Relations between self-regulation and early writing: Domain specific or task dependent?

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A B S T R A C T

Research has established that self-regulation plays an important role in early academic skills such as math and reading, but has focused less on relations with other early skill domains such as writing. The purpose of the present study was to extend that line of research by assessing the relation between self-regulation and early writing. Participants for Study 1 included 161 preschool and 139 kindergarten children. Participants for Study 2 included 274 kindergarten children. Participants in both studies were assessed using a direct measure of self-regulation (Head-Toes-Knees-Shoulders task; Cameron Ponitz et al., 2009) and a variety of writing measures. Results indicated that self-regulation was significantly and positively related to aspects of early writing; however, there are grade differences in the aspects of writing to which it relates. Most importantly, the pattern of results indicated that the relation between self-regulation and early writing is dependent on the specific type of task and the nature of the task used to measure a given skill. This finding has important implications not only for examining the role of self-regulation and writing, but also for other academic skills.

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1. Introduction

Writing is a complex task. To produce a written product, a child must first generate an idea. Then they must draw upon semantics to convert the idea into language. Finally, they must translate the idea into written language, which at its most rudimentary level draws on children's fine motor skills, letter-writing skills, and knowledge of letter–sound correspondence. Past research has indicated that cognition (Hayes, 1996; Puranik & Lonigan, 2012), oral language (Berninger et al., 2006; Dyson, 1983; Hooper et al., 2011; Kim et al., 2011; Puranik & Al Otaiba, 2012), and transcription skills (Bourdin & Fayol, 1994; Bourdin, Fayol, & Darciaux, 1996; Graham & Harris, 2000; Olive & Kellogg, 2002) contribute to this complex process for young beginning writers.

Beyond cognitive–linguistic components, behavioral components are also crucial considerations that can impact a child's writing. One behavioral component, self-regulation, is a key contributor to the success of skilled writers (Graham & Harris, 2000). As illustrated in prominent cognitive models of writing (Hayes & Berninger, 2009; Hayes & Flower, 1980, 1987Hayes & Flower, 1980, 1987), the writing process is constrained by memory and supported by self-regulation. As writers mature, self-regulation skills become increasingly important for planning, reviewing, and revising text. Although young, emergent writers do not engage in higher-level planning and organizing while writing, they are faced with other unique challenges such as learning to write their names, learning to write letters, and spell words. Preliminary evidence by Gerde, Skibbe, Bowles, and Martoccio (2012) suggests that self-regulation may play an equally important role in emergent writing as it does for developed writing. The goal of the current study is to further examine the relation between self-regulation and emergent/early writing.

1.1. Self-regulation

Self-regulation refers to a person's ability to focus attention, manage thoughts and emotions, and inhibit some behaviors in favor of other less-dominant behaviors (McClelland & Cameron, 2012; Rimm-Kaufman & Wanless, 2012). In young children, it is generally assessed by measures that require the integration of inhibitory control, attentional flexibility, and working memory (McClelland & Cameron, 2012). Because self-regulation is a multi-dimensional construct that requires controlling and directing one's actions, emotions, attention, and thinking, it takes years to develop

(Wanless et al., 2016). Although self-regulation develops over many years, it shows rapid growth potential in early childhood (Wanless et al., 2016). In fact, self-regulation begins developing at birth and can be observed in children before they begin preschool (Kopp, 1982; Rimm-Kaufman & Wanless, 2012).

A substantial body of research indicates that self-regulation may be important for children to make a successful transition and learn in a classroom setting (e.g., Blair, 2002; Blair & Diamond, 2008). As children undergo transition from the home environment or day care center to an academic setting, such as preschool, there is an increase in the demand for self-regulation skills to support classroom learning. These skills help the child meet the daily demands of the immediate classroom environment and can be observed and measured through a variety of classroom rules and activities. These indicators include the child's ability to focus attention on a given task, or the ability to follow instructions to complete a task or activity.

1.2. Self-regulation and academics

Interest in self-regulation skills and its impact on academics is relatively new. However, accumulating evidence indicates that self-regulation predicts academic achievement from preschool into adulthood (e.g., Blair & Razza, 2007; McClelland et al., 2007). Further, research indicates that these skills play a role in early academic success across cultures (Lan, Legare, Ponitz, Li, & Morrison, 2011; Wanless, McClelland, Acock, Chen, & Chen, 2011; Wanless, McClelland, Acock, Ponitzm et al., 2011; von Suchodoletz et al., 2013). In past research, the primary focus for measures of early academic success has been math, vocabulary, and emergent reading (Cameron Ponitz, McClelland, Matthews, & Morrison, 2009; Howse, Calkins, Anastopoulos, Keane, & Shelton, 2003; McClelland, Acock, & Morrison, 2006; McClelland et al., 2007). During the preschool years, higher self-regulation scores have been found to correspond with better math, vocabulary, and reading scores, as well as listening comprehension (Cameron Ponitz et al., 2009; Howse et al., 2003; McClelland et al., 2007). Kindergarten children with low self-regulation skills fall increasingly behind more self-regulated peers in math and reading through second grade (McClelland et al., 2006). In fact, the gap in achievement between these groups remains consistent through sixth grade (McClelland et al., 2006).

In general, self-regulation skills are consistently and positively correlated to math abilities across ages and cultures (Blair & Razza, 2007; Bull & Scerif, 2001; Howse et al., 2003; McClelland et al., 2007; von Suchodoletz et al., 2013; Wanless, McClelland, Acock, Chen et al., 2011). In addition to having strong concurrent relations with math, self-regulation also often appears to have a strong predictive relation (Blair & Razza, 2007; Cameron Ponitz et al., 2009). The higher academic demands rooted in the complexities of math likely require greater self-regulation. Proficiency in math requires a child to actively reason through a problem to arrive at the solution, and goes beyond memorization of arithmetic knowledge (Blair & Razza, 2007). As a result, self-regulation skills collectively and uniquely contribute to greater success in mathematic problem solving (Bull & Scerif, 2001; Blair & Razza, 2007).

A different pattern is seen when examining concurrent relations between self-regulation and reading and vocabulary. Some research suggests that self-regulation may play a significant role in the development of emergent reading skills such as letter name and word identification (McClelland et al., 2007), vocabulary (Becker, Miao, Duncan, & McClelland, 2014; McClelland et al., 2007; Wanless et al., 2016), and sound awareness (Matthews, Ponitz, & Morrison, 2009) in preschool and kindergarten children. In contrast, other researchers have failed to identify any significant relation between self-regulation and phonemic awareness (Blair & Razza, 2007), vocabulary (Cameron Ponitz et al., 2009), and Letter–Word Iden-

tification (Matthews et al., 2009; Cameron Ponitz et al., 2009) skills in preschool and kindergarten children.

