of children used letters (but no accurate sounds) in their story writing, and only 3.3% of children represented sounds in their story writing (Figure 7). Almost none of the children (1.3%) used correct spelling in their story writing. Children produced an average of 1 letter in their stories (M = 1.09, SD = 2.11), and generally did not produce different letters (M = .87, SD = 1.46). Children represented almost no sounds on average in their stories (M = .26, SD = 1.52), and generally did not produce

phonemic or invented spelling words (*M* = .02, *SD* = .19). Children also did not tend to write name words (e.g., their own name, mom, dad) (*M* = .01, *SD* = .08), spell words correctly (*M* = .03, *SD* = .32), or use punctuation and space between words (*M* = .01, *SD* = .08).

In the spring, children showed some improvement, with 24% of children scribbling stories and 22.7% of children writing with letter-like shapes (Figure 8). The majority of children (42.7%) wrote with letters (but no accurate sounds), only 7.3% of children used sounds in their story writing, and 3.3% spelled the words in their stories correctly. Children represented more sounds on average in the spring than they did in the fall (*M* = .64, *SD* = 2.57), but still did not tend to produce phonemic or invented spelling words (*M* = .15, *SD* = .66) or name words (*M* = .01, *SD* = .08). In addition, almost no children spelled words correctly (*M* = .07, *SD* = .59) or used punctuation and space between words (*M* = .03, *SD* = .16).

Relations Between Self-Regulation and Writing Tasks

To answer research question two, *How is self-regulation related to writing for each task?*, we first examined the descriptive statistics of the independent variable, HTKS, and the correlations between this variable and each writing task. No prominent outliers were identified for HTKS in the fall or spring, however 32% of children scored a zero in the fall indicating floor effects, which the scatterplot indicated was not related to age. For the HTKS task in the fall, children varied widely on their scores (*M* =10.78, *SD* = 13.06). Statistics were similar for HTKS in the spring (*M* =14.89, *SD* = 14.90). Table 2 shows Spearman correlations between children's HTKS scores in the fall and spring and the four writing tasks in the fall and spring. Correlations showed self-regulation in the fall was significantly correlated with each writing task in the fall (*r*s .279-.456). Fall self-regulation was also significantly correlated with spring name and word

writing, but not letter or story writing. In the spring, self-regulation was correlated with all four writing tasks (*r*s .247-.415).

An ordinal logistic regression analysis was performed on children's fall name writing as outcome and children's fall scores on the HTKS task as predictor. Table 3 shows regression coefficients, Wald statistics, odds ratios, and 95% confidence intervals of the odds ratios for the predictor. The Nagelkerke Pseudo R^2 = .129. Children's fall HTKS score was found to be a statistically significant predictor of fall name writing. The odds ratio was 1.05, indicating that every one unit difference in HTKS score was associated with being 1.05 times more likely to be in a higher category for name writing. As such, for example, for a 1 standard deviation difference (*SD* = 13.06) in HTKS score, children would be 1.89 times more likely to be in a higher name writing category.

The same analysis was performed on children's fall letter writing as outcome and children's fall scores on the HTKS task as predictor (see Table 3). The Nagelkerke Pseudo R^2 = .122. Children's fall HTKS score was found to be a statistically significant predictor of fall letter writing. The odds ratio was 1.06, indicating that every one unit difference in HTKS score was associated with being 1.06 times more likely to be in a higher category for letter writing. As such, for example, for a 1 SD difference (*SD* = 13.06) in HTKS score, children would be 2.19 times more likely to be in a higher name writing category.

To examine potential relations between HTKS and children's fall word writing, another ordinal logistic regression was performed with children's fall word writing as outcome and children's fall scores on the HTKS task as predictor (Table 3). The Nagelkerke Pseudo R^2 = .113. Children's fall HTKS score was found to be a statistically significant predictor of fall word writing. The odds ratio was 1.05, indicating that every one unit difference in HTKS score was

associated with being 1.05 times more likely to be in a higher category for word writing. As such, for example, for a 1 SD difference (*SD* = 13.06) in HTKS score, children would be 1.87 times more likely to be in a higher word writing category.

The same analysis was performed on children's fall story writing as outcome and children's fall scores on the HTKS task as predictor (Table 3). The Nagelkerke Pseudo R^2 = .187. Children's fall HTKS score was found to be a statistically significant predictor of fall story writing. The odds ratio was 1.065, indicating that every one unit difference in HTKS score was associated with being 1.07 times more likely to be in a higher category for word writing. As such, for example, for a 1 SD difference (*SD* = 13.06) in HTKS score, children would be 2.28 times more likely to be in a higher word writing category.

Longitudinal Relations Between Self-Regulation and Writing

To answer research question three, *how is self-regulation related to writing for each task over time?,* an ordinal logistic regression analysis was performed on children's spring name writing as outcome and two predictors: children's fall scores on the HTKS task and, to account for children's initial writing skill, fall scores on name writing. Analysis was performed using SPSS. The model was statistically significant for fall HTKS predicting spring name writing. However, when fall name writing was added to the model as a predictor, fall HTKS was no longer a statistically significant predictor (see Table 4). This indicates that while fall HTKS predicts the level of name writing in the spring, it does not predict the change in name writing scores over time. This was also the case for letter and story writing; when children's fall scores were added to each respective model as a predictor, fall HTKS was no longer a statistically significant predictor of spring writing.

