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Social skills and problem behaviors as mediators of the relationship between behavioral self-regulation and academic achievement☆

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ABSTRACT

Early behavioral self-regulation is an important predictor of the skills children need to be successful in school. However, little is known about the mechanism(s) through which self-regulation affects academic achievement. The current study investigates the possibility that two aspects of children's social functioning, social skills and problem behaviors, mediate the relationship between preschool self-regulation and literacy and math achievement. Additionally, we investigated whether the meditational processes differed for boys and girls. We expected that better self-regulation would help children to interact well with others (social skills) and minimize impulsive or aggressive (problem) behaviors. Positive interactions with others and few problem behaviors were expected to relate to gains in achievement as learning takes place within a social context. Preschool-aged children ($n = 118$) were tested with direct measures of self-regulation, literacy, and math. Teachers reported on children's social skills and problem behaviors. Using a structural equation modeling approach (SEM) for mediation analysis, social skills and problem behaviors were found to mediate the relationship between self-regulation and growth in literacy across the preschool year, but not math. Findings suggest that the mediational process was similar for boys and girls. These findings indicate that a child's social skills and problem behaviors are part of the mechanism through which behavioral self-regulation affects growth in literacy. Self-regulation may be important not just because of the way that it relates directly to academic achievement but also because of the ways in which it promotes or inhibits children's interactions with others.

1. Introduction

More than 80% of American children participate in preschool in the year prior to kindergarten (Barnett et al., 2010) with these early schooling experiences usually designed with the goal of improving children's short- and long-term academic achievement (Bowman, Donovan, & Burns, 2000). Nonetheless, some research suggests that over half of children enter kindergarten without the social and academic skills needed for success (Rimm-Kaufman, Pianta, & Cox, 2000). Thus researchers and policy-makers are increasingly seeking to understand what preschool skills contribute to concurrent and later academic achievement. Current findings suggest that, in addition to contextual factors associated with home and school (Bingham, 2007; Evans & Shaw, 2008), child behavioral skills account for a substantial portion of children's early academic achievement (Hindman, Skibbe, Miller, & Zimmerman, 2010). In particular, early self-regulation has been identified as a key predictor of both current and later academic achievement (Blair, 2002, 2003; Blair & Razza, 2007; Duncan et al., 2007; Matthews, Cameron Ponitz, & Morrison, 2009; McClelland, Acock, & Morrison, 2006; McClelland & Morrison, 2003; McClelland et al., 2007). For example, children with higher levels of self-regulation in kindergarten also have higher levels of academic achievement from kindergarten through sixth grade with the gap in achievement widening between kindergarten and second grade (McClelland et al., 2006).

However, little is known about the mechanisms through which early self-regulation predicts young children's emergent academic achievement. One potential mechanism may be through the child's social functioning (Eisenberg, Fabes, Guthrie, & Reiser, 2000). For instance, how well the child self-regulates may affect the ways in which children interact with peers and teachers in the classroom (Miller, Gouley, Seifer, Dickstein, & Shields, 2004), which in turn relates to academic gains (Hamre & Pianta, 2001). However, few studies to date have empirically evaluated social functioning

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as a possible mechanism underlying the relationship between self-regulation and academic achievement (Denham et al., 2012; Valiente et al., 2011; Valiente, Lemery-Chalfant, Swanson, & Reiser, 2008). Of those that have, most utilized teacher reports of self-regulation, social functioning, and/or academic achievement which may lead to less accurate results due to method bias (e.g., teachers rate high-achieving children as having high self-regulation, few problem behaviors, and/or high social skills, Carr & Kurtz, 1991). These studies also often consider several aspects of social functioning together, thus not allowing for the possibility that aspects of social functioning, such as social skills and problem behaviors, may meditate the relationship differently (Eisenberg, Valiente, & Eggum, 2010). Likewise, only one study to date has focused on preschool-aged children (Denham et al., 2012) and only in Head Start, despite the fact that preschool self-regulation has been implicated as an early marker for later academic achievement for children generally (Mischel et al., 2011). Understanding the process through which self-regulation is associated with academic achievement is critical if we are to support young children in their acquisition of these skills. The current study investigates, via a multi-method approach, the possibility that two aspects of children's social functioning, social skills and problem behaviors, mediate the relationship between self-regulation and children's academic achievement within the preschool setting.

1.1. Self-regulation

Self-regulation is a broad concept referring to the process whereby an individual deliberately utilizes his or her skills and attributes to create an overt response to the ongoing demands of the environment in a manner that is contextually appropriate (Aksan & Kochanska, 2004; Blair & Razza, 2007; Cameron Ponitz et al., 2008; Cole, Michel, & Teti, 1994; Kochanska, Coy, & Murray, 2001). In other words, to self-regulate, a child must utilize her cognition, motivation and emotions to create a response in line with contextual expectations. The current study focuses specifically on one aspect of self-regulation, behavioral self-regulation, which is the ability to integrate cognitive skills such as attention, working memory, and inhibition to select an appropriate overt behavior (McClelland et al., 2007). Although behavioral self-regulation does not capture the emotional aspects of self-regulation deemed relevant for learning (Cameron Ponitz et al., 2008; Valiente et al., 2011), it captures the child's ability to produce an appropriate behavioral action in response to the contextual demands of the environment. Behavioral self-regulation helps children to pay attention, remember instructions, and stay on task, all within the midst of environmental distractions (Blair, 2002; Cameron Ponitz et al., 2008; McClelland et al., 2007). Research on behavioral self-regulation suggests that, although the cognitive skills typically known as executive functioning (i.e., working memory, attention, and inhibition) are key components of self-regulation, behavioral self-regulation also involves integration of the individual executive functioning skills into a contextually appropriate overt response, and is therefore a broader concept than executive functioning (McClelland & Cameron, 2012; McClelland et al., 2007). For example, the ability to follow directions in the classroom presumably requires the integration of working memory to maintain the directions in memory as well as inhibition to hold back from engaging in an appealing alternative to teacher directions.

Strong behavioral self-regulation has been linked to better academic achievement for children in grade school (Howse, Calkins, Anastopoulos, Keane, & Shelton, 2003; Howse, Lange, Farran, & Boyles, 2003), even for those at-risk for underachievement (Sektnan, McClelland, Acock, & Morrison, 2010). In preschool, self-regulation is associated with higher literacy, vocabulary, and math outcomes as well as with greater gains in those academic outcomes during the school year (McClelland et al., 2007). Early self-regulation may also have lasting effects on children's academic development, as previous findings suggest that aspects of behavioral self-regulation measured at age four predict academic achievement throughout primary school, as well as college (McClelland, Acock, Piccinin, Rhea, & Stallings, 2013; Mischel et al., 2011). Taken together these studies indicate that self-regulation plays an important role in current and later academic achievement; however, past research offers limited insight into the underlying mechanisms that support this relationship.