Similar mixed findings have been noted when examining the predictive relation between self-regulation and academic skills, across different ages in early childhood. McClelland et al. (2007) reported that growth in self-regulation predicted growth in emergent reading, vocabulary, and math skills over the preschool year. By contrast, Cameron Ponitz et al. (2009) reported that self-regulation was a predictor of growth in math scores for kindergarten children, but not a predictor of growth in reading or vocabulary scores. Unlike the process of learning math, which likely requires greater self-regulation to master the tiered developmental process of conceptualizing, understanding procedures, and using active reasoning, a child's reading skills unfold through the use of more automated skills such as letter identification, word identification, and phonological awareness. Once a child masters these basic skills and begins to read, perhaps these skills become second nature, and the child does not have to work as hard as during the initial learning phase. A skill that is performed automatically or a task during which a child does not have to work very hard requires less planning, programming, inhibition, and overall self-regulation. In summary, although the above evidence suggests that self-regulation may be important for academic skills, there is also evidence to indicate that self-regulation may have a differential relation to specific academic skills (Wanless et al., 2016), leading researchers to conclude that the relation between self-regulation and academics may be domain specific (Cameron Ponitz et al., 2009).

1.3. Self-regulation and task dependency

Might there be another possible explanation for the differential relation between self-regulation and academic skills? In this paper, we argue that the relation between self-regulation and academic skills is not domain specific but task dependent, specifically the type (particular kind or group of activities) of task and the nature (inherent characteristic or constitution) of the task. When the task is sufficiently challenging, self-regulation may be important to children's performance on the task. This may help to explain why McClelland et al. (2007) reported that self-regulation was significantly related to letter-identification skills in their preschool population, whereas Cameron Ponitz et al. (2009) found that self-regulation did not significantly contribute to letter–word identification in their study with kindergarten children, although the identical task was used in both studies, namely the Letter–Word Identification from the Woodcock–Johnson III Tests of Cognitive Abilities (WJ-III; Woodcock, McGrew, & Mather, 2001). Self-regulation may be more critical for literacy development during preschool, at a time when children are acquiring emergent literacy skills, and may be less critical later when those skills become automatic. So the relation between self-regulation and a given skill may depend upon the alignment between the type of task and the child's phase of development – less self-regulation needed for tasks that align with a child's developmental level and more needed when the task is at the upper end, or beyond their zone of proximal development.

Another reason for the discrepancy in the findings of various studies could be on account of the nature of the tasks used to measure a given skill. Matthews et al. (2009) measured phonological awareness using the Sound Awareness subtest of the WJ-III (Woodcock et al., 2001). On this subtest, children are required to delete and substitute phonemes and syllables to form new words. Blair and Razza (2007) used the Elision subtest of the Preschool Comprehensive Test of Phonological and Print Processing (Pre-CTOPP; Lonigan, Wagner, Torgesen, & Rashotte, 2007) to measure phonemic awareness. In this task, children are required to perform

elision (removing words from compound words and sounds from a word to form a new word) but were provided with visual support. Blair and Razza found that self-regulation was not related to phonemic awareness in their study with 5-year olds, whereas Matthews et al. found that self-regulation was related to phonological awareness in their study with 5-year-olds. Although both studies examined phonological awareness, the differences in the nature of the tasks used to measure phonological awareness skills could explain the discrepancy in findings; the Elision subtest used by Blair and Razza may have been easier for the 5-year-olds than the Sound Awareness subtest used by Matthews et al. (2009). Importantly, Blair and Razza provided visual support, thus changing the nature of the task (in this case, reducing task demands). Such results suggest that although the task per se may be beyond the child's zone of proximal development, changing the nature of the task changes the amount of self-regulation needed to complete the task.

1.4. Self-regulation and writing

In line with cognitive models of writing (Hayes & Berninger, 2009; Hayes & Flower, 1980, 1987), studies in older children by Graham and colleagues (e.g., Graham, 1997; Graham & Harris, 2000; Graham, Harris, & Mason, 2005) have shown that self-regulation is required for high-level planning and organization of writing. Part of writing difficulties for older children may be traceable to poor acquisition or use of self-regulation processes. Compared to skilled writers, developing writers show little high-level planning and organization prior to writing (Graham, 1997; Graham & Harris, 2000; Zimmerman & Risemberg, 1997).

Minimal research has been completed on the role of self-regulation in early or emergent writing, although there appear to be a few recent exceptions. In a longitudinal examination of kindergarten and first-grade children, Kent, Wanzek, Petscher, Al Otaiba, and Kim (2014) reported that a writing model including self-regulation (attention) was a better fitting model than a model with only reading and spelling. Self-regulation was uniquely and positively related to compositional fluency in kindergarten and predictive of both composition quality and fluency in first grade. Gerde et al. (2012) examined the contribution of several variables including self-regulation to name writing in preschool children. Self-regulation accounted for 7.1% of the total variance in children's name-writing skills after accounting for other important predictors such as letter knowledge, home literacy environment, and decoding. These findings provides initial empirical evidence that self-regulation may play a unique, and developmentally specific role in early and emergent-writing skills.

1.5. Current study

The primary purpose of this study is to examine the relation between self-regulation and early writing. Additionally, as articulated earlier, there is evidence to suggest that the relation between self-regulation and academic skills may depend on the type of task – more critical for when a child is acquiring a certain skill and less critical when a child has mastered a given skill. Furthermore, the relation may depend on the nature of the task. Hence, the secondary purpose is to examine the issue of task dependency, both the type and the nature of the task in relation to writing. To that end in Study 1, first we examined the relation between writing and self-regulation skills using some identical writing tasks across two grades – preschool and kindergarten – to examine whether the relation between self-regulation and writing depends on whether the task is aligned (or not) with the child's developmental level (type of task). In Study 2, we examined whether the relation between self-regulation and writing depends on the nature of the task.

2. Study 1

According to Berninger and Winn's (2006) not-so-simple view of writing, the ability to write includes transcription and text-generation skills. Transcription refers to the process of encoding letters, sounds, words, and sentences into print and includes handwriting and spelling. Text generation refers to the process of converting ideas into written language. In the early years of beginning to write, transcription skills use up most of children's cognitive energy, interfering with their ability to generate text (e.g., Graham, Berninger, Abbott, Abbott, & Whitaker, 1997; Jones & Christensen, 1999). Underdeveloped, inefficient transcription processes constrain the fluency and quality of composing (Bourdin & Fayol, 1994, 2002; Bourdin et al., 1996; Olive & Kellogg, 2002). Therefore, achieving automaticity in transcription skills is important for text generation.