Word writing, however, proved to be an exception to this pattern. Table 4 shows regression coefficients, Wald statistics, odds ratios, and 95% confidence intervals for the odds ratios for the predictor. The Nagelkerke Pseudo R^2 = .393. Children's fall HTKS score was found to be a statistically significant predictor of spring word writing, even when accounting for children's fall word writing. The odds ratio was 1.05, indicating that every one unit difference in HTKS score was associated with being 1.05 times more likely to be in a higher category for word writing. As such, for example, for a 1 SD difference in HTKS score, children would be 1.89 times more likely to be in a higher word writing category.

Discussion

This work expands the literature in three important ways. First, this study provides valuable insight into children's performance on a diverse set of common writing tasks across the preschool year along nearly identical scales. Second, this study sheds light on the differential relations between self-regulation and each writing task across the preschool year. Third, the use of ordinal data in this study provides a unique examination of relations between self-regulation and early writing that does not assume increasing value or equal distance between levels of development.

The present study provides an expansive, in-depth description of longitudinal early writing data. Previous work examining writing in similar depth has been cross-sectional (e.g., Puranik & Lonigan, 2011), and previous longitudinal studies have focused narrowly on one or two writing tasks (e.g., Diamond et al., 2008). My work, however, evaluates children's growth and ability on multiple diverse tasks designed to capture the full spectrum of development across the preschool period. Children demonstrated growth in their level of writing from fall to spring in each of the four tasks, indicating that even very young children can develop this variety of skills across the year. Growth in name writing was particularly evident, with three times as many children spelling their names accurately in the spring (36.9%) as in the fall (11.9%). This is similar to previous work identifying significant growth from fall (7%) to spring (39%) (Diamond et al., 2008).

This study used nearly identical coding schemes, contrary to previous work, which allowed me to compare children's performance across writing tasks. Among the tasks, word and story writing were most difficult for children in the fall and remained more difficult than name and letter writing in the spring. This is consistent with previous findings indicating that children

write their names and letters in both fall and spring with greater proficiency than more difficult forms of writing such as those elicited through invented spelling tasks (Zhang et al., 2017). This finding is unsurprising, as word and story writing require children to grapple with sounds and combinations of multiple letters, while name and letter writing demand less of children. This was also evident in children's tendency to correctly write the first letter of their name in spring, while their ability to reproduce the first letter of words—which required them to sound out the letter prior to writing it—lagged far behind. Children's mastery of the first letter of their name is expected, given that name letters (and particularly the first letter of children's names) are often the first letters they produce (Treiman et al., 2001). Consequently, children's struggle to write the first letter of words as compared to their ability to reproduce that of their name may suggest that children do not tend to use letter-sound correspondence in name writing, consistent with previous work indicating that children do not recognize the letters or sounds they have represented in their names (Drouin & Harmon, 2009). This has been reflected in studies with both typically-developing children (Welsch et al., 2003) and children with language impairment (Cabell et al., 2009), as well as children who use non-English languages (Levin, Both-De Vries, Aram, & Bus, 2005). Thus, this study adds weight to the assertion that young children are not necessarily using phonological awareness when writing their names (Bialystock, 1995; Bus et al., 2001), and instead depend upon logographic conceptualization in which their name is more akin to a picture than individual letters.

While some children demonstrated knowledge of print concepts—skills emphasized in the conceptual knowledge dimension of Puranik and Lonigan's (2014) theoretical framework—by using horizontal and linear writing to produce their names and words in the fall, by spring most children were writing horizontally and linearly. In alignment with this study's findings,

previous work has indicated that print concepts develop early and grow across the year (Puranik & Lonigan, 2011). Notably, in this sample, children's use of these print concepts appeared to depend slightly on the writing task. More children wrote horizontally and linearly in their name writing than their word writing in both fall and spring. However, the number of children exhibiting knowledge of these print concepts increased similarly in both name and word writing across the year. This may indicate that, while these skills are particularly accessible to children during name writing, children may be generalizing this skill across tasks. It is certainly clear that children are developing knowledge of print concepts early.

Letter-writing appeared to be a particularly accessible task for children, with over half writing accurate letter forms in the fall and almost all children producing correct forms in the spring. In this sample, the number of children accurately writing at least one letter in the fall (56.8%) even exceeded those accurately writing their names (11.9%), and this was true in the spring as well with more children writing at least one letter accurately (83.2%) than children writing names accurately (36.9%). These differences, however, likely reflect the amount of writing required by the child within each task, given that children's names consist of multiple letters instead of just one. This is also evidenced by the finding that about the same number of children correctly wrote the first letter of their name in fall (48%) and spring (72.6%) as the number of children who accurately wrote at least one letter in fall (56.8%) and spring (83.2%).