1.2. The role of social functioning

Social functioning may represent one of the key mechanisms that underlie the relationship between self-regulation and academic achievement. Broadly, social functioning refers to the child's ability to appropriately interact in social situations and often includes children's levels of emotionality, empathy, pro-social behavior, conscience, social skills, and problem behaviors (Eisenberg, Pidada, & Liew, 2001). We focus on two important aspects of social functioning that have consistently been related to both self-regulation and academic achievement: social skills and problem behaviors. Theoretically, high levels of self-regulation should be associated with social functioning (Eisenberg, Sadovsky, & Spinrad, 2005; Eisenberg et al., 2010). Children who, for example, can attend to important interactional cues, and remember rules related to how they should engage in classroom social environments (e.g., take turns), while inhibiting an initially socially undesirable negative reaction or impulsive aggression are relatively more likely to behave appropriately in the classroom social context (Eisenberg et al., 2000). Interactions with peers and teachers make up an important part of the process by which children learn and construct knowledge (Bronfenbrenner & Morris, 2006; Hamre & Pianta, 2001; Vygotsky, 1977). Notably, better self-regulation appears to place children in a more advantageous position to engage in high-quality social interactions with teachers and peers which, in turn, results in learning and academic achievement.

Despite this, only recently has research begun to explicate on the possible mediation relationship between self-regulation, aspects of social functioning, and academic achievement (Eisenberg et al., 2005, 2010). Across two studies, Valiente et al. (2008, 2011) found that social functioning mediated the relationship between self-regulation and academic achievement in grade school, with evidence that these relationships hold over a span of several years. Additionally, a recent study by Denham et al. (2012) indicates that lower preschool executive function was bi-directionally related to aggression/negative emotionality, which, in turn, related to lower teacher-reported academic achievement in kindergarten.

Although past research involving child social functioning and its relation to other skills has often focused upon the collective role of both social skills and problem behaviors within social functioning (Valiente et al., 2011), recent work suggests that social skills and problem behaviors may have different roles in the relation between self-regulation and academic outcomes. Research utilizing principal components analyses indicates that social skills form a different component of social functioning than problem behaviors (Denham et al., 2012; Gresham & Elliott, 1990). Moreover, work by Denham et al. (2012) indicates that aggression/negative emotionality, mediated the pathway between preschool executive function and kindergarten achievement in a low-SES population, but not pro-social behaviors/social skills. This, along with theory (Eisenberg et al., 2010), suggests that the process linking self-regulation to academic achievement through social functioning may be different depending on the

aspect of social functioning considered (i.e., social skills versus problem behaviors). Thus, within the current study, we investigate how social skills and problem behaviors each mediate the relationship between self-regulation and academic achievement.

1.2.1. Social skills

One way that self-regulation may be linked to academic achievement is that self-regulation supports children's ability to initiate positive interactions with others and these positive interactions facilitate learning. Empirically, children with better self-regulation tend to have better social skills (Diener & Kim, 2004; Eisenberg, Fabes, Bernzweig, & Karbon, 1993; Ladd, Birch, & Buhs, 1999; Miller et al., 2004; Raver, Blackburn, Bancroft, & Torp, 1999). For instance, self-regulation contributes to social skills, such as sharing, and remaining emotionally positive (Denham et al., 2012; Eisenberg et al., 2000; Hubbard & Coie, 1994; Raver et al., 1999). Likewise, children with higher levels of self-regulation tend to demonstrate higher levels of socially competent behaviors (e.g., helping others, being friendly) during peer interactions (Fabes et al., 1999). Conversely, children who struggle with self-regulation tend to demonstrate social reticence, often having difficulty utilizing appropriate strategies to initiate interactions with peers (Coplan, Gavinski-Molina, Lagace-Seguin, & Wichmann, 2001; Fabes, Martin, Hanish, Anders, & Madden-Derdich, 2003).

Although some findings suggest social skills may not be related to later achievement (Duncan et al., 2007), an increasingly robust body of literature suggests that the two are closely linked (Birch & Ladd, 1998; Coplan et al., 2001; Denham et al., 2012; Eisenberg et al., 2010; Fabes et al., 2003; Ladd et al., 1999; Valiente et al., 2008, 2011; Wentzel, Donlan, & Morrison, 2012). For instance, social skills (particularly pro-social behaviors), are related to Head Start attendees' early literacy and mathematics skills, especially for girls (Bierman, Torres, Domitrovich, Welsh, & Gest, 2009). Better social skills help children to initiate positive peer interactions and these interactions can help children learn positive behaviors through peer modeling and provide the child with resources (e.g., support and acceptance) (Birch & Ladd, 1997, 1998; Bronson, 2000; Hamre & Pianta, 2001; Ladd & Burgess, 2001). Both help facilitate the child's adoption of positive learning strategies and help them build a foundation for successful academic achievement, particularly in difficult situations (Alexander & Entwisle, 1988; Fredricks, Blumenfeld, & Paris, 2004; Keogh, 2003; Ladd et al., 1999; Zimmerman & Schunk, 2001). Additionally, recent intervention work suggests that improving self-regulation and social skills concurrently promotes gains in early literacy skills and later social skills (Bierman et al., 2008). Together, these studies offer preliminary evidence that self-regulation relates to academic achievement in part via social skills as higher levels of self-regulation help children to appropriately initiate positive interactions with both teachers and other children and, in turn, these interactions facilitate learning.

1.2.2. Problem behaviors

Another possible mechanism that may underlie the relationship between self-regulation and academic achievement is the child's exhibition of problem behaviors. Lower levels of self-regulation have been related to a greater number of problem behaviors, particularly externalizing problems such as aggression, impulsivity, and defiance (Denham et al., 2012; Eisenberg et al., 2001; Hill, Degnan, Calkins, & Keane, 2006; McCabe & Brooks-Gunn, 2007). Children with lower levels of self-regulation are more likely than those with higher levels of self-regulation to engage in off-task and disruptive behaviors during instructional activities and learning (Rimm-Kaufman, La Paro, Downer, & Pianta, 2005), especially when a difficult task is presented (Carr, Taylor, & Robinson, 1991). For instance, children with low self-regulation are less likely, as compared to peers with higher levels of self-regulation, to avoid negative interactions (e.g., aggressive or defiant interactions, venting and tantrums) that disturb the learning environment (Fabes et al., 1999; Hill et al., 2006). Higher levels of problem behaviors have been linked to peer conflict, and negative teacher-child relationships (Ladd et al., 1999; Miller et al., 2004). For example, children exhibiting greater problem behaviors are more likely than children who exhibit few problem behaviors to receive commands from their teachers, indicating a less positive relationship (Dobbs & Arnold, 2009). They are often excluded by teachers from the classroom (Pianta, Steinberg, & Rollins, 1995) and rejected by peers within the classroom (Arnold, Homrok, Ortiz, & Stowe, 1999; Arnold, Ortiz, et al., 1999), thereby reducing their time for interactional learning (Arnold, Homrok, et al., 1999; Arnold, Ortiz, et al., 1999). Perhaps related to this reduced learning time, externalizing problem behaviors have also been shown to have a strong, negative relationship with children's later academic achievement (Arnold, 1997; Bierman et al., 2009; Doctoroff, Greer, & Arnold, 2006). In particular, problem behaviors appear to interfere not only with classroom learning processes, but with the own child's ability to engage in learning. In short, these studies highlight that self-regulation may also affect children's academic achievement through children's exhibition of problem behaviors, as children who exhibit lower levels of self-regulation tend to act out more, which may result in negative classroom relationships and a disruption in their own ability to learn.