Broad patterns can be observed as children's transcription and text generation develop. In preschool, children are not composing text; however, they are capable of writing. Preschool children often attempt to write their names, write letters, and spell words before they enter kindergarten and receive any formal writing instruction. Per Puranik and Lonigan's (2014) model of emergent writing for preschoolers, assessment of preschool writing included name writing, letter writing, and spelling.

By the time children are in kindergarten, they are able to write alphabet letters and spell words more proficiently and produce written text. In keeping with research practice (e.g., Kim et al., 2011; Puranik & Puranik & Al Otaiba, 2012; Wagner et al., 2011), writing tasks used to measure transcription skills in kindergarten children included letter writing, letter-writing fluency, and spelling. Identical tasks and scoring method were used to assess letter writing and spelling across both grades to help us disentangle the issue of task dependency. Self-regulation may be needed for preschool children to learn letter-writing skills, which are new to them. Preschool children eventually learn to write all letters of the alphabet, and by kindergarten, letter writing becomes a fairly automatic task. Hence, the role of self-regulation for a skill such as letter writing may decrease with time and vary by grade. A similar argument can be made for spelling.

While letter writing may be more automatic for kindergarten children than for preschool children, a timed task such as letter-writing fluency may be less automatic, and hence more difficult. So in addition to a letter-writing task, kindergarten children were also administered a letter-writing fluency task, which is a common measure of writing fluency at the kindergarten level (e.g., Kim et al., 2011; Wagner et al., 2011). Finally, we used a measure of composition to examine writing beyond the word level for the kindergarten children. Composing phrases and sentences is cognitively demanding for kindergarten children, as they need to draw upon their letter-sound knowledge and string letters together to spell words and compose sentences that may require greater self-regulation.

Based on the results of Gerde et al. (2012), we expected that the relation between self-regulation and name writing would be significant for preschool children. When examining transcription skills (letter writing and spelling) for preschool and kindergarten children, the relation between self-regulation and writing for both cohorts was expected to mimic the relation between self-regulation and emergent reading, significantly related to reading tasks in preschool but not in kindergarten (Cameron Ponitz et al., 2008; McClelland et al., 2007). Hence, self-regulation should only contribute significantly to name writing, letter writing, and spelling for preschool children who are learning to write, because these tasks are cognitively demanding and novel. Kindergarten children are expected to demonstrate near mastery of these three tasks; therefore, no significant relation was anticipated between letter writing, and spelling and self-regulation for kindergarten children. How-

Table 1
Participant demographics.

Study 1		Preschool (n = 161)		Kindergarten (n = 139)	
		n	% of sample	n	% of sample
Gender	Male	74	54	69	49.6
	Female	87	46	70	50.4
Race/ethnicity	African American	53	32.9	20	14.4
	Asian	5	3.1	3	2.2
	Hispanic	2	1.2	5	3.6
	Caucasian	94	58.4	103	74.1
	Other	6	3.7	8	5.8
School SES	Low	49	30.5	27	19.4
	Mid	75	46.7	73	52.5
	High	34	21.1	38	27.3
Study 2				Kindergarten (n = 274)	
				n	% of sample
Gender	Male			139	50.7
	Female			135	49.3
Race/ethnicity	African American			82	29.9
	Asian			6	2.2
	Hispanic			3	1.1
	Caucasian			165	60.2
	Other			17	6.2
School SES	Low			80	29.2
	Mid			134	48.9
	High			60	21.9

Note: Total sample Study 1, n = 300.

ever, a significant relation is expected between self-regulation and letter-writing fluency and composition for kindergarten children.

2.1. Method

2.1.1. Participants

Children for this study were recruited at two sites: one in northwestern Pennsylvania and the other in North Central Florida. At both sites, a wide range of preschools/daycare centers (n = 55) and kindergartens (n = 72) were targeted to insure inclusion of families with diverse socioeconomic statuses (SES). Schools were classified as follows: low SES > 75%, low-mid 50–75%, mid SES 50%, mid-high 50–25%, and high SES < 25% with children receiving free and reduced priced lunch.

Each child's participation in the study was confirmed through a consent form distributed to the parent by way of the child's classroom teacher. Across both test sites, signed consents were received for 300 children. Trained assessors individually tested each child's skills over two to three visits. The length of each visit was contingent upon the child's ability to attend to the task, with the average visit lasting thirty minutes.

The mean age of the participants enrolled in preschool was 57.37 months (*SD* 5.5; range 48–72 months), and the mean age for the kindergarten participants was 73.21 months (*SD* 3.7; range 61–81 months). The sample was nearly equally split between sexes (47.7% male). Preschool children (n = 161) comprised 53.7% of the sample. English was the primary language for all study participants, as determined by a parent survey. A variety of ethnicities were represented, and none of the participants had any known developmental delays as determined by their teachers' reports. Demographic information for the participants is provided in Table 1.

2.2. Measures

All children were administered a measure of self-regulation. Preschool children's writing was measured using three tasks: name writing, letter writing, and spelling. Children in kindergarten were also administered the same three tasks. In addition, they were administered a letter-writing fluency task and a standardized measure of composition. All measures were individually administered

in the spring of the school year. Two trained researchers scored all tasks to establish inter-rater reliability and to reduce data entry errors. All discrepancies were discussed and resolved, and both raters agreed on the final scores entered. The percentages for correct agreement were calculated for the non-standardized writing assessments.

2.2.1. Self-regulation

The Head-Toes-Knees-Shoulders task (HTKS; Cameron Ponitz et al., 2009; McClelland et al., 2007) was used to assess self-regulation. HTKS was used because it taps multiple aspects of executive function – attention, working memory, and inhibitory control. It is a short, easy-to-use, and popular measure of self-regulation designed for use with young children aged 4–6 years. Comparable to classroom demands, such as raising a hand before speaking, children are required to use inhibitory control and use working memory to remember the instructions. The task includes four commands: "Touch your head," "Touch your toes," "Touch your knees," and "Touch your shoulders." Children are instructed to do the opposite of what the assessor requests. This requires children to halt instinctive reactions to follow the stated command and demonstrate inhibitory control by performing the opposite of the stated task. "Touch you head" pairs with "Touch your toes," just as "Touch your knees" pairs with "Touch your shoulders." Accordingly, when the examiner states the command "*Touch your toes*," the child is required to touch his head. The first part of the task is restricted to "Touch your head" and "Touch your toes." In the second segment, the child is trained on "Touch your knees" and "Touch your shoulders." The training is followed with 10 test items that randomly present all four commands. Two points are assigned for each correct response. One point is assigned for a self-correction. Self-correction is defined by any noticeable movement toward a wrong action followed by the correct action. Zero points are allocated for an incorrect response. The maximum score on HTKS is 40 if child produces all 20 correct responses correctly. Inter-rater reliability and test–retest reliability reported for preschool and kindergarten children are high, with alphas of .93 across several studies (Cameron Ponitz et al., 2009; McClelland et al., 2007; McClelland & Cameron, 2012). Construct validity for the HTKS evaluated by examining correlations with the Child Behavior Rating Scale (CBRS; Bronson, Tivnan, & Seppanen, 1995) is .25 for attentional focusing and .20 for inhibitory control (Cameron Ponitz et al., 2009).