While children struggled with word writing overall, more children used letters in the spring than in the fall as they wrote words, indicating an increase both in children's ability to produce letters and their understanding that words should contain distinct letters (as opposed to scribbles or pictures), even if children are not certain exactly which letters to include. This finding is consistent with previous work indicating that while this task is difficult for children,

improvement is evident across the year (Zhang et al., 2017). As such, it is important to acknowledge that despite the challenging nature of this task, children are developing skills in word writing across the preschool year. Notably, the number of children including sounds in their words nearly tripled from fall to spring, and children excelled at using sounds in this task in comparison to story writing in both fall and spring. This was particularly evident in the spring, with nearly 40% of children using sounds to write words but only 7.3% of children using sounds to write stories. This dramatic difference is likely due to the open-ended nature of story-writing, in which children can verbalize words with many letters, any number of words, or even sentences and are then prompted to write their verbalization. This may result in children becoming overwhelmed as they attempt to reproduce their own verbalization on paper, as opposed to writing the single CVC word prompt in the word writing task. In addition, children who confidently write their names and letters may revert to a lower level of sophistication when faced with a particularly challenging writing task such as story-writing (Sulzby & Teale, 1985).

Children's development of story writing is a particularly important addition to the literature. Previous work using tasks that require children to compose has indicated that children struggle with this skill, and floor effects have been observed with young children in particular (Puranik & Lonigan, 2011). Story writing appeared to be challenging for children in the current study as well, as indicated by the minimal number of sounds and letters and the general lack of words, names, punctuation and spacing in children's stories. However, children did show growth in their story writing skills, most notably with the number of children using letters doubling from fall to spring. Children also represented over two times more sounds in spring than they did in the fall. As such, while it was difficult for children to generate the more open-ended written products required by a story writing task, their attempts reveal improvement.

The variety of tasks in this study spans the writing abilities represented across the existing theoretical frameworks (Berninger, 2000; Kaderavek et al., 2009; Puranik & Lonigan, 2014), and offers a comprehensive view of children's writing by allowing children to use their emergent handwriting, spelling, and composing skills to generate different written products. Children's improvement in each task across the year also demonstrates that these writing tasks are developmentally appropriate in preschool and thus can provide insight into children's growth and ability. In particular, our in-depth examination of children's performance on story and word writing assessments in this study provides information previously inaccessible in the literature. As such, future studies should seek to include assessments that give children the opportunity to use composition-related skills. This can provide a more comprehensive look at early writing by allowing children the freedom to write what they want and would be likely to produce. Given that children still vary widely in their demonstration of writing skills across these four tasks, understanding how self-regulation relates to each task remains important.

Differential Relations to Self-Regulation

The Spearman correlation with ordinal data showed relations between self-regulation and each writing task in the fall, and between self-regulation and each task in the spring, similar to previous work conducted with continuous data (Gerde et al., 2012; Zhang et al., 2017). However, fall self-regulation only correlated with spring name and word writing. While self-regulation predicted children's outcomes on each task in the fall, this relation was not found for the spring while controlling for children's fall scores. This finding aligns with previous work indicating that children's initial writing level may be more important for their ongoing writing development than their self-regulatory ability (Gerde et al., 2012; Kegel & Bus, 2014; Ouellette & Sénéchal, 2008; Zhang et al., 2017).

Children's writing skills at preschool entry tended to be highly stable across time, such that children remained in their rank order from fall to spring. That is, children who performed low in the fall tended to remain low in comparison to peers who performed higher in the fall and remained higher in the spring. Given that children's level of writing in the fall of preschool seems to define their growth and that quality learning environments are critical for language and literacy prior to preschool entry (Connor & Morrison, 2006; Hart & Risley, 1995; Sénéchal & LeFevre, 2002; Son & Morrison, 2010), it is important to consider both how parents support children's skills at home prior to entering preschool and how teachers support children's skills across the preschool year.

In terms of the home environment, we know that parent levels of writing support are predictive of preschooler's decoding skills and phonological awareness (Skibbe, Bindman, Hindman, Aram, & Morrison, 2014), as well as fine motor skills (Bindman, Skibbe, Hindman, Aram, & Morrison, 2014). However, little is known about how parents support young children's writing development in the home environment. Existing studies have shown that parents typically offer strategies narrowly focused on print concepts, such as producing the letter form for the child without providing instruction (Bindman et al., 2014; Skibbe et al., 2014). Parents also tended to offer low levels of support, such as simply saying the target word aloud while the child attempted to write it. Given that parents are relying upon only one or two of these strategies with children, parent support in the home is likely insufficient to help children learn the variety of skills necessary for writing development.

The stability of children's writing skills may also suggest that teacher practices are not profoundly affecting children's writing development. This implication is not surprising, given work demonstrating that teacher practices regarding appropriate modeling and discussion of

writing rarely aligned with research-based practices, even when teachers were trained on these strategies (Hindman & Wasik, 2011). In addition, teacher practices generally include providing materials and supports for handwriting, but few supports for developing children's composing or spelling skills (Bingham, Quinn, & Gerde, 2017; Gerde et al., 2015). On the whole, it seems that both teachers and parents are doing little to support early writing, despite the repeatedly demonstrated criticality of this skill and that standards from NAEYC (Copple & Bredekamp, 2009) and the Common Core State Standards (Common Core Standards Initiative, 2012) exist to guide teaching practice. The lack of appropriate knowledge and practice by teachers and parents with regard to early writing for young children is a particular concern given national reports revealing that the vast majority of elementary and middle school students are failing to write at a proficient level (NCES, 2002; NCES, 2012).

