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# Observed Peer Competence Moderates Links between Children's Self-Regulation Skills and Academic Performance

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## Abstract

The current study focuses on the relations between observed measures of children's self-regulation and academic achievement, as well as the extent to which observations of children's peer competence in preschool moderates these links. Data were drawn from 102 students (male = 48; $M_{age}$ = 4.82 years, $SD_{age}$ = 0.46 years) enrolled in pre-kindergarten classrooms. A series of linear path models was used to test study hypotheses, and the nature of significant interactions was elucidated by examining simple slopes and regions of significance. Children's self-regulation, but not peer competence, significantly predicted both reading and math performance assessed using

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the Woodcock Johnson III, β = .43, $p < .001$ and β = .39, $p < .001$, respectively. Tests of moderation effects revealed that the association between children's poor self-regulation and poor math performance, but not reading performance, β = −.28, $p = .022$ and β = −.11, $p = .23$, was negated for children with average to high peer competence. These results demonstrate the protective quality of peer competence for academic performance using observational methods collected in preschools.

### Keywords

Peer Competence; Self-Regulation; Academic Achievement

## Introduction

Early school achievement lays the groundwork for subsequent trajectories of academic, social, and economic success (Duncan et al., 2007; Ursache, Blair, & Raver, 2012), and thus there is a growing body of research examining the relations between various preschool skills and early achievement (Masten et al., 2012; Montroy, Bowles, Skibbe, & Foster, 2014; Willoughby, Kupersmidt, Voegler-Lee, & Bryant, 2011). Self-regulatory skills, broadly defined as the ability to direct behavior based on the contextual demands of the situation (Calkins & Fox, 2002; Posner & Rothbart, 2000), have emerged as one set of factors that are critical for early success in school (Blair, 2002) and subsequent academic achievement in childhood and adolescence (Blair, Granger, & Razza, 2005; Lin, Lawrence, & Gorrell, 2003; Montroy, Bowles, Skibbe, McClelland, & Morrison, 2016). In addition to direct relations between children's own self-regulatory skills and academic achievement, aspects of the social environment and a child's ability to navigate that environment have implications for both self-regulation and school success (Rambaran et al., 2016). Although the literature is growing, there remains a paucity of research that examines how the ability to successfully navigate the social environment, referred to here as peer competence, influences the links between a child's own self-regulation and early academic achievement.

The present study examines the processes through which children's self-regulation and peer competence in preschool interactively contribute to academic performance at the transition to kindergarten. Guided by the principle that children's development should be understood in relation to their typical environment (Kagan, 2003), we rely on observational measures of children's self-regulation and peer competence that were collected at children's preschool (defined here as center-based care arrangements attended by children prior to their enrollment in kindergarten), potentially providing increased insight and specificity into the mechanisms contributing to academic performance over laboratory-based data collection procedures. Further, we advance existing work by examining these processes just prior to children's transition to formal schooling, a developmental period critical for supporting trajectories of social and academic success (Leerkes, Paradise, O'Brien, Calkins, & Lange, 2008; Rubin, Burgess, & Hastings, 2002).

## Self-Regulation and Early School Achievement

Much research examining the links between self-regulation and school achievement has adopted a broad defition of self-regulation (see Nigg 2016 for detailed description) which views regulation as guiding actions, emotions, and cognitions through the dyanimc interplay between both top-down (e.g., cognitive or effortful control, executive attention, executive function) and bottom-up (e.g., behavioral or reactive inhibition, arousal) processes. Informed by this work, other studies have focused on more specific cognitive or behavioral aspects of regulation, such as inhibitory control (Mischel, Shoda, & Rodriguez, 1989), emotion regulation (Gross, 2014), or executive functioning (Blair & Razza, 2007). Moreover, research examining links between children's self-regulation and school achievement benefits from theoretical and empirical work characterizing how a child's *instrinsic* self-regulation is influenced by extrnsic regulators in the social environment because the classroom requires children to draw on multiple self-regulatory processes in both social- and task-oriented scenarios throughout the school day (Nigg, 2016; Posner & Rothbart, 2000; Sameroff, 2010).