2.2.2. Preschool writing skills

2.2.2.1. Name writing. Children were asked to write their first name using a paper and pencil provided to the child. Name writing was scored on a developmental scale of zero to nine in line with previous research (e.g., Puranik & Lonigan, 2011). Scores were assigned based on the presence or absence of developmental features of writing including linearity, discreteness, directionality, phonetic representation, first letter of name, many letters of name, and correct spelling of name. The final score was the sum of all the features; so the maximum score possible was nine. Internal consistency reliability for name writing was .87 and inter-rater reliability of scoring was 97.8%.

2.2.2.2. Letter writing. As a measure of letter-writing skills each child was asked to independently write 26 upper case letters dictated by the examiner in a random order. The task was verbally presented by stating, "*I want you to write out some letters for me. If you do not know them all, that is alright. Just try your best.*" Responses were scored on a scale of zero to two. A score of "2" was assigned if the written letter was both correct and well formed. A score of "1" was allotted for letters that were poorly formed and/or written in reverse. An incorrect response or no response received a score of

"." The maximum score possible on the letter-writing task was 52. Inter-rater reliability of scoring was 92%.

2.2.2.3. Invented spelling. The spelling task included eight consonant–vowel–consonant words. The child was prompted for the individual letters for the first three items. The scoring was based on a modified version of the spelling scale used by previous researchers (Puranik, Lonigan, & Kim, 2011; Tangel & Blachman, 1992). Responses were scored on a developmental scale with scores of zero (no response) to nine (conventional spelling). To account for the developmental progression of children's emerging writing skills, the scale represents the progression of spelling from random letters, initial consonants, phonetically related attempts, and invented spelling to conventional spelling. The maximum score possible was 72 (8 words × score of 9/word). Internal consistency reliability for the spelling task was high (Cronbach's α = .98) for both preschool and kindergarten children. Inter-rater reliability of scoring was 93.2%.

2.2.3. Kindergarten writing skills
2.2.3.1. Letter-Writing Fluency (LWF). Kindergarten children were asked to write the entire lowercase alphabet as quickly and as accurately as possible in one minute. This task has been widely used to assess handwriting automaticity (e.g., Graham et al., 1997; Jones & Christensen, 1999; Puranik & Al Otaiba, 2012; Wagner et al., 2011) with good concurrent validity (correlations ranging from .46 to .63 with criterion writing measures of handwriting, spelling, and composition for kindergarten children; Puranik, Patchan, Sears, & McMaster, 2016). Prior to the task, the child was instructed not to erase a mistake if one was made; instead the child was told to cross out the mistake and continue writing. Scoring was completed on a three-point scale. One point was awarded for each correctly written letter, .5 point was awarded to letters that were uppercase, reversed, or poorly formed, and a score of 0 was given when the letter was missing or incorrect. The final score was the number of points earned in one minute with a maximum score of 26.

2.2.3.2. Composition. The Test of Early Written Language, 2nd Edition (TEWL-2; Hresko, Herron, & Peak, 1996) is designed to assess and identify a child's strengths and weaknesses in writing. The contextual writing subtest of the TEWL-2 was used to assess the child's ability to write a story based upon a picture prompt. This task is only appropriate for children aged five and older; therefore, it was only administered to the kindergarten children. The picture prompt comprised three sequential action pictures, and the child was instructed to write a story about the pictures. Children were given 15 min to complete the task. Internal consistency reliability is reported to be high (α = .94; Hresko et al., 1996). Concurrent validity was established with a variety of assessments. The TEWL-2 is moderately correlated to the Peabody Individual Achievement Test-Revised (PIAT-R; Markwardt, 1989) Written language subtest (.57), the Wide Range Achievement Test (WRAT-R; Jastak & Wilkinson, 1984) Spelling subtest (.47), and the Diagnostic Achievement Battery (DAB) Writing subtest (.49).

3. Results

Across all study measures, the preschool group had all data present, whereas the kindergarten group had three participants with missing data. Bayesian estimation was used to account for missing data. The study participants were nested within 129 schools, and hence, multilevel modeling was used to account for school influence as a contributor to differences in writing scores, even though there were no level-two predictors.

To examine the influence of child and school-level factors, intraclass correlation coefficients (ICCs) were calculated for each writing measure for the preschool and kindergarten groups. The ICCs at the school level for individual writing scores of the preschool group were as follows: 13.4%, 13.6%, and 35.4% for name writing, letter writing, and spelling, respectively. Variances for the kindergarten ICCs at the school level for each of the writing measures were as follows: 18.4%, 12.3%, 18.9%, and 18.9% for letter writing, spelling, LWF, and the TEWL-2 Contextual assessments, respectively. The ICC values for both age groups indicated that some variance was

Table 2
Descriptive statistics for Studies 1 and 2.

Variable Study 1		Mean Preschool (n = 161)	SD	Range	Skewness	Kurtosis	Mean Kindergarten (n = 139)	SD	Range	Skewness	Kurtosis
Child age (months)		57.37	5.53	48–72	.35	−.6	73.21	3.69	61–81	−.71	1.03
Self-regulation (HTKS)		16.48	13.75	0–40	.17	−1.46	33.24	8.2	0–40	−2.61	7.01
Writing measures – Transcription											
	Name Writing	7.55	2.14	0–9	−1.72	2.56					
	Letter Writing	20.63	16.77	0–52	.34	−1.32	45.29	4.77	33–52	−.63	−.3
	Invented Spelling	32.33	18.34	0–70	.38	−.96	65.92	4.95	45–71	−2.01	4.42
	Letter-Writing Fluency						12.89	6.7	1–26	.3	−.97
Writing measures – Text generation											
	Composition						6.94	5.31	0–26	1.17	1.53
Study 2							**Kindergarten** (n = 274)				
Child age (months)							67.37	3.85	60–78	.09	−.95
Self-regulation (HTKS)							33.01	6.79	0–40	−2.29	6.73
Writing measures – Transcription											
	Letter-Writing Fluency						9.97	5.42	0–23	.37	−.55
	Spelling						18.49	2.81	7–30	−.33	.65
Writing measures – Text generation											
	SW-WW						14.83	5.72	0–31	−.89	1.08
	SW-CWS						9.91	5.46	0–28	.04	−.25
	Essay-WW						14.35	9.17	0–47	.53	.31
	Essay-CWS						6.80	5.89	0–30	1.14	1.22

Note: HTKS = Head-Toes-Knees-Shoulders; Spelling = Spelling subtest from the WJ-3; Composition = Contextual Writing subtest from the TEWL-2; SW = Sentence Writing; WW = Words Written; CWS = Correct Word Sequences. All reported data are raw scores.

explained at the school level and suggested that children from the same schools had scores that were somewhat related to each other (Peugh, 2010). The magnitude of these ICCs supported the need for multilevel modeling to account for the lack of independence in the data, by school; but those models did not include level-two predictors.