A Case for Ordinal Measurement

Children's development of skills across these tasks was evident even as we have characterized writing in an ordinal way, instead of the continuous approaches commonly used in the literature (e.g., Rowe & Wilson, 2015; Diamond et al., 2008; Puranik et al., 2011). Continuous coding assumes increasing value and equal distance between levels of development, which may not accurately reflect development given that the relative importance of certain features of early writing remains unknown. A great deal of work has attempted to identify these phases (Bloodgood, 1999; Hildreth, 1938; Liberman, 1985; Sulzby & Teale, 1985), and our work aligns with these same phases of drawing and scribbling, letter-like shapes, fully-formed letters, use of sounds, and conventional spelling. However, while previous studies have simply assumed that these phases would lead to this rank order of task difficulty, this work finally identifies that order. In both fall and spring, children scored highest in letter writing, then name, then word, and

lowest in story writing. Thus, it is clear that our ordinal approach to these data is appropriate, and that we have articulated these categories in the accurate order. It is critical to note that confirming this order was only possible because we coded each of the four tasks on nearly identical scales, enabling them to be compared, while previous work using multiple tasks has been coded in ways that do not allow for comparison across tasks (e.g., Zhang et al., 2017; Puranik et al., 2018).

By using ordinal data, this study has acknowledged the unidentified nuances of early writing development, and thus sought to provide more accuracy in measurement. What remains unknown, however, is whether the identified categories are equidistant, or if other categories exist. Future research needs to further explore the potentially continuous nature of these categories. However, until we test whether this is the accurate and meaningful developmental progression of early writing, we should be measuring these categories with ordinal data.

Educational Implications

It seems that teachers are preparing children well for name and letter writing, as children have a sense of name and letter writing across the year. They struggle far more however with opportunities to write their compositions or dictated words, which provides an excellent opportunity for teachers to focus on these areas. However, while children in the current study had difficulty with the productive or writing aspect of composing, the generative element of composing is an excellent way to begin writing instruction as all children have ideas they want to communicate (Kissel, Hansen, Tower, & Lawrence, 2011). Even children who cannot write letters can compose, which allows teachers to draw attention to print concepts or letter-sound correspondence by modeling the writing of letters based on the child's composition. For children who are writing letters, the composing process gives them an opportunity to use their letters in a

meaningful way to create a message. Research has indicated that offering authentic opportunities to compose is particularly valuable, as these opportunities provide children with a motivating purpose to write that reflects real-world use (Duke, Purcell-Gates, Hall, & Tower, 2006; Neuman, Roskos, Wright, & Lenhart, 2007). Children may generate a list of questions about fish as the class begins a study of ocean life, write mail to students in neighboring classrooms, or create books about their interests to share with the class. These authentic writing experiences engage children while providing opportunities for teachers to support their spelling and composing skills. The benefit of such opportunities has been observed by Bingham and colleagues (2017), who found that children in classrooms where teachers offer composing opportunities and scaffolds to encourage composing have stronger writing skills by the end of preschool.

Limitations

It is important to acknowledge a few limitations of this study. Although the direct measure of self-regulation used in this study was both comprehensive (Ponitz et al., 2009) and psychometrically sound (McClelland et al., 2014), we recognize that it was challenging for this young sample such that many children struggled in the fall. However, the distribution was such that the task still functioned appropriately within the models.

While our story-writing task allowed children to use their handwriting, spelling, and composing skills, it's important to acknowledge that we coded for transcription as an outcome rather than the oral composition itself. This was essential to enable comparison across the four target tasks, as the other tasks cannot be examined for composing or generative knowledge. However, initial work has begun to examine the ideas children generate (Rowe & Wilson, 2015) to shed more light on how to assess this particularly intangible construct. Future work might

code for children's verbal output as they plan their writing, and again after they have written their product, to get a sense of the relation between oral language composition and written production.

Finally, we recognize that the planned missingness design reduced the sample size available for analysis with certain tasks. However, the sample size remained sufficient for the analyses used.

Conclusions

Study findings indicated that children's performance across a comprehensive set of four writing tasks improves from fall to spring of the preschool year, demonstrating that these tasks are developmentally appropriate in preschool and can thus provide insight into children's writing skill and growth. The unique and accurate use of ordinal data with nearly identical coding scales reveals a rank order for these tasks, which remains consistent in both fall and spring. This rank order follows, from least to most difficult: letter writing, name writing, word writing, and story writing. Self-regulation appears to be related to young children's writing, both in fall and spring as well as across time. However, children's initial writing level may be more important for their ongoing writing development than their self-regulatory ability. This indicates that what parents do at home is critical for preparing young children for school entry. The stability of children's writing scores across the year further indicates that teachers should be enhancing their practice to promote maximum growth in children's skills throughout the preschool period.