1.3. Gender differences in mediation

In addition to examining possible mediators that may help to explain the association between self-regulation and academic achievement, the current study allows for the possibility that these processes may be different for boys and girls. Gender differences in academic achievement have been well established in recent years, with girls achieving higher grades and higher levels of education than boys (Birch & Ladd, 1998; Duckworth & Seligman, 2006; Silverman, 2003). Recent research has also indicated early gender differences in self-regulatory skills (Kochanska et al., 2001; Matthews et al., 2009; McClelland et al., 2007), and to some degree, in the relationship between self-regulation and academic achievement (Denham et al., 2012; Ready, LoGerfo, Burkam, & Lee, 2005). Although mean differences in self-regulation (which tend to be small in preschool, $d = .08$; Cameron Ponitz et al., 2008) and academic performance ($d = .19$; Ready et al., 2005) have been established for boys and girls, very little research has examined whether the process that underlies the relationship between self-regulation and academic achievement is different. This area of inquiry is important, as research suggests that there is variation in the ways that boys and girls socialize and/or express problem behaviors (particularly related to aggression) and how these behaviors relate to academic achievement (Crick & Grotpeter, 1995; Denham et al., 2012; Doctoroff et al., 2006; Keenan & Shaw, 1997). For instance boys, but not girls, who engage in fewer pro-social interactions and exhibit overt aggressive behaviors tend to have lower early literacy skills in preschool (Doctoroff et al., 2006). This suggests that the processes relating self-regulation, social functioning, and academic achievement may be different for boys and girls. Understanding early gender differences in these processes, even if effect sizes are small, represents an important step in understanding how best to support children's early academic skills.

1.4. Research aims

Self-regulation in preschool has been identified as an important predictor of current and later academic achievement thus providing a solid foundation for future success (Blair, 2002, 2010; Mischel

et al., 2011). However, it remains unclear what mechanisms drive this association, making it difficult to determine how best to support children's development within the classroom. The current study tested whether children's social functioning within the classroom is part of the process through which self-regulation relates to early academic growth. Specifically, we investigated whether children's reported social skills and/or problem behaviors mediated the relationship between behavioral self-regulation and growth in literacy and math across preschool. Finally, we examined whether the mediation process was moderated by gender.

2. Method

2.1. Participants

Children (n = 118, 78 males) and their families were recruited from two NAEYC-accredited preschools located in the Midwest. The children were in 12 classes taught by seven teachers in either morning, afternoon, or full-day sessions (several teachers taught more than one class). The average age of the children in the study was 49.52 (SD = 6.41) months, with a range of 36 months to 65 months. The parent-reported racial makeup of the children in the study included White or Caucasian (70.6%), Black or African American (2.9%), Hispanic or Latino (1.5%), Asian (8.8%), as well as parents who indicated 'Other' ethnicities (16.2%). Of those parents who responded, a majority (80%) reported that English was the primary language spoken at home. Notably, results from analyses with only native English speakers versus the full sample yielded the same pattern of results, thus we report findings based on the full sample. Parents were also asked to report the mother's highest level of education completed. Respondents included: no high school diploma (1.6%); high school diploma or equivalent (1.6%); some college or technical training (18.7%); bachelor's degree (37.5%); and beyond a bachelor's degree (40.6%).

2.2. Measures

2.2.1. Behavioral self-regulation

Behavioral self-regulation was measured using the Head–Toes–Knees–Shoulders task (HTKS; Cameron Ponitz, McClelland, Matthews, & Morrison, 2009; Matthews et al., 2009). The HTKS is a 20-item task that requires children to perform an opposite motor response of what is verbally instructed to them. During the assessment, children were required to remember four paired behavioral rules ("touch your toes," "touch your head," "touch your shoulders," and "touch your knees"). When asked to perform one rule (e.g., touch your head), the child had to do the opposite (i.e., touch your toes). Examiners could re-explain the behavioral rules up to three times during the training and practice items of the HTKS. For each item, children were given a score of 0 for an incorrect response (i.e., child touched head when instructed to "touch head"), a score of 1 when they self-corrected an initial incorrect response (i.e., when asked to "touch head", child began to touch head, and then self-corrected and touched toes), and a score of 2 if they were able to respond correctly initially (e.g., examiner instructed child to "touch head" and child immediately touched toes). Total scores on this measure ranged from 0 to 40, with higher scores indicating higher levels of behavioral self-regulation.

Previous research has indicated that the HTKS measure is both valid and reliable (Cameron Ponitz et al., 2008, 2009; Connor et al., 2011; McClelland et al., 2007; Wanless et al., 2011). HTKS scores are significantly correlated with reported self-regulation in the classroom (r = .20–.48) and parental reports of attention and inhibitory control (r = .20–.25) (Cameron Ponitz et al., 2009; McClelland et al., 2007). The HTKS has been shown to have high inter-rater reliability (κ = .90) and internal consistency generally above .90, see recent articles by Cameron Ponitz and colleagues for further information on the validity and reliability of this measure (Cameron Ponitz et al., 2009; Wanless et al., 2011). Cronbach's alpha within our sample was .82 indicating an acceptable level of internal consistency.

2.2.2. Social skills and problem behaviors

Teachers reported on children's social skills and problem behaviors using portions of the Social Skills Improvement System (SSIS; Gresham & Elliott, 2008), which is a revised version of the widely used Social Skills Rating System (SSRS; Gresham & Elliott, 1990). The SSIS is normed for children between the ages of 3 and 18 and includes domains in the areas of social skills, problem behaviors, and academic competence.

The social skills domain includes seven subscales: 7 communication items (e.g., making eye contact), 6 cooperation items (e.g., helping others), 7 assertion items (e.g., initiating behaviors), 6 responsibility items (e.g., showing regard for property), 6 empathy items (e.g., showing concern and respect for others), 7 engagement items (e.g., joining in activities) and 7 self-control items (e.g., responding appropriately in conflict and non-conflict situations), for a total of 46 items in the overall social skills domain. The current study excludes the 7 item self-control subscale as this subscale is thought to measure the same latent trait (i.e., self-regulation) as the HTKS task, though notably none of the subscales were highly correlated with this measure of self-regulation (analyses with self-control included also yielded the same pattern of results). On each of the items, teachers rated the frequency of a particular social skill using a 4-point scale of *Never, Seldom, Often*, or *Almost Always*. Total raw scores for the social skills domain were used in all analyses. Internal consistency reliability for the social skills domain, as reported in the SSIS manual, is .97 (Gresham & Elliott, 2008). In the current study, Cronbach's alpha was .98.

Teachers reported on children's problem behaviors using a selection of subtests from the SSIS (Gresham & Elliott, 2008) including the externalizing, the hyperactivity/inattention and bullying subscales (analyses with just externalizing behaviors, or with externalizing and bullying yielded the same pattern of results). Externalizing behaviors include being verbally or physically aggressive, failing to control one's temper, and arguing. Bullying behaviors include bullying others, forcing children do things against their will and scaring them. Hyperactive/inattentive behavior includes being distracted easily or inattentive. Together, these scales included 18 items. As with the social skills domain, teachers rated the frequency of a particular problem behavior using a 4-point scale of *Never, Seldom, Often*, or *Almost Always*. Total raw scores for these subscales were used for all analyses. Internal consistency reliability for the externalizing, bullying, and hyperactivity/inattention subscales, as reported in the SSIS manual, are .93, .75, and .90 respectively (Gresham & Elliott, 2008). Together, Cronbach's alpha from our sample was .90 indicating high internal consistency. Data from one child were dropped from the analyses because his/her reported problem behaviors score was an outlier within the current dataset (over three standard deviations above the mean), with a score more than double the normative level reported for preschoolers (Gresham, Elliott, & Kettler, 2010). Thus the final sample size included 117 children. In all analyses, problem behaviors were normalized by conducting a square root transformation to correct for the degree of skew (skew = .94).