3.1. Descriptive statistics

Descriptive statistics were examined separately by grade and are summarized in Table 2. Large variability was noted in the preschool self-regulation scores as measured by HTKS. Twenty-one percent of the sample obtained a score of zero, or showed floor effects, and 1.2% of the sample attained a perfect score, or showed ceiling effects. Within the preschool group, girls scored an average of six points higher than boys on the HTKS measure. For the name-writing task, scores ranged from 0 to 9, although almost 53% scored at ceiling. Both letter writing and spelling had large standard deviations indicating large variability in student performance. Lastly, correlations between measures were examined for the preschool group. HTKS score was significantly correlated with all preschool writing measures (r's = .31–.82). Similarly, all preschool writing variables were significantly correlated with each other (see Table 3). Tests of normality, including skewness and kurtosis, fell within acceptable ranges across all outcome variables except for invented spelling, which had high kurtosis. Individual examination of histograms, however, suggested that outliers were not disproportionately driving the magnitude or direction of results for this outcome (Gravetter & Wallnau, 2014).

As expected, less variability was noted in the HTKS scores for the kindergarten group as compared to the preschool group. Approximately 94% of the kindergarten children scored over 20 points. Only .7% scored at floor, and 5.8% scored at ceiling. As anticipated, letter-writing scores averaged close to ceiling. Kindergarten children performed in the high average range in the invented spelling task with approximately 90% of the sample scoring above 60 points. Although variability within the letter writing and invented spelling measures was narrow, skewness and kurtosis were within the acceptable range based on the standards recommended by Kline (2005). Raw scores were used for the TEWL-2: Contextual subtests to align with the researcher generated writing tasks, which do not

have standardized scores. The mean (and SD) of the TEWL-2: Contextual subtest was 6.94 (5.31). All kindergarten writing measures were significantly correlated with each other. The spelling measure had the highest correlations with the other writing measures.

3.2. Relation between self-regulation and writing

Multilevel modeling (MLM) results are reported separately for preschool and kindergarten. The models included age and gender as control variables in line with studies examining the relation between self-regulation and academics (e.g., Cameron Ponitz et al., 2009; Wanless, McClelland, Acock, Chen et al., 2011). Gender was dummy coded (0 = female; 1 = male). Separate models were calculated for each of the outcome variables for preschool and kindergarten. Model 1 consisted of the control variables. Model 2 additionally included HTKS scores to examine the unique variance of self-regulation as a contributor to various writing tasks. Our models have intercepts with random variance components, and each covariate has fixed effects across schools. Grand mean centering was used for our control variables, and group mean centering was used for our predictors, except for gender that was dummy coded and thus not centered (Enders & Tofighi, 2007; Peugh, 2010).

Self-regulation for the preschool group was significantly related to letter writing and spelling, but not to the name-writing scores. In other words, on average, preschoolers who were 1 standard deviation higher than the average self-regulation level in their school had higher letter writing (by .20 SDs) and spelling (by .19 SDs) scores. In Model 1, age and gender accounted for 24.7% and 23.2% of the variance for letter writing and spelling, respectively (see Table 4). After including HTKS in the model, gender was not significantly related to writing outcomes in this sample. The addition of HTKS scores in Model 2 contributed 2.5% of unique variance to letter writing and 2.1% of unique variance to invented spelling.

For the kindergarten group, self-regulation scores were not significantly related to letter writing or LWF. As reported in Table 3, HTKS performance for kindergarten children was significantly correlated to invented spelling and the TEWL-2: Contextual subtest performance. In Model 1, the control variables explained 7.6% of the variance for the TEWL-2: Composition Writing subtest. Although self-regulation was significantly related to the compositional measure, it did not add any unique variance for the TEWL-2:

Table 3
Pearson correlations for preschool and kindergarten samples from Studies 1 and 2.

	1	2	3	4	5	6	7
Study 1 Preschool sample (n = 161)							
1. HTKS	–						
2. Name Writing	.31**	–					
3. Letter Writing	.43**	.56**	–				
4. Invented Spelling	.46**	.51**	.82*	–			
Study 1 Kindergarten sample (n = 139)							
1. HTKS	–						
2. Letter Writing	.11	–					
3. Invented Spelling	.25**	31**	–				
4. Letter-Writing Fluency	.14	.29**	.42**	–			
6. Composition	.18*	.18*	.25**	.31**	–		
Study 2 Kindergarten sample (n = 274)							
1. HTKS	–						
2. Letter-Writing Fluency	.22*	–					
3. Spelling	.36**	.39**	–				
4. SW-WW	.13*	.29**	.38**	–			
5. SW-CWS	.19*	.34**	.31**	.72**	–		
6. Essay-WW	.09	.37**	.33**	.40**	.28**	–	
7. Essay-CWS	.13*	.36**	.39**	.37**	.39**	.75**	–

Note: HTKS = Head-Toes-Knees-Shoulders; Spelling = Spelling subtest of the Woodcock Johnson Test of Cognitive Abilities, 3rd edition; Composition = Contextual Writing subtest of the Test of Early Written Language, 2nd edition; SW = Sentence Writing; WW = Words Written; CWS = Correct Word Sequences.

  * Correlations significant at the .05 level (2 tailed).
 ** Correlations significant at the .01 level (2 tailed).

Table 4
Preschool and kindergarten multilevel modeling results for Study 1.