APPENDICES

APPENDIX A: Tables

Table 1. *Means and Standard Deviations for Writing Tasks in Fall and Spring*

Variable	Fall		Spring	
	M	SD	M	SD
Name	2.44	0.97	3.13	0.82
Letter	3.07	1.15	3.67	0.77
Word	2.19	1.00	3.03	1.13
Story	1.81	0.99	2.43	1.04

Table 2. *Correlations of Writing Tasks with Self-Regulation*

	1	2	3	4	5	6	7	8	9	10
1. Fall HTKS	--									
2. Fall Name	.344**	--								
3. Fall Letter	.279**	.660**	--							
4. Fall Word	.335**	.499**	.574**	--						
5. Fall Story	.456**	.475**	.456**	.540**	--					
6. Spring HTKS	.415**	.519**	.465**	.318**	.460**	--				
7. Spring Name	.307**	.495**	.522**	.323**	.359**	.396**	--			
8. Spring Letter	.083	.391**	.450**	.139	.212*	.322**	.391**	--		
9. Spring Word	.381**	.578**	.545**	.445**	.410**	.415**	.585**	.443**	--	
10. Spring Story	.192	.416**	.415**	.338**	.375**	.247*	.447**	.266**	.588**	--

Note.
* . Correlation is significant at the 0.05 level (2-tailed).
**. Correlation is significant at the 0.01 level (2-tailed).

Table 3. *Ordinal Logistic Regression Models Predicting Fall Writing Task Performance*

Variable	β	Wald	Odds Ratio	95% Confidence Interval	
				Lower	*Upper*
Name	.666	10.77	1.89	1.30	3.08
Letter	.784	8.24	2.14	1.30	4.39
Word	.627	9.02	1.89	1.30	2.73
Story	.823	10.02	2.42	1.30	4.39

Table 4. *Ordinal Logistic Regression Models Predicting Spring Writing Task Performance*

Variable	β	Wald	Odds Ratio	95% Confidence Interval	
				Lower	*Upper*
Name	.392	2.38	--	.901	2.40
Letter	-.313	.630	--	.334	1.60
Word	.640	5.06	1.89	1.08	3.33
Story	-.078	.069	--	.520	1.64

Note. Odds ratios are not calculated or reported for models that did not reach significance.

APPENDIX B: Figures

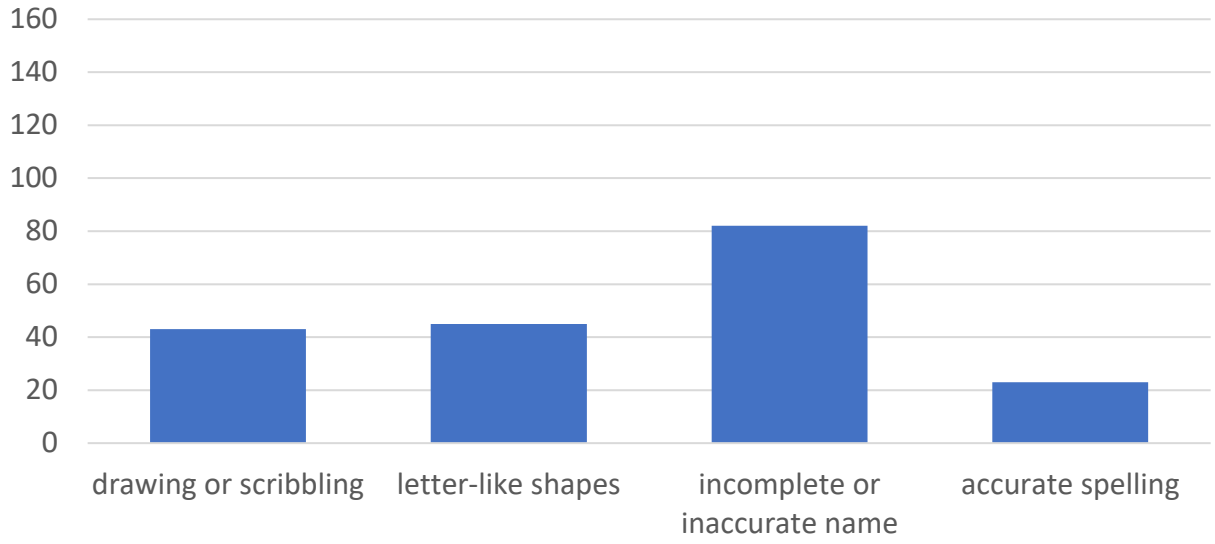

Figure 1. Fall name writing frequencies.