2.2.3. Literacy

Literacy skills were represented by three indicators: decoding, letter knowledge, and phonological awareness. Decoding was assessed using the Letter-Word Identification (LWI) subscale of the Woodcock-Johnson Tests of Achievement (WJ-III; Woodcock

& Mather, 2001). This 76-item test requires children to first identify letters followed by having them decode increasingly more difficult words. Results were scored using Rasch-based *W* scores. Reliability on this measure for children 3–8 years of age is excellent (range = .96–.99).

To assess letter knowledge, both uppercase and lowercase letters were tested as previous findings suggest that including lowercase letter knowledge extends the measure's range and enables for more effective measurement, particularly for children with higher levels of letter knowledge (Bowles, Pentimonti, Gerde, & Montroy, 2014). The entire alphabet was presented one letter at a time on 3-in.-by-5-in. index cards, with eight different forms consisting of all letters in a different random order, although lowercase letter assessment always followed uppercase. Children were asked to name the letter as it appeared on the index card. Scores could range from 0 to 52. Cronbach's alpha within our sample was .99.

Phonological awareness was assessed using the phonological awareness subtest of the Test of Preschool Early Literacy (TOPEL; Lonigan, Wagner, Torgesen, & Rashotte, 2007). This 27-item subtest contains four item sets. The first two item sets measure elision abilities, or the ability to drop out specific sounds (e.g., say heat without/t/). The remaining sets measure blending abilities, or the ability to combine sounds (e.g., what do you get when you combine/ca/and/p/). The TOPEL phonological awareness subtest has an internal consistency reliability of .87 for ages 3–5. Within our sample, Cronbach's alpha was .90. We utilized raw scores for all analyses as standard scores for the TOPEL phonological awareness subtest are by age and therefore inappropriate for examining growth. Calculating standard scores using a common age for all children yielded the same pattern of results as the raw scores.

2.2.4. Math

Children's early math skills were measured using the Test of Early Mathematics Ability 3rd Edition (TEMA-3; Ginsburg & Baroody, 2007). The TEMA-3 is a 72-item assessment of early math skills (ages 3–8) and concepts such as counting, enumeration, producing sets, addition, and subtraction. Many of the items on the TEMA-3 utilize pictures and manipulatives, such as tokens, blocks, and note cards, helping to make the test more age appropriate for younger children (e.g., can you hand me exactly 19 blocks?). Raw scores were used in all analyses. Analyses with TEMA-3 standard scores using a common age for all children yielded the same pattern of results as the raw scores. Internal consistency reliability for the TEMA-3 ranges between .94 and .96; within our sample it was .84.

2.3. Procedures

All of the families and children that participated in the current study were part of an ongoing longitudinal study, the Michigan Longitudinal Study of Early Literacy Development (MLSELD; Bowles et al., 2014) investigating children's cognitive, academic, and social development during preschool. Families were invited to participate in the study at the beginning of the school year and participating children were tested individually in their schools by trained research assistants in the fall and spring of the school year. The order of assessments was randomized. Teachers reported on children's development in the areas of social skills and behavioral problems in the winter of the school year after they had an adequate amount of time to interact with children and observe their behavior.

3. Results

Means and standard deviations are listed in Table 1. Correlations for the predictor, outcome, and background variables (mother education, age) are presented in Table 2. Due to the fact data were collected from children in 12 different classrooms, we considered utilizing a multi-level approach. However, the intra-class correlations (ICCs), which are an indication of variation across classrooms, were small for the predictor variable (self-regulation ICC = .09) and the outcome variables (letter knowledge ICC = .02, phonological awareness IC = .05, letter-word decoding ICC = .05), and when we treated analyses in a multi-level framework, the models would not converge due to the small number of clusters. Thus multilevel modeling was not used in the final analyses. Notably the ICC's were more substantial for the teacher-reported mediation variables (problem behaviors = .30, social skills = .31). However this may be an artifact related to differences in how teachers report (Rimm-Kaufman et al., 2000). With this possibility in mind, we also considered these variables group-mean centered by classroom. These analyses yielded a similar pattern of findings as analyses with the raw scores. All analyses were completed in Mplus (Muthén & Muthén, 1998–2010) utilizing full information maximum likelihood to account for missing data (see Table 1 for number of children tested on each assessment). Initially, mother's education, child's reported race/ethnicity and child's age were used as covariates within all models. However, race/ethnicity was not related to any of the predictor, mediator, and outcome variables, so for the sake of parsimony, it was dropped from all final analyses, but mother's education and child's age were included as covariates.

Table 1
Descriptive statistics for predictor and outcome variables.

Variables	%			
Mother education				
<HS	1.6			
HS	1.6			
SC	18.8			
BA	37.5			
>BA	40.7			
Race/ethnicity				
White/Non-Hispanic	70.6			
Hispanic	1.5			
African-American	2.9			
Asian	8.8			
Other	16.2			
	M	*SD*	Range	*N*
Child age	49.52	6.41	36–65	109
Self-regulation, fall	13.19	13.22	0–39	109
Math, fall (raw scores)	11.28	9.12	0–51	110
Math, spring (raw scores)	14.73	11.17	0–47	102
Letter-word decoding, fall (W scores)	334.49	33.41	264–486	105
Letter-word decoding, spring (W scores)	347.21	34.61	264–498	103
Phonological awareness, fall (raw scores)	12.50	7.03	0–27	105
Phonological awareness, spring (raw scores)	14.26	7.63	0–27	109
Letter knowledge, fall	25.17	18.38	0–52	105
Letter knowledge, spring	30.90	18.63	0–52	110
Problem behaviors: (teacher SSIS) – externalizing/hyperactivity/inattention/bullying	2.15	1.50	0–5.29	111
Social skills: (teacher SSIS; raw scores) – excludes self-control	78.20	22.25	8–115	111

Note: < HS = less than high school, HS = high school diploma, SC = some college, BA = Bachelor's degree, and >BA = higher than a bachelor's degree. The problem behaviors variable includes the externalizing, hyperactivity/inattention and bullying subscales of the SSIS and has been transformed via the square root transformation. The social skills variable includes all of the SSIS social skills subscales except self-control.

Table 2
Correlations for predictor, outcome, and background variables.