		Model 1		Model 2	
		Standardized coefficient (SE)	p	Standardized coefficient (SE)	p
Preschool sample					
Name Writing	CA	.31 (.07)	.00	.30 (.08)	.00
	Gender	−.20 (.08)	.00	−.11 (.07)	.06
	HTKS			.05 (.08)	.40
Letter Writing	CA	.49 (.06)	.00	.44 (.07)	.00
	Gender	−.12 (.07)	.11	.00 (.07)	.94
	HTKS			.20 (.07)	.01
Invented Spelling	CA	.47 (.08)	.00	.42 (.08)	.00
	Gender	−.14 (.06)	.03	.05 (.07)	.53
	HTKS			.19 (.07)	.01
Kindergarten sample					
Letter Writing	CA	.01 (.09)	.92	.01 (.09)	.94
	Gender	−.24 (.04)	.00	−.21 (.11)	.09
	HTKS			.05 (.08)	.49
Invented Spelling	CA	.24 (.08)	.00	.24 (.08)	.01
	Gender	−.23 (.04)	.00	−.04 (.11)	.74
	HTKS			.11 (.08)	.14
Letter-Writing Fluency	CA	.16 (.10)	.11	.15 (.09)	.08
	Gender	−.19 (.08)	.00	−.19 (.07)	.00
	HTKS			.07 (.08)	.46
Composition	CA	05 (.09)	.61	.06 (.09)	.53
	Gender	−.27 (.06)	.00	−.1 (.10)	.55
	HTKS			.21 (.08)	.01

Note: CA = Chronological Age; Gender = 0 for females, 1 for males; HTKS = Head-Toes-Knees-Shoulders; Composition = Contextual Writing subtest of the Test of Early Written Language, 2nd edition.

Composition Writing subtest. Composition was significantly correlated with letter writing, LWF, invented spelling, and spelling. After including the HTKS, gender was not significantly related to letter writing, invented spelling, or composition, but it was related to letter-writing fluency. Specifically, on average, boys scored .19 points lower than girls on letter-writing fluency, after controlling for age and HTKS scores, which is a small fraction of a standard deviation.

4. Study 2

Writing affords a unique opportunity; it allows for different types of measurement. In Study 1, we coded children's letter writing and spelling using established schemes for emergent writers to be consistent across both grades, and composition was scored using a standardized test protocol. However, this may not have best captured kindergarten children's writing. Therefore, in Study 2, we coded writing using curriculum-based measures (CBM) in line with frequently used measures of writing in kindergarten to further tease apart the issue of the nature of the task and its impact on self-regulation.

4.1. Method

4.1.1. Participants

Children for Study 2 were recruited from seven different schools and 15 different classrooms located in northwestern Pennsylvania (n = 274). Each child's participation in the study was confirmed through an approved consent form distributed to the parent by way of the child's classroom teacher. The mean age of the participants was 67.37 months (SD 3.85; range 60–78 months). The sample was nearly equally split between sexes (50.7% male). A variety of ethnicities were represented, and none of the participants had any known developmental delays as determined by their teachers' reports. Demographic information for the participants is provided in Table 1.

4.1.2. Measures

All children were individually administered the HTKS, a measure of self-regulation as described in Study 1. All writing tasks, with the exception of spelling, were administered to the whole class at the end of the school year. Children's writing was coded using established protocols used to measure CBMs.

4.1.3. Transcription skills

4.1.3.1. Letter-Writing Fluency. The task was identical to the LWF task described in Study 1 expect that it was group-administered to the whole class.

4.1.3.2. Spelling. To examine spelling, the spelling subtest from the WJ-III (Woodcock et al., 2001) was administered. This subtest requires children to write letters and words of increasing complexity. The subtest is discontinued after the child provides six consecutive incorrect responses. Per the scoring manual, responses are scored as 0 (incorrect) or 1 (correct). Raw scores were used in the analysis for this study. The WJ-III spelling subtest has a test–retest reliability of .95 (Woodcock et al., 2001).

4.1.4. Text-generation skills

4.1.4.1. Sentence writing. For this task, students were given pictures and had to write as many sentences as possible describing the pictures in three minutes. The sentences were coded for the number of correct word sequences (SW-CWS) and words written (SW-WW). A CWS was two adjacent words that were correctly spelled and grammatically and semantically acceptable within the context of the sentence, and WW was the count of the total number of words written by the student without considering correct or incorrect usage in context or spelling. These measures have been widely used in previous studies with young children (e.g., Ritchey, 2008; McMaster, Du, & Petursdottir, 2009) with good reliability and validity (alternate-form reliabilities r > .70, and criterion-related validity from r = .50 to .60).

4.1.4.2. Essay. Students' ability to generate text at the discourse level was assessed with an essay task. The assessor first introduced the task informing the students that they had to write an essay

Table 5
Kindergarten multilevel modeling results for Study 2.

		Model 1		Model 2	
		Standardized coefficient (SE)	p	Standardized coefficient (SE)	p
Letter-Writing Fluency	CA	.67 (.32)	.39	.03 (.44)	.69
	Gender	1.78 (.23)	.003	1.67 (.59)	.004
	HTKS			.17 (.04)	.001
Spelling	CA	.02 (.04)	.68	−.12 (.04)	.78
	Gender	.93 (.33)	.005	.86 (.31)	.007
	HTKS			.14 (.07)	.0001
SW-WW	CA	−.44 (.089)	.1	−.17 (.88)	.05
	Gender	1.68 (.67)	.01	1.59 (.66)	.02
	HTKS			.13 (.05)	.01
SW-CWS	CA	−.09 (.08)	.24	−.13 (.08)	.11
	Gender	1.78 (.64)	.005	1.67 (.62)	.008
	HTKS			.17 (.04)	.0001
Essay-WW	CA	.06 (.14)	.67	.04 (.14)	.78
	Gender	4.38 (1.05)	.0001	4.32 (1.05)	.0001
	HTKS			.09 (.07)	.23
Essay-CWS	CA	.14 (.09)	.13	.18 (.09)	.19
	Gender	2.58 (.69)	.0001	2.52 (.69)	.0001
	HTKS			.09 (.05)	.07

Note: CA = Chronological Age; Gender = 0 for females, 1 for males; HTKS = Head-Toes-Knees-Shoulders; Spelling = Spelling subtest of the Woodcock Johnson Test of Cognitive Abilities, 3rd edition; SW = Sentence Writing; WW = Words Written; CWS = Correct Word Sequences.

about what they liked in kindergarten. After introducing the task, the assessor helped the students brainstorm ideas. Then the students had five minutes to complete their essay. Similar to coding for sentences, the essays were also coded for the number of Correct Word Sequences (Essay-CWS) and Words Written (Essay-WW). The essay task has been used in previous studies (e.g., Puranik & Al Otaiba, 2012) with good concurrent validity correlations with standardized and unstandardized measures of writing, *r* = .56–.73 (Puranik et al., 2016).

All CBM-W were double-coded with high reliability (i.e., 82–95% agreement; ICC = .98–.99) by trained research assistants. Any discrepancies were resolved through discussion and, a final agreed upon score was entered.