Many methods of measuring children's self-regulatory capacities exist, each with its own combination of advantages and disadvantages. For example, direct assessments offer the advantages or routinization and precision, but at a potential cost to ecological validity. In contrast, measures completed by a parent or teacher may provide a more holistic depiction of how the child exercises self-regulatory capacities at home or in school, but introduces the potential for reporter bias. In the current study we employed the Preschool Self-Regulation Assessment Assessor Report (PRSA), which provides insight into children's ability to exercise inhibitory control and executive attention (Smith-Donald, Raver, Hayes, & Richardson, 2007). The PRSA offers the advantages of an observational measure completed by a third party, but minimizes the potential for reporter bias by enlisting a trained researcher as that reporter.

Despite the variation in approaches to defining and measuring self-regulation, findings across studies that focusing on the links between self-regulation and schooling present a consistent message: children's self-regulation plays a fundamental role in supporting academic achievement (Montroy et al., 2014; Ursache et al., 2012; Willougby et al., 2011). The impact of self-regulation on academic success is not surprising, given the range of classroom activities that place demands on children's self-regulatory skills (Ponitz et al., 2009; Rimm-Kaufman, Curby, Grimm, Nathanson, & Brock, 2009). For example, teachers often make sequenced requests of students that require children to inhibit a dominant response (e.g., continuing to work or play) and display a subdominant response (e.g., return to your seat or clean up). Similar demands are made throughout the school day: children often are expected to disengage with desired activities in service of starting something new and to raise their hands rather than calling out or approaching the teacher.

## Self-Regulation, Peer Competence, and Early School Achievement

Consistent with previous research (Eisenberg et al., 2005, 2010; Rubin et al., 2011), the current study adopts a holistic view of 'peer competence' that encompasses information

about children's sociability, assertiveness, communication, and conflict with their peers. Children who exhibit peer competence enjoy positive interactions and relationships with their peers (Rubin, Bukowski, & Laursen, 2009). There has been considerable theoretical and empirical attention paid to emergence of peer competence, with different accounts emphasizing the importance of early peer interactions (Rubin, Root, & Bowker, 2010). Research has shown that engagement in early social interactions with peers, particularly interactions that allow for the practice and exchange of roles, lead to the development of perspective-taking skills (Rubin et al., 2009) that characterize socially competent behavior (Lindsey & Berks, 2019).

The emergence of peer competence has cascading implications for children's early school achievement (Gifford-Smith & Brownell, 2003; Rubin, Bukowski, & Laursen, 2009). A large body of research suggests that children who display high levels of peer competence tend to be more engaged in and to excel at academic tasks (Wentzel, 2009; Wentzel, Barry, & Caldwell, 2004). In contrast, children who suffer frequent negative experiences with their peers exhibit poor academic functioning (Schwartz, Gorman, Nakamoto, & Toblin, 2005; Vitaro, Barker, Boivin, Brendgen, & Tremblay, 2006). This is because the classroom is an inherently social setting (Coplan, Bullock, Archbell, & Bosacki, 2014; Raver, Blackburn, Mary, & Nancy, 1999), and student participation with peers in both structured and unstructured classroom activities is not only key to supporting academic achievement but enhances students' commitment to learning (Rambaran et al., 2016; Robert et al., 2000). When participation and engagement in cooperative learning is interrupted, as they often are for children with lower levels of peer competence (Coplan, Ooi, & Rose-Krasnor, 2015; Rubin, Root, & Bowker, 2010), students are at risk for withdrawing from future activities, poor identification with school, and poor academic performance (Coplan & Arbeau, 2008; Coplan & Rubin, 2010).