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Self-regulation, fall	–	–	–	–	–	–	–	–	–	–	–	–	–
2. Child age, fall (in months)	.43	–	–	–	–	–	–	–	–	–	–	–	–
3. Mom's education	.20	−.12	–	–	–	–	–	–	–	–	–	–	–
4. Letter knowledge, fall	.37	.21	.28	–	–	–	–	–	–	–	–	–	–
5. Phonological awareness, fall	.54	.46	.01	.44	–	–	–	–	–	–	–	–	–
6. Letter-word decoding, fall	.46	.29	.15	.75	.53	–	–	–	–	–	–	–	–
7. Math, fall	.63	.52	.23	.59	.68	.62	–	–	–	–	–	–	–
8. Letter knowledge, spring	.41	.27	.07	.76	.55	.62	.55	–	–	–	–	–	–
9. Phonological awareness, spring	.53	.33	.15	.40	.70	.52	.62	.58	–	–	–	–	–
10. Letter-word decoding, spring	.37	.20	.20	.74	.52	.74	.56	.73	.54	–	–	–	–
11. Math, spring	.53	.45	.25	.64	.59	.62	.80	.64	.68	.65	–	–	–
12. Problem behaviors	−.26	−.10	−.20	−.29	−.30	−.33	−.40	−.39	−.48	−.28	−.40	–	–
13. Social skills	.25	.04	.24	.31	.39	.32	.39	.43	.51	.29	.40	−.72	–

Note: All correlations at or above ±.21 are significant at the $p < .01$ level.

3.1. Self-regulation and academic achievement

We examined academic achievement separately for literacy and for math as there is some evidence that self-regulation is differentially related to literacy and math achievement (Blair & Razza, 2007; Matthews et al., 2009). Fall and spring literacy achievement were defined by latent literacy factors with three indicators: letter name knowledge, phonological awareness and letter-word decoding at each time point. Growth was defined as a latent factor of spring scores controlling for fall scores. Model fit for the literacy growth factor was good based on the CFI (.98; Hu & Bentler, 1999) and SRMR (.02; Hu & Bentler, 1999), adequate based on the TLI (.91; Hu & Bentler, 1999), and poor based on the RMSEA (.11; Browne & Cudeck, 1993). Examination of possible sources of misfit based on modification indices suggested three paths: two residual correlations (fall phonological awareness with spring phonological awareness and fall letter knowledge with spring phonological awareness) and one regression relationship (spring letter knowledge on fall letter-word decoding) had high modification indices. However, adding these three paths was not justifiable theoretically. Therefore, we did not incorporate them in the final analyses, and concluded that the original factor provided adequate fit to the data. We used the original factor in all subsequent analyses. Fall and spring math achievement were defined as the children's score on the TEMA-3 measure at each time point, and math growth was defined as spring TEMA-3 scores controlling for fall scores.

Higher fall behavioral self-regulation scores were associated with higher literacy scores in the fall, $\beta = 0.41$, $p < .01$, in the spring, $\beta = .47$, $p < .01$, and were also a significant predictor of growth in early literacy skills, $\beta = 0.45$, $p < .01$. That is, children who began preschool with higher levels of behavioral self-regulation gained more in literacy skills throughout the year relative to children starting with the same level of literacy skills but with lower levels of behavioral self-regulation. Higher levels of fall behavioral self-regulation were associated with higher math scores in the fall, $\beta = 0.46$, $p < .01$ and spring, $\beta = .35$, $p < .05$. However, fall behavioral self-regulation was not a significant predictor of growth in math skills, $\beta = 0.04$, $p = 0.59$. This is likely due to the fact that there was little variability in growth in math when fall math was accounted for (fall math $\beta = .76$, $p < .01$, R-squared = .65).

3.2. Mediation models

To examine the role of social skills and problem behaviors as potential mediators in the relationship between behavioral self-regulation and literacy and math achievement, we utilized a mediation analysis within structural equation modeling (MacKinnon, 2008; MacKinnon, Lockwood, Hoffman, West, & Sheets, 2002) with bootstrapped direct and indirect effects, which have been shown to provide the most appropriate confidence intervals among currently available techniques (Hayes, 2009; MacKinnon, Lockwood, & Williams, 2004; Preacher & Hayes, 2008). We considered social skills and problem behaviors, both separately and simultaneously, as mediators of the relation between self-regulation and growth in literacy and growth in math. We focused on growth to account for the time necessary for the mediation process to unfold (Selig & Preacher, 2009).

3.3. Growth in literacy

3.3.1. Social skills

As presented in Fig. 1, a child's reported social skills mediated the relationship between fall behavioral self-regulation and growth in literacy as the confidence interval for the indirect effect did not include zero, $b = .10$, $CI^{95} = [0.02, 0.25]$, $\beta = .16$. Children who began preschool with higher levels of behavioral self-regulation tended to have better social skills, which, in turn, was associated with greater gains in literacy over the course of the year. The direct mediated effect between fall behavioral self-regulation and growth in literacy remained significant, $b = .24$, $CI^{95} = [0.09, 0.47]$, $\beta = .38$ when social skills was included as a mediator, indicating that social skills did not fully mediate the relationship between self-regulation and literacy growth. The total effect of fall behavioral self-regulation on growth in literacy was $b = .34$, $CI^{95} = [0.15, 0.62]$, $\beta = .54$, so child-reported social skills (i.e., the indirect effect) accounted for .54–.38/.54 = 30% of the relationship between behavioral self-regulation and growth in literacy.

3.3.2. Problem behaviors

Reported problem behaviors mediated the relationship between behavioral self-regulation and growth in literacy as the confidence interval for the indirect effect did not include zero, $b = .06$, $CI^{95} = [0.01, 0.17]$, $\beta = .11$; see Fig. 2. Children who began preschool with higher levels of behavioral self-regulation tended to exhibit fewer problem behaviors, which subsequently was associated with greater gains in literacy skills over the course of the year. The direct mediated effect between fall behavioral self-regulation and growth in literacy remained significant when problem behaviors was included as a mediator, $b = .23$, $CI^{95} = [0.07, 0.46]$, $\beta = .41$, indicating that problem behaviors did not fully mediate the relationship

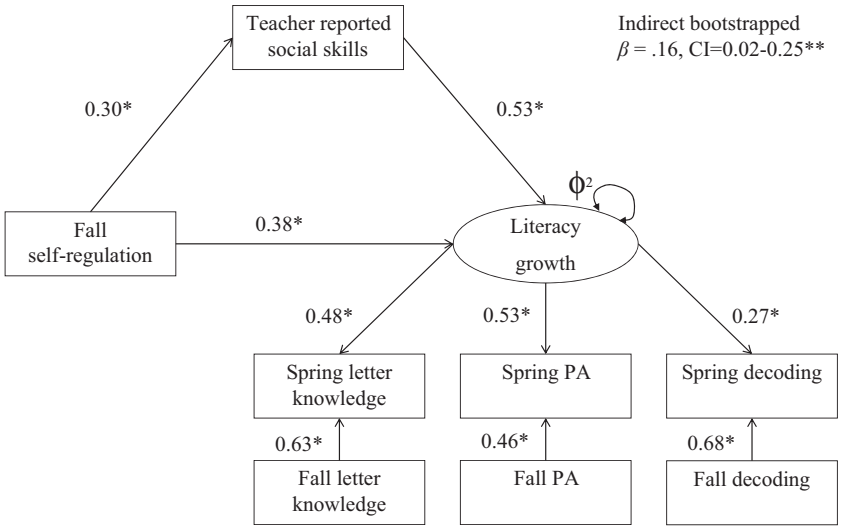

Fig. 1. Mediation of the relationship between growth in literacy and fall behavioral self-regulation by social skills. Residuals and exogenous covariates (age, mother education) are suppressed in order to simplify the figure. Fall PA and spring PA refer to fall phonological awareness and spring phonological awareness respectively. Regression coefficients are standardized. *$p < .05$. **Confidence intervals that do not include zero are considered statistically significant.

between behavioral self-regulation and growth in literacy. The total effect of fall behavioral self-regulation on growth in literacy was $b = .29$, $CI^{95} = [0.10, 0.55]$, $\beta = .52$ with a child's reported problem behaviors (i.e., the indirect effect) accounting for .52–.41/.52 = 21% of the relationship between behavioral self-regulation and growth in literacy.