4.2. Results

Descriptive statistics are summarized in Table 2. The mean HTKS score was 31.01 (*SD* = 6.79). Only .7% scored at floor, and 4.1% scored at ceiling. The study's 274 participants were nested within seven schools, and hence, multilevel modeling was used to account for school influence as a contributor to differences in writing scores. These analyses were conducted with fixed effects of level 1 predictors and without level 2 predictors. Similar to Study 1, age and gender were used as control variables. Separate models were calculated, beginning with an unconditional model, thereafter adding the control variables, and then the HTKS variable (see Table 5).

4.3. Relation between self-regulation and writing

To examine the influence of school level factors, intraclass correlation coefficients (ICCs) were calculated for each writing measure. The ICCs at the school level for individual writing scores were as follows: 27%, 3%, 7%, 10%, 6%, and 3% for LWF, spelling, SW-WW, SW-CWS, Essay-WW, and Essay-CWS, respectively. The ICCs indicate that a substantial amount of variance was explained at the school level for the LWF and SW-CWS measures, and scores could not be considered independent (Peugh, 2010).

The transcription measures – LWF and spelling – showed small albeit statistically significant correlations with HTKS. LWF and spelling were moderately correlated with each other and also showed moderate correlations with the text-generation measures (see Table 3). Results of the MLM indicated that age and gender accounted for 2% each of the variance for LWF and spelling, respec-

tively. The addition of HTKS scores in Model 2 contributed 5% of unique variance to LWF and 11% of unique variance to spelling.

As reported in Table 3, HTKS performance for kindergarten children was significantly correlated to both sentence writing CBM measures and Essay-CWS but not Essay-WW. LWF was moderately correlated with the sentence and essay-writing measures. Similar correlations were noted between spelling and CBM sentence and essay-writing measures. As expected, the two sentence writing measures were highly correlated to each other, as were the two essay-writing measures. The sentence writing measures were moderately correlated with the essay-writing measures.

Our models had no level-two predictors, and allowed for a random intercept and fixed effects across schools. Grand mean centering was used for control variables and group mean centering for predictors, except for gender that was dummy coded and thus not centered (Enders & Tofighi, 2007; Peugh, 2010). Results of these analyses (see Table 5) showed that the control variables of age and gender explained 2% of the variance for each of the sentence writing measures (SW-WW and SW-CWS). HTKS accounted for an additional 3% of the variance in SW-WW and 5% of the variance in SW-CWS. For the Essay-writing CBM measures, the control variables explained 5% and 4% of the variance for the Essay-WW and Essay-CWS, respectively. The addition of HTKS in Model 2 only added an additional 1% unique variance to Essay-CWS and did not account for any additional variance for the Essay-WW measure. For all outcomes that had a significant relation to self-regulation in Model 2, children with 1 standard deviation higher than their school's average self-regulation level, on average, showed higher outcomes than their peers (.17 SDs letter writing, .14 SDs spelling, .13 SDs SW-WW, and .17 SDs SW-CWS). Across all final models, gender was significantly related to outcomes, after controlling for age and HTKS scores. In all cases, the relation suggested higher outcome scores for girls than boys, ranging from the smallest relation with girls' spelling (about 1/3 of a standard deviation), and the largest relation with girls' essay words written (about 1/2 of a standard deviation).

5. Discussion

The primary goals for the present study were to examine the relation between early writing skills and self-regulation. Specifically, we were interested in examining the issue of task dependency – both type and nature of the task. To examine whether the rela-

tion between self-regulation and writing depends on the type (a particular kind or group of activities) of task we used similar writing tasks across preschool and kindergarten in Study 1. To examine whether the relation between self-regulation and writing depends on the nature (inherent characteristic or basic constitution) of the task, in Study 2, we examined writing in a different group of kindergarten children changing the structure and scoring of the writing measures used. Findings suggest that although self-regulation was related to aspects of early writing, there were grade-level differences in the aspects of early writing to which it relates. There was evidence to suggest that the relation between self-regulation and writing is task dependent – both on the type and nature of the task used to measure a given skill.

5.1. Self-regulation and type of task

Results of Study 1 showed that self-regulation was importantly related to aspects of emergent and early writing in preschool, with the exception of name writing. For the preschool sample in the current study, results did not show a significant relation between self-regulation and the name-writing task as hypothesized. These results contradict previous research by Gerde et al. (2012), who found self-regulation to be a significant contributor to name writing for preschool children. The difference in the studies' findings may be due to the differences in the participants' ages and the time during the school year when the tests were administered. The children in the current study were on average 10 months older than those in the Gerde et al. study, and had seven additional months of formal education prior to testing. As a result, the majority of preschool children in the current study scored between seven and nine points on the name-writing task, and typically achieved ceiling performance. These results suggest mastery of name writing. Although the result contradict the findings of Gerde et al. (2012), they are consistent with the hypothesis that mastered skills require or engage less self-regulation than novel skills.

Consistent with this study's hypothesis, the results indicated that self-regulation was significantly and positively related to the preschool writing tasks of letter writing and spelling. Both tasks are considered challenging for preschool children. These findings are consistent with past research, which identified self-regulation's role in the early academic skills of math and literacy in preschool children (Espy et al., 2004; McClelland et al., 2007). It appears that self-regulation skills may also be important for preschool children's emergent writing skills.

The kindergarten sample showed a different pattern of results. Performance on the letter writing and invented spelling tasks did not co-vary with individual differences in self-regulation, as hypothesized. Children were expected to perform close to ceiling on the letter writing and invented spelling tasks because these tasks assessed a basic finite set of skills that are typically mastered early (Ritchey, 2008; Bloodgood, 1999; Puranik & Al Otaiba, 2012). These results in combination with the preschool results suggest that the relation of self-regulation and writing is dependent on the type of task. When tasks chosen are aligned with a child's developmental level, self-regulation skills are less important.

Finally, we turn to the relation between self-regulation and composition. Self-regulation was found to relate significantly to the TEWL-2: Contextual Writing subtest for kindergarten children in Study 1 and CBM sentence and essay measures in Study 2. This indicates that the early forms of self-regulation may play a role in the foundation of compositional writing and are consistent with this study's expectations and hypotheses. Composing at the sentence and discourse level is a challenging task for kindergarten students requiring more self-regulation. Composing invoked skills in the areas of attention, working memory, and inhibitory control, all of which are incorporated in the construct of self-regulation.

These results are consistent with recent results reported by Kent et al. (2014) in kindergarten and first grade students examining the relation between self-regulation and writing composition. It is also consistent with past research on older elementary school children, which suggests that writing at the discourse level requires more advanced self-regulatory skills to organize, plan, and revise (Berninger & Amtmann, 2003; Graham & Harris, 2000).