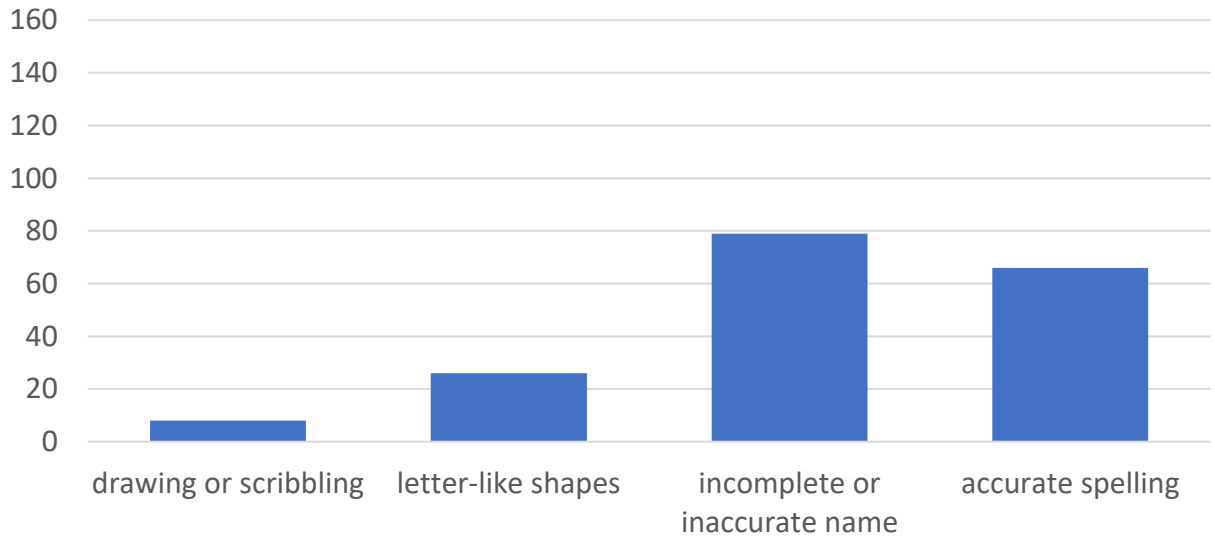

Figure 2. Spring name writing frequencies.

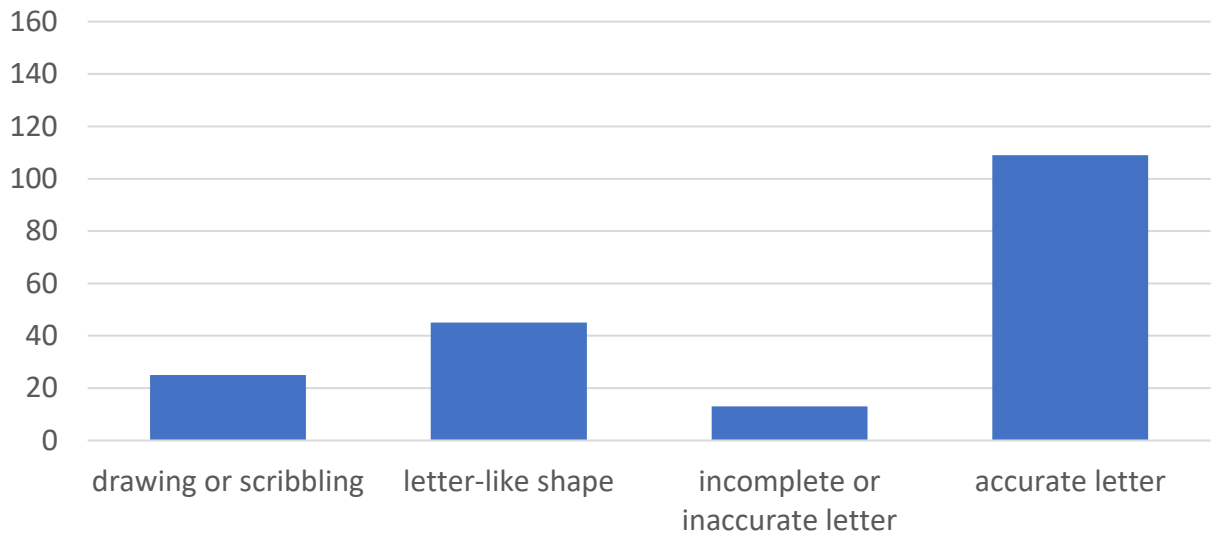

Figure 3. Fall letter writing frequencies.