3.3.3. Social skills and problem behaviors

Next we considered both problem behaviors and social skills simultaneously as mediators in order to determine the contributions of both to the relationship between self-regulation and growth in literacy. As displayed in Fig. 3, we found that both problem behaviors and social skills together mediated the relationship between behavioral self-regulation and growth in literacy achievement as the confidence interval for the indirect effect did not include zero, $b = .09$, $CI^{95} = [0.02, 0.23]$, $\beta = .15$, however, the individual indirect pathway through problem behaviors was no longer significant, $b = .03$, $CI^{95} = [-.02, 0.11]$, $\beta = .05$, whereas the indirect pathway through social skills was ($b = .07$, $CI^{95} = [0.01, 0.22]$ $\beta = .11$. The direct mediated effect between fall behavioral self-regulation and growth in literacy also remained significant when both mediators were included, $b = .22$, $CI^{95} = [0.07, 0.45]$, $\beta = .37$, indicating that problem behaviors and social skills together did not fully mediate the relationship between self-regulation and literacy growth. However, within these data, problem behaviors and social skills were collinear, $r = -.72$, $p < .01$ (typically social skills and problem behaviors are correlated between .30 and .60; Gresham & Elliott, 2008) and constraining the indirect pathways to be equal did not introduce significant misfit, $\Delta\chi^2 = 0.76$, $\Delta df = 1$, $p = .38$; however constraining problem behaviors to zero did, $\Delta\chi^2 = 13.47$, $\Delta df = 1$, $p < .01$. Thus, no conclusion about the relative importance of the social skills compared to problem behaviors can be made.

3.3.4. Growth in mathematics

Although there was no significant relation between fall behavioral self-regulation and growth in math, we still considered social skills and problem behaviors as mediators. Our findings indicate that neither the direct or indirect effects were significantly

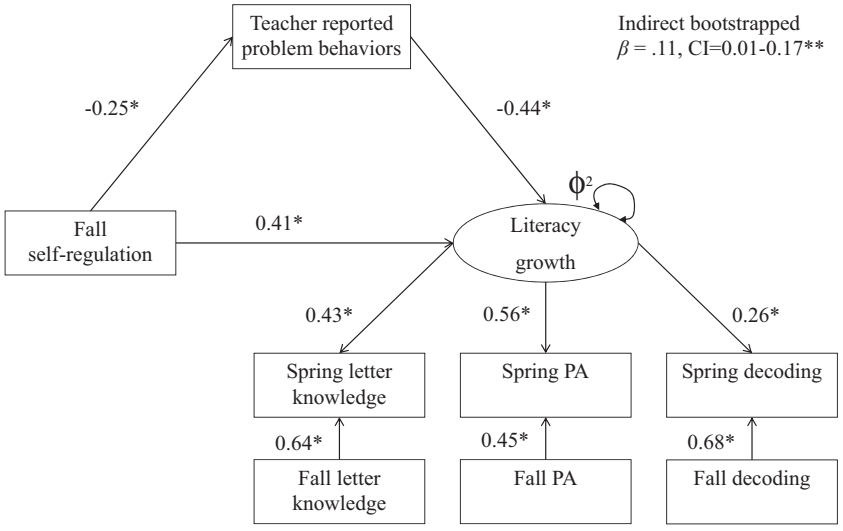

Fig. 2. Mediation of the relationship between growth in literacy and fall behavioral self-regulation by problem behaviors. Residuals and exogenous covariates (age, mother education) are suppressed in order to simplify the figure. Fall PA and spring PA refer to fall phonological awareness and spring phonological awareness respectively. Regression coefficients are standardized. *$p < .05$. **Confidence intervals that do not include zero are considered statistically significant.

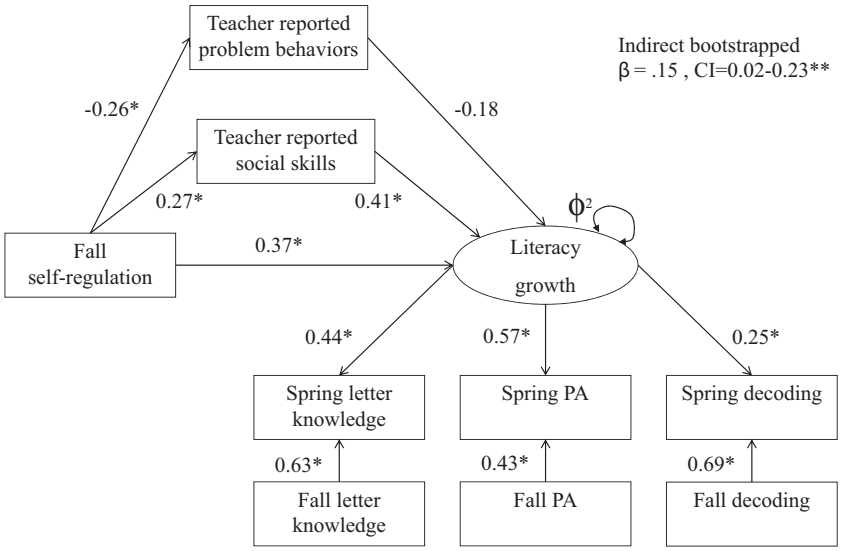

Fig. 3. Mediation of the relationship between growth in literacy and fall behavioral self-regulation by problem behaviors and social skills. Residuals and exogenous covariates (age, mother education) are suppressed in order to simplify the figure. Fall PA and spring PA refer to fall phonological awareness and spring phonological awareness respectively. Regression coefficients are standardized. *$p < .05$. **Confidence intervals that do not include zero are considered statistically significant.

different from 0 for either social skills (direct: $b = .02$, $CI^{95} = [-0.09, 0.12]$, $\beta = .03$; indirect: $b = .02$ $CI^{95} = [-0.01, 0.07]$, $\beta = .03$) or problem behaviors (direct: $b = .02$, $CI^{95} = [-0.10, 0.12]$, $\beta = .03$; indirect: $b = 0.01$, $CI^{95} = [-0.01, 0.05]$, $\beta = .01$). Thus, we did not analyze the relationship between behavioral self-regulation, growth in math and social skills/problem behaviors further.