The notion that the child is in a dynamic rather than passive relationship with his or her surroundings is a basic tenet of contemporary developmental and educational science (Bronfenbrenner, 1994; Sameroff, 2000). Most transactional models of self-regulation focus on the ways in which self-regulatory capacities are influenced by external regulators, most often caregivers in early life, but self-regulation continues to consolidate across development, and this process is driven, at least in part, through children's interactions with others. It is also the case that the social environment in schools can support these same adaptive behaviors as external regulators, with multiple studies showing that positive social functioning serves as an important link between self-regulation and academic achievement (Montroy et al., 2014; Valiente et al., 2008), and that external influences on self-regulation can have lasting consequences. That is, competent peer interactions can directly support children's self-regulation in classrooms and, as consequence, support academic achievement. For example, one longitudinal study implementing naturalistic observational protocols found that the positive influences of social relationships in the classroom on a child's behavior in one grade can influence that child's behavior and academic success in the subsequent grade (Connor et al., 2006; Morrison & Connor, 2009).

Most relevant to the current study is the potential for the social environment to *support* regulatory processes when a child's intrinsic capacities falter (Lagasse et al., 2016;

Sameroff, 2010). Peer interactions can serve to establish positive relationships which provide a model of positive behaviors, emotional support and guidance (Hamre & Pianta, 2001; Ladd & Burgess, 2001), and can promote the use of positive learning strategies, particularly in difficult situations (Fredricks et al., 2004). However, a child can only realize the potential for the social environment to support self-regulation if they are capable of *competent* peer interactions. The current study aims to examine the extent to which peer competence can compensate for or buffer the negative influences of low self-regulation on academic achievement. That is, can a child's network of external regulators support a child's success in the classroom when one's own self-regulatory capacities falter?

## Current Study

The current study leverages an observational measure of children's peer competence, the Individual Classroom Assessment Scoring System (inCLASS; Downer, Booren, Lima, Luckner, & Pianta, 2010), to examine whether children's peer competence buffers against poor academic achievement for children with poor self-regulation or promotes academic achievement for well-regulated children (Criss, Pettit, Bates, Dodge, & Lapp, 2002). Specifically, we hypothesize that measures of children's self-regulation will positively predict both children's reading and math performance, and that the association between poor self-regulation and poorer math and reading performance will be attenuated for those children who demonstrate peer competence in the preschool context.

## Methods

### Participants

Participants (total n = 102, male = 48) in the current analyses were drawn from the *masked for review* study, a project that was designed to examine the interplay between child self-regulation, parenting, and the preschool classroom context in prediction of Kindergarten readiness. Participants were recruited from 12 pre-kindergarten and day care centers in central North Carolina ($M_{age}$ = 4.82 years, $SD_{age}$ = 0.46 years) through flyers and other community recruitment efforts. The sample was racially diverse (51.0% European American, 20.6% African American, 15.6% Hispanic, 2.0% Asian American, and 10.8% other or declined to respond). Of the 102 participating children, 27 attended a Head Start preschool program suggesting total family incomes below the federal poverty line.

### Procedure

Data were collected during two visits to participating schools. At the first visit, which occurred early in the school year but after an acclimation period of greater than 2 weeks, trained research assistants conducted classroom observations and facilitated the completion of the paradigms described below. Children's self-regulation data were collected by trained research assistants during onsite pull-out sessions. After the completion of these assessments, children returned to their classrooms and the research assistants began classroom observations using the Individualized Classroom Assessment Scoring System (inCLASS) (Downer et al., 2010). Research assistants unobtrusively observed the participating children for a total of 1 hour across one school day, broken down into 10-

minute segments; this protocol facilitated the observation of the participating children across various classroom contexts, including structured and unstructured interactions with peers. At the second visit, trained research assistants returned to participating schools near the conclusion of the school year to administer the Woodcock-Johnson III (WJ-III) (Woodcock, McGrew, & Mather, 2001), which was the most current version of the Woodcock-Johnson at the time data were collected. All study protocols for the *masked for review* study were reviewed and approved by the Institutional Review Board at *masked for review* (IRB #12–0580).