5.2. Self-regulation and nature of task

Measures of LWF were included in the current study to assess kindergarten children in a manner that aligned with their developmental phase. Self-regulation was expected to have a similar role in writing as it does in math. That is, the relevance of self-regulation was expected to change as the tasks grew in complexity between preschool and kindergarten (Blair & Razza, 2007; Bull & Scerif, 2001). Results from Study 1 indicated that self-regulation did not significantly relate to the LWF task as hypothesized; however, it was significantly related in Study 2.

On the surface, these results might appear discrepant. The LWF task is designed as a classroom assessment; however, in Study 1, we tested children in a one-on-one setting. In Study 2, LWF was assessed as intended in a whole classroom setting. The revised structure of this task in Study 1 could have possibly decreased the relevance of self-regulation. For example, in a whole-classroom format, children may have had to listen more attentively or stay more focused to listen to the directions compared to the manner in which they received instruction in a one-on-one setting. However, by assessing LWF individually, we inadvertently controlled for typical environmental distractions by assessing children in a quiet space. These modifications may have unintentionally compensated for variance in self-regulation needs by furnishing unintended external regulation, which decreased the need for inhibitory control and helped the child to succeed at the task. Thus changing the nature of the task changed the relation between self-regulation and LWF. These results are akin to the differences in the findings between Matthews et al. (2009) and Blair and Razza (2007) regarding the relation between self-regulation and phonological awareness. Recall that Blair and Razza found that self-regulation was not related to phonemic awareness in their 5-year-old students, whereas Matthews et al. found a significant relation. As mentioned earlier, Blair and Razza provided visual support, thus changing the nature of the task. The differences in results between self-regulation and LWF in Studies 1 and 2, clearly indicate that the relation between an academic skill and self-regulation varies as a result of the nature of the task.

An identical pattern was noted for spelling; in Study 1, the relation between self-regulation and spelling was not significant; however, in Study 2, it was significant. In Study 1, a researcher-generated task was used to examine spelling. As mentioned earlier, this was done to have an identical task across preschool and kindergarten. The researcher-generated task contained only eight simple CVC words, which may not have allowed the more proficient spellers in kindergarten to display their spelling knowledge. Additionally, it was scored using a developmental scoring scale. The developmental scoring system is designed to provide credit for the developing knowledge that children display (for example, a point is awarded for writing only the first letter of a word). However, this scoring system may not have been most appropriate for kindergarten children. It may have had an affect akin to scaffolding, wherein items were not scored as correct or incorrect, instead they rewarded for displaying any knowledge about spelling. The results indicated that kindergarten children scored above 60 points (max score 72). In Study 2, we used a standardized assessment to measure spelling, and it was scored using a dichotomous scoring system based on the protocol. In addition, the assessment was not confined

to eight words. Once again, the results are consistent with the argument that the type and the demands of task chosen to examine the role of self-regulation and academic skills is an important consideration. In the case of writing (as opposed to reading and math), an added complexity is the particular rubric used to measure a given writing skill. As expected, self-regulation was significantly related to CBM writing sentence and essay-writing measures.

To summarize, the results from Studies 1 and 2 show that self-regulation is related to emergent/early writing. Furthermore, there was evidence to suggest that the type and nature of the task used to examine the relation between self-regulation and a given skill are important. In Study 1, self-regulation was related to letter writing and invented spelling for preschool children because these tasks are still challenging for them. It was not related to name writing in this sample, as the majority of children were proficient in writing their names. Self-regulation was not related to letter writing and invented spelling in kindergarten children, as hypothesized. These results for letter writing and invented spelling indicate that self-regulation is important when a child is acquiring a certain skill (as in preschool) and less critical when a child has mastered a given skill (as in kindergarten). Thus the type of task used to examine the relation between self-regulation and a given academic skill matters. Furthermore, changing the structure for the spelling and LWF in Study 2 changed the relation between self-regulation and these two measures, indicating that the nature of the task also matters.

Beyond adding to the literature base on the relation between self-regulation and early/emergent writing, the more important findings of this study we believe are that the results of the study showed that the relation between self-regulation and writing was task dependent – varying as a result of the type of task used and task demands. These results have important implications for not only future research on writing, but also future research examining the relation between self-regulation and academic skills. The results underscore the importance and the need to select tasks judiciously before drawing conclusions about the relation between self-regulation and outcome measures.

5.3. Limitations and future directions

The results of this study add to the growing literature on the role self-regulation plays in children's early academic skills, specifically early writing. There were several strengths to this study; however, there were also limitations that must be acknowledged. For example, although we attempted to recruit participants from a very diverse set of daycare centers, preschools, and kindergarten classrooms, our information was based on school SES. Other factors such as a child's socioeconomic status and family characteristics may be important variables and should also should be examined as potential mediators or moderators of any relation between self-regulation and writing performance.

Another possible limitation is the concurrent nature of the data limiting our ability to test bidirectional associations between self-regulation and writing skills. Examining bidirectional associations is an important avenue for future work, especially in light of more recent studies reporting such results (e.g., Bohlmann, Maier, & Palacios, 2015; Connor et al., 2016; Fuhs, Turner, Farran, & Dong, 2014; Guo, Sun, Breit-Smith, Morrison, & Connor, 2014). In addition, high kurtosis for the invented spelling variable in Study 1 suggested that outliers made this distribution more non-normal than other outcome distributions. Although HTKS was not our outcome variable, high kurtosis was noted in both studies with half of the participants scoring more than 35 points (max. 40). We used HTKS because it is a commonly used measure to examine self-regulation in this age range. However, our results indicated that greater assessment development is needed to be able to provide information that is sensitive to self-regulation skills in this age group.

A final limitation of this study was that the task dependency was measured across two different studies. A more stringent and empirical approach would have been to assess LWF by randomly assigning kindergarten children to a whole class or a one–one–one assessment format and then examining the relation between self-regulation and LWF across the two groups. Similarly, assessing spelling using a researcher-generated task (as used in Study 1) and standardized measures (as used in Study 2) and then examining the relation between spelling and self-regulation might provide a more stringent test for the issue of task dependency. These remain tasks for the future.

Another important future avenue for research is to determine whether focusing on children's self-regulation skills during early development may strengthen their writing foundation. Findings from previous literature suggest that practicing self-regulation skills with children during the early preschool years may be beneficial (Brock, Rimm-Kaufman, & Wanless, 2014; Diamond, Barnett, Thomas, & Munro, 2007). The results of this study add one more benefit to that list-emergent writing. Brock et al. (2014) proposed that children with high self-regulation skills benefit from different teaching approaches than those with low self-regulation skills. It may also be important for teachers to use early assessments of self-regulation to help identify children with lower self-regulation skills who may need different approaches to writing instruction as well.

Acknowledgements

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