3.4. The role of gender

The average score on the behavioral self-regulation task in the fall for girls ($M = 12.89$, $SD = 13.73$) was not significantly different from the average score for boys ($M = 13.35$, $SD = 13.04$; $t(107) = -.17$, $p = .87$, $d = .03$). We first considered whether literacy growth was measured in the same way for both boys and girls, that is, factorial invariance of the literacy growth factor (Horn & McArdle, 1992). We began by considering a model where factor means, variances, covariances, and the factor loadings for the three literacy indicators (letter knowledge, phonological awareness, and letter-word decoding) were constrained to be the same for both boys and girls. We then progressively relaxed the indicator intercepts, factor means, the autoregressive coefficients, and factor loadings. In all cases, there were no significant decreases in misfit when constraints were relaxed suggesting strict metric invariance; see Table 3 for model comparison details. We therefore concluded that literacy growth is measured in the same way for boys and girls.

To investigate the role of gender in the relationship between fall behavioral self-regulation and growth in literacy, we started with a model in which all parameters were constrained to be equal for boys and girls. We then relaxed the parameters associated with the relationship between behavioral self-regulation and literacy growth as well as the parameters associated with the mediators within the mediation models. In all cases, relaxing parameters did not result in significantly better model fit (see Table 3), indicating that social skills and problem behaviors mediated the relationship between behavioral self-regulation and literacy growth in similar ways for boy and girls.

4. Discussion

This study investigated whether social skills and problem behaviors, two elements of social functioning, are part of the process that links behavioral self-regulation to academic achievement during preschool. Results indicated that both social skills and problem behaviors mediate the relationship between self-regulation and growth in early literacy skill, but not math, and this was similar for both boys and girls. These findings suggest that a child's social skills and problem behaviors are part of the mechanism through which behavioral self-regulation affects growth in early literacy achievement.

4.1. Self-regulation and academic achievement

Children with higher behavioral self-regulation in the current study scored significantly higher on literacy and math measures in the fall and spring of the preschool year (with a stronger relationship between fall math and fall self-regulation than fall self-regulation and fall literacy). Likewise children with high levels of self-regulation also exhibited greater gains in literacy achievement across the preschool year, adding to the considerable evidence that early behavioral self-regulation is an important aspect of academic

Table 3
Gender Differences Models.

Step	χ^2	*df*	$\Delta\chi^2$	Δdf	*p*
1. Growth factor invariance					
Fully constrained	26.86	20			
Free loadings	23.36	18	3.50	2	0.17
Free growth	21.32	15	2.04	3	0.56
Free intercepts	18.20	12	3.12	3	0.37
2. Gender differences in social skills mediation					
Fully constrained	96.86	67			
Free loadings	89.26	52	7.60	15	0.94
Free intercepts	87.64	48	1.62	5	0.90
Free var. and covar.	85.54	39	2.10	9	0.99
3. Gender differences in PB mediation					
Fully constrained	90.42	67			
Free loadings	82.50	52	7.92	15	0.93
Free intercepts	78.80	48	3.70	5	0.59
Relaxed var. and covar.	76.59	39	2.21	9	0.99
4. Gender differences in PB and social skills mediation					
Fully constrained	110.16	82			
Free loadings	97.92	63	12.08	19	0.88
Free intercepts	96.07	59	1.85	4	0.76
Free var. and covar.	92.51	49	3.56	10	0.97

Note: Var. = variance; Covar. = covariance; PB = problem behaviors.

achievement and school readiness (Blair, 2002; Howse, Calkins, et al., 2003; Howse, Lange, et al., 2003; McClelland et al., 2007; Sektnan et al., 2010).

In our study, behavioral self-regulation was not associated with *growth* in math although, consistent with other research, behavioral self-regulation was related to the *level* of math achievement (Blair & Razza, 2007; Espy et al., 2004; Tominey & McClelland, 2011). To our knowledge, only one previous study (McClelland et al., 2007) directly addressed the relation between behavioral self-regulation and growth in math during the preschool time period. They found greater mean growth and greater individual variability in growth in math and, contrary to our study, they found that behavioral self-regulation was related to growth in math. However, they utilized a different measure of math performance (WJ-III Applied Problems), which involves children's language skills to a greater extent than the calculation focused measure used in the current study (Skibbe, Hindman, Connor, Housey, & Morrison, 2013). Thus, the divergent conclusions may simply reflect a greater role of language in their math measure.

Indeed, similar to other studies (Tominey & McClelland, 2011) we found little variability in spring math skills after accounting for fall scores. This may reflect the observation that preschool children are not receiving systematic instruction, particularly on calculation based mathematical skills (Baroody, Lai, & Mix, 2006); even NAEYC-accredited programs have been found lacking in some of the key elements that support mathematical learning (Johnston, 2010). If children are not receiving systematic instruction on calculation-based skills, then they also have few opportunities to utilize self-regulation in order to access knowledge reliant on calculation. Clearly these findings point to the need for future research evaluating how math develops during preschool, how best to measure this development, and what skills specifically link to growth in math during preschool.

4.2. Mediators between behavioral self-regulation and literacy achievement

As one of the few studies (Denham et al., 2012; Valiente et al., 2008, 2011) to examine the mechanisms through which self-regulation may relate to academic achievement, results demonstrated that a significant amount of the variance in this relationship could be accounted for by both social skills (i.e., 30%) and problem behaviors (i.e., 21%). This suggests that self-regulation is important, not just because of the way that it relates directly to academic achievement, but also because of the ways in which it promotes or inhibits children's interactions with others.

By evaluating the relationship between self-regulation, social functioning, and academic achievement in a meditational framework, this study extends previous theory (Bronfenbrenner & Morris, 2006; Eisenberg et al., 2010; Hamre & Pianta, 2001; Vygotsky, 1977) and findings (Denham et al., 2012; Valiente et al., 2008, 2011) with results indicating that when direct assessments of both self-regulation and academic achievement are utilized, part of the process whereby self-regulation predicts academic achievement is through social functioning. Specifically, and in line with findings from grade school-aged children (Valiente et al., 2008, 2011), these findings support the hypothesis that students' relationships in the school context are important for school success, giving children the resources they need to lay a foundation for learning (Birch & Ladd, 1997; Eisenberg et al., 2010; Hamre & Pianta, 2001; Ladd & Burgess, 2001). In this study, children with higher behavioral self-regulation also had higher social skills, thus they were more likely to take turns during conversations, show kindness to others when they are upset and/or tell teachers when there was a problem.

These social skills, in turn, are related to literacy gains across preschool. We can speculate that self-regulation helps children engage in learning activities via boosting their social skills because much of the learning in preschool is interactional and takes place within a social setting (Bronson, 2000). For instance, within circle time, children are asked to both personally engage and listen as peers share, requiring the ability to withhold an initial pre-potent response to speak over someone else and take turns within the large-group conversation, thus gaining academic knowledge from these back and forth exchanges. Likewise, children who utilize their self-regulation skills to engage socially likely find support within peer and teacher interactions giving these children the opportunity to express their needs and subsequently elicit the help they need to succeed within the school environment (Birch & Ladd, 1997; Hamre & Pianta, 2001). Thus, children who are self-regulated are able to reciprocally interact positively with both teachers and other children within these settings (e.g., large and small group), which facilitates learning.