## Measures

**Peer Competence.—**The Individualized Classroom Assessment Scoring System (inCLASS; Downer et al., 2010) is an observational tool that is designed to characterize children's competence in classroom interactions across three domains: teacher interactions, peer interactions, and task orientation. Prior research has established the convergent (Downer et al., 2010) and predictive (Williford, Vick Whittaker, Vitiello, & Downer, 2013) validity of the inCLASS in prior research. Research assistants attended an intensive training session and demonstrated reliability on standardized training videos prior to conducting live observations. Upon demonstrating reliability, these trained research assistants observed participating children across six 10-minute segments, and mean scores were used to derive ratings on the peer domains described above. Inter-rater reliability was examined in two ways: using results from these initial inCLASS training clips, as well as double-coded, live observations during data collection. As a team, the coders were within one point of the master code 85% of the time across all five training videos (a range of 74–92% across the 9 domains). In addition, the intraclass correlation was 0.65, considered an acceptable level for observational assessments (Cicchetti & Sparrow, 1981).

To assess peer competence, the current study uses an unweighted average of four domains within the peer interaction dimension. *Peer sociability* refers to the child's experience of positive emotions and behaviors with peers, a propensity to seek peer interactions, and social awareness and responsiveness. *Peer conflict* (reverse scored) measures the degree to which children's interactions with other children are characterized by tension, resistance, and negativity. *Peer assertiveness* is characterized by the successful initiation of peer interactions, and self-confidence with peers. *Peer communication* describes children's communication with peers, including the ability to use speech as a functional tool, and intimations and maintenance of communications. The internal consistency of these domains was high ($\alpha = .85$) and a confirmatory factor model showed that standardized factor loadings were high and in the expected direction across each of the domains (ranging from |0.85 to 0.92|).

**Self-Regulation.—**Children's self-regulation was assessed using the Preschool Self-Regulation Assessment (PSRA) Assessor Report (Smith-Donald et al., 2007) that provides assessors' global ratings of children's strength and difficulties in behavioral self-regulation along both attention/impulse control and effortful control-related dimensions. The PRSA has demonstrated measurement equivalence across diverse racial and ethnic groups, and across boys and girls (Raver et al., 2008). Procedurally, the assessors observe children's behaviors

during a series of direct executive functioning, effortful control, and cognitive assessments including *Head, Toes, Knees, Shoulders* (Ponitz et al., 2009), *Toy Sort* (Goldsmith & Rothbart, 1990), *Gift Wrap* (Kochanska, Murray, & Harlan, 2000), and *Object Memory* (Baker-Ward, 1984). After the tasks were administered, the 28-item PSRA Assessor Report was completed. The PSRA Assessor Report is used to assess children's self-regulation in the current study because it provides a global picture of these skills throughout the assessor-child interaction; an interaction which mirrors many of the task-based and transition-oriented demands put on children throughout the school day. Prior research has demonstrated concurrent validity for the Assessor Report with respect to the behavioral measures of self-regulation included in the PSRA (Smith-Donald et al., 2007). Items were coded using a Likert scale ranging from 0 to 3, with some items reverse coded to minimize automatic responding. Factor analyses in previous samples have guided the use of two factors (Raver et al., 2011; Smith-Donald et al., 2007), one characterizing the child's self-regulation and another characterizing the child's positive emotional expression. In the current study, an aggregate of the 16 self-regulation items (e.g., *things/plans before task, refrains from touching materials, remains seated during testing, regulates arousal, difficulty waiting between tasks*) was used as a global indicator of children's self-regulation skills, with the scale demonstrating good internal consistency ($\alpha = .91$).

**Academic Achievement.—**The Woodcock-Johnson Tests of Achievement III (WJ III; (Woodcock et al., 2001) comprise a battery of standardized tests that assess early mathematical and literacy skills. The concurrent validity of the WJ III with multiple measures of academic achievement and intellectual capacity has been established in previous research (Schrank, McGrew, & Woodcock, 2001). Two performance indices were included as covarying outcomes in the current study. The *letter-word identification* (WJ-LW) is a sub-test of the WJ that measures a child's word identification skills by asking the child to read words of increasing difficulty. The *applied-problems* (WJ-AP) sub-test measures a child's ability to analyze and solve math problems by listening to a problem, recognizing the appropriate procedure, and performing the appropriate calculations. Consistent with previous work using these measures, criterion-referenced proficiency scores (*W scores*) were used for both outcomes which provide insight into the degree of proficiency on tasks relative to similarly-aged peers, thus providing insight into academic standing prior to kindergarten entry. Specifically, the *W* score is a foundational metric for all derived scores (e.g., standard scores, percentile ranks, relative proficiency indexes) which uniquely allows for (1) the comparison of scores across the scale, regardless of where the interval falls along said scale, and (2) simultaneously incorporates information about the participant's performance ability level and item difficulty (Jaffe, 2009).