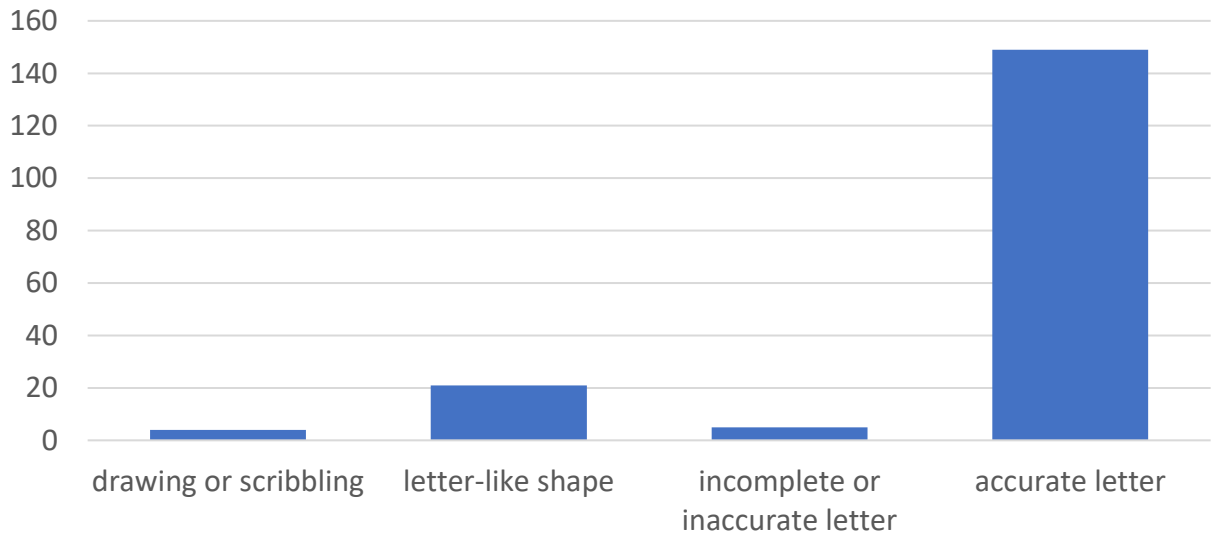

Figure 4. Spring letter writing frequencies.

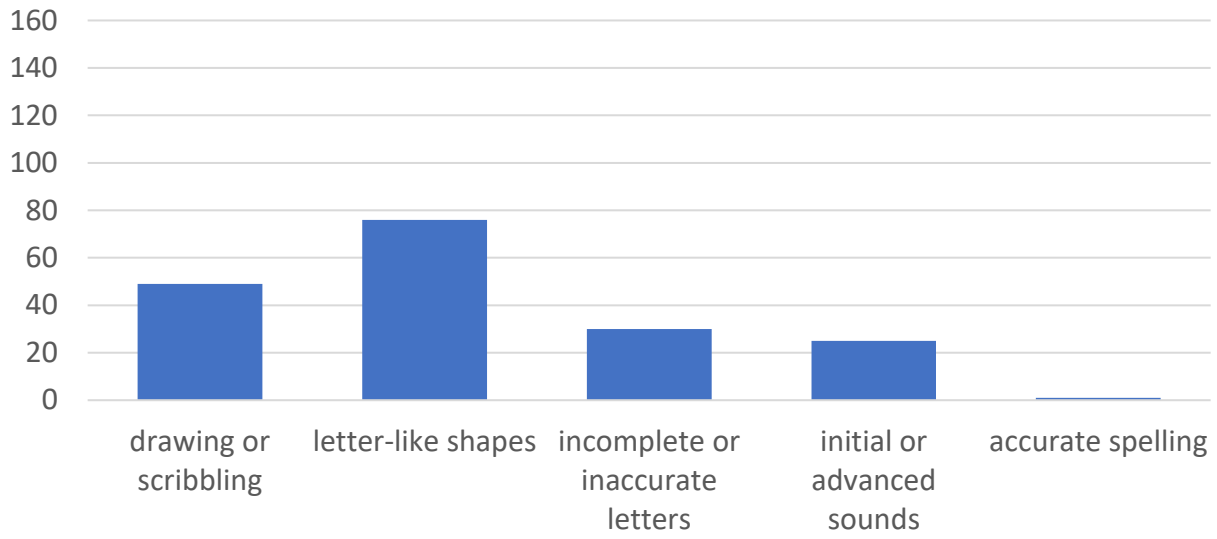

Figure 5. Fall word writing frequencies.

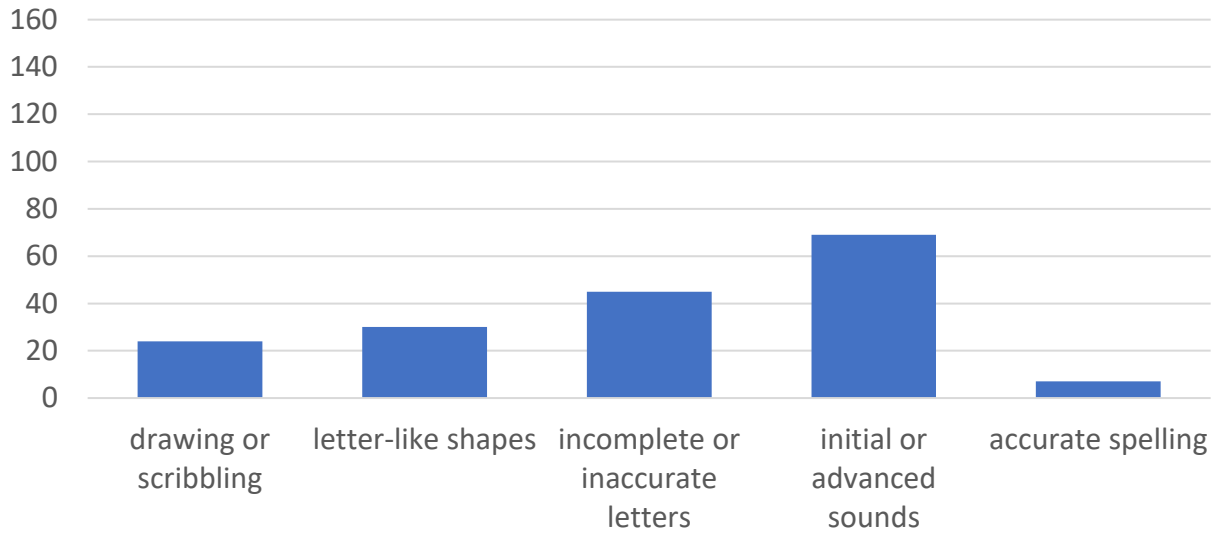

Figure 6. Spring word writing frequencies.