Children's reported problem behaviors also mediated the relationship between self-regulation and growth in literacy. In our study, children with low self-regulation skills were reported to act more impulsively, have more temper tantrums, and were thought to bully others more often than children with higher levels of self-regulation. Teachers are less likely to engage in teaching activities with children who are difficult to manage (Arnold, Ortiz, et al., 1999; Carr et al., 1991), thus, these behaviors likely resulted in fewer learning opportunities and therefore fewer literacy gains across preschool. This suggests that children who begin school with lower levels of self-regulation may, due to their limited ability to engage well with others, benefit less from classroom learning opportunities as these opportunities are embedded within interactional contexts. These differences in achievement may prove cumulative, as children with lower self-regulation skills perform worse than their higher-rated peers on math and literacy measures throughout elementary school, with the gap widening between kindergarten and second grade (McClelland et al., 2006). This effect, often called the Matthew effect, may be partially explained by the social interaction explanation expounded on in the current study to account for the relationship between self-regulation and growth in literacy. Practically, helping children self-regulate their behavior may ameliorate later Matthew effects. Related to this possibility, intervention research suggests improving self-regulation and social skills is related to higher literacy skills and better social skills, even in at-risk populations (Bierman et al., 2008).

Although social skills and problem behaviors each separately mediated the relationship between self-regulation and literacy growth, it is unclear whether one is a more important predictor than the other. For instance, within a model including both pathways, social skills remained a significant mediator of the relationship between self-regulation and growth in literary while the pathway through problem behaviors was no longer significant. However, alternative models where the problem behaviors pathway was constrained to zero resulted in significant misfit, suggesting problem behaviors do play a role in the relationship between self-regulation and growth in literacy. Notably, social skills and problem behaviors were more highly related within the current sample than in previous research (and indeed when these pathways were constrained to equal each other, it did not result in significant misfit). Perhaps this is because the schools sampled within the current study tended to serve higher income populations than those that have found social skills and problem behaviors to be more highly differentiated (Gresham & Elliott, 1990). In related work, Denham et al. (2012) found that only problem behaviors, but not social skills/pro-social behavior, mediated the relationship between executive function and academic achievement in Head Start classrooms. Thus, although this study offers preliminary

evidence of the importance of both social skills and problem behaviors in the relationship between self-regulation and early literacy development, future research is necessary to determine whether the mediational nature of social skills and problem behaviors varies across populations.

4.3. The role of gender

Lastly, we examined whether a child's gender moderates the relationship between self-regulation, social skills, problem behaviors and academic achievement. Counter to previous findings with kindergartners (Matthews et al., 2009; Ready et al., 2005), we found no gender differences in the relationship between self-regulation and academic achievement. Importantly, there was no evidence that gender affected the way that social skills and/or problem behaviors mediated the relationship between behavioral self-regulation and growth in literacy. One possible explanation is that gender differences tend to unfold as children age, with past findings suggesting that gender differences related to academic achievement are often not apparent during children's early school years, but are more likely to occur in middle and high school (Entwisle, Alexander, & Olson, 2007; Hyde, Fennema, & Lamon, 1990; Willingham, Cole, Lewis, & Leung, 1997). Gender differences may be too small to identify in this age group (Matthews et al., 2009) but grow in magnitude with age. For instance, mean differences between boys and girls in academics (d = .19) in preschool are small to moderate (Ready et al., 2005), however the magnitude of the effects appear to increase considerable by high school (d = .58; Serbin, Stack, & Kingdon, 2013).

Alternatively, gender differences may be less likely to occur among preschoolers in middle- to high-SES populations, such as the population from which the current study sample is drawn. Previous work evaluating children in first grade found that boys demonstrated lower levels of academic achievement compared to girls both in first grade and throughout elementary school only if they were from lower-SES families, whereas boys from middle- to high-SES families performed similarly to girls (Entwisle et al., 2007). However, to our knowledge, the interactional relationship between SES and gender has not been evaluated during preschool or in relation to self-regulatory skills. Thus, it is possible that we did not find gender differences in the relation between self-regulation and academic achievement because children's relatively high SES within this sample is a protective factor for boys or because gender differences that tend to favor girls in academic achievement have not yet developed in this population. These possibilities should be evaluated within future longitudinal work.

4.4. Practical implications

Given that self-regulation is an important contributor to aspects of school readiness, developing methods to enhance early self-regulation skills in preschool classrooms may be critical. Several curricula exist that purport to boost early self-regulation skills (e.g., Tools of the Mind, Bodrova & Leong, 2007), and research supports the effectiveness of one curriculum in which activities directly targeting self-regulation are associated with significantly better scores on both self-regulatory tasks and academic achievement tasks in preschool (Diamond, Barnett, Thomas, & Munro, 2008). This suggests that self-regulation skills can be supported within a preschool setting. Likewise some intervention research suggests that classroom-level interventions (Bierman et al., 2008) as well as interventions directly targeting self-regulation (Tominey & McClelland, 2011) can promote better literacy skills, such as letter-word decoding, but it is less clear if self-regulation training results in widespread achievement gains. Future research investigating the utility of self-regulation training is needed in order to evaluate better how best to support young children's early school readiness skills via self-regulation.

4.5. Limitations and future research

Several limitations should be considered for the present work. The measures of social skills and problem behaviors used in the current study relied on teacher reports, similar to previous research in this area (Sektnan et al., 2010; Smith, Borkowski, & Whitman, 2008). Results may have been different if observational measures related to a child's social skills and problem behaviors were utilized (Denham et al., 2012). Teacher reports may be capturing both the child's interactional patterns and teacher's perceptions of the child (based on their beliefs; Carr & Kurtz, 1991), which may be biased. Thus, in addition to the direct measures of self-regulation and academic outcomes that we utilized, future research should consider direct observations of the child's social skills and problem behaviors as well.

Second, self-regulation is an important aspect of navigating the transition to kindergarten (Rimm-Kaufman et al., 2000) as often children must negotiate a new, more structured learning environment and interact with a new peer cohort. However, we did not follow children as they made the transition into kindergarten, so we were unable to investigate whether these relations changed or endured over time. It is possible that a child's social skills and exhibition of problem behaviors may account for more of the association between self-regulation and academic growth during this transition because of these new peer interactions coupled with a more structured setting. Thus, future research is necessary to examine these processes over time.

Third, the current study draws from a fairly homogenous population in terms of socio-economic status. It is possible that the results may have been different if a more heterogeneous population was sampled. However, recent research suggests that the effects of self-regulation on academic achievement do not vary among different-SES populations (McClelland & Wanless, 2012), although it is less clear whether the processes linking self-regulation to academic achievement are the same across a more heterogeneous population. Further research involving different populations and more diverse samples is needed to examine more thoroughly the relationship between self-regulation and academic achievement via child social functioning.

5. Conclusion

The skills children develop in preschool, particularly self-regulation, are critical for their concurrent and later academic achievement (Mischel et al., 2011). Thus, understanding the process through which early self-regulation is associated with academic achievement is important in order to support the positive development of these skills within the classroom. In the current study, social skills and problem behaviors were found to separately and jointly mediate the relationship between behavioral self-regulation and growth in literacy achievement across the preschool year. Thus, self-regulation appears to be foundational in how children interact with others within their environment, subsequently affecting their learning. Researchers and educators need to consider carefully how best to support self-regulatory skills in the classroom in order to optimize children's social functioning, and ultimately their learning within the classroom.

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