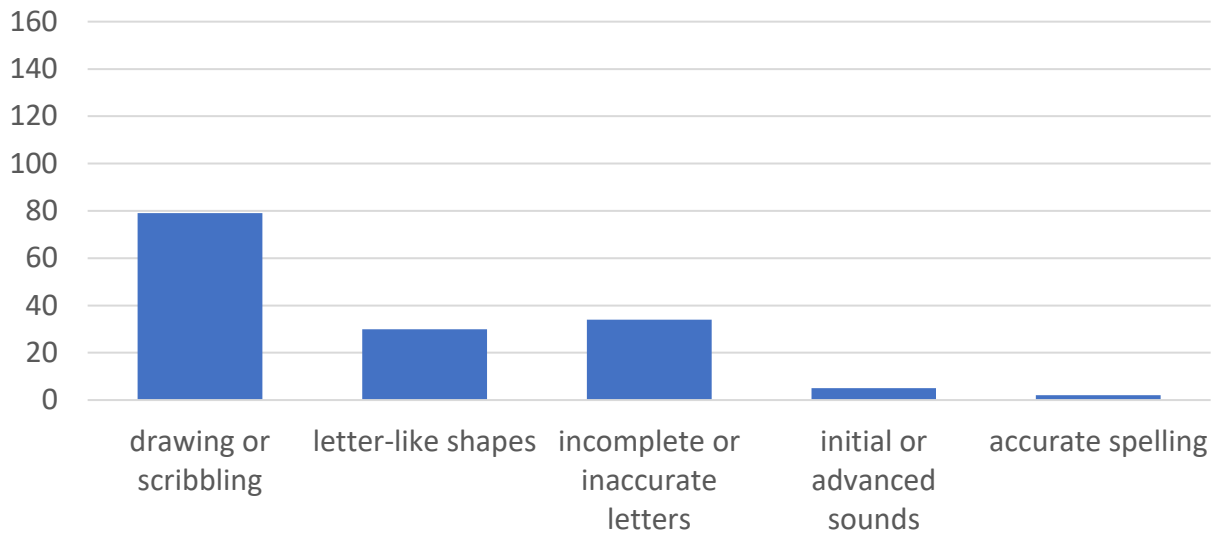

Figure 7. Fall story writing frequencies.

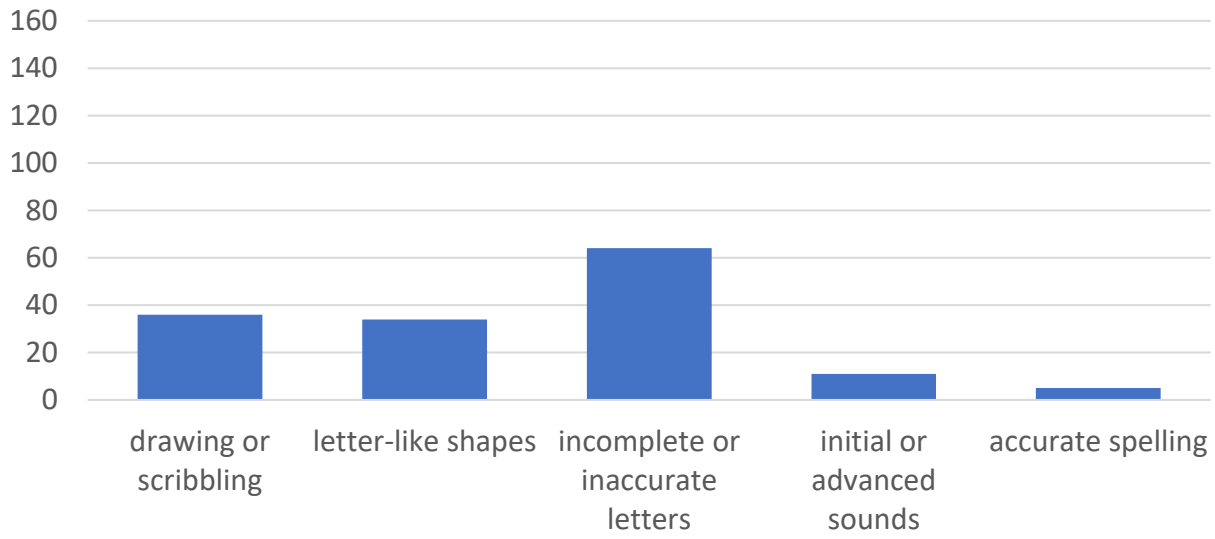

Figure 8. Spring story writing frequencies.

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