**Additional Covariates.—**Additional covariates included child's sex, age at assessment, and minority status which were reported by the primary caregiver either at the time of recruitment or assessment. As described in more detail below, non-independence among observations due to shared classrooms, which systematically vary due to qualities of the teacher, similar income demographics, Head Start status, and other shared influences, was accounted for by including teacher ID as a clustering variable in all analyses.

### Analytic Plan

The primary analytic approach involved estimating a series of linear path models in which reading and math performance were regressed on children's self-regulation, peer competence, and model covariates. The first model examined the main effects of self-regulation and peer competence on later reading and math performance. The second model examined the interaction between self-regulation and peer competence in the prediction of reading and math performance. The nature of significant interactions was elucidated following the recommendations provided by Roisman and colleagues (Roisman et al., 2012). First, in order to estimate the association between the predictor (self-regulation) and outcome (performance) at two specific reference points, significant interactions were probed at one standard deviation above and below the mean for the moderator variables (peer competence). Second, regions of significance (RoS) analyses, which identify the exact range of values of the moderator for which the independent and dependent variables are significantly associated, were used to determine the levels of peer competence at which children's self-regulation predicts reading and math performance, but also at which levels of self-regulation these associations were significant. All participants with complete or partial data were included in the analyses using full-information maximum likelihood (FIML) which is well recognized as an effective method for analyzing data with moderate to large amounts of missing data and has been demonstrated to provide less biased parameter estimates than other commonly used tehcinqies, such as listwise deletion (Enders & Bandalos, 2001). Both models were saturated and the performance outcomes were simultaneously included as correlated outcomes in both models. Importantly, corrections to the standard errors in each predictive model to account for non-independence of observations due to the nested structure of classroom data (i.e., shared teacher experiences, similar school demographics) were implemented using the TYPE=COMPLEX and CLUSTER procedures in Mplus (Asparouhov & Muthen, 2010). Significant interactions were probed and simple slopes were examined to identify regions of significance. All analyses were conducted in Mplus 8.0 (Muthén & Muthén, 2010).

## Results

The bivariate correlations, means, and standard deviations for the model covariates and variables of interest can be seen in Table 1. Children's self-regulation skills were positively correlated with both reading and math performance. Self-regulation skills were also positively correlated with child's sex such that females demonstrated higher ratings on assessor reports of self-regulation. Peer competence was not significantly correlated with either performance outcome, children's self-regulation, or the covariates. Table 2 includes the standardized and unstandardized model parameters. Variables were centered to aid interpretation and hierarchical regression models with covarying outcomes tested direct and interactive associations. Significant main effects indicated that children's self-regulation, but not peer competence, statistically significantly predicted both reading and math performance, $\beta = .43$, $p < .001$ and $\beta = .39$, $p < .001$, respectively. The conditional residuals of the reading and math performance significantly covaried, $cov(\zeta_{LW}, \zeta_{AP}) = .51$, $p < .001$.

Tests of moderation effects revealed a significant interaction between children's self-regulation skills and peer competence in the prediction of math but not reading performance, β = −.289, $p$ = .022 and β = −.11, $p$ = .23, respectively. Simple slopes analyses are displayed in Figure 1 and reveal that the positive relation between children's self-regulation skills and math performance was significant for children demonstrating peer competence one standard deviation below the mean, b = 4.91, $p$ < .001, but not peer competence one standard deviation above the mean, b = .04, $p$ = .84. Examination of the RoS indicated that the positive slope between self-regulation skills and math performance was significant for individuals with average to low peer competence (lower threshold with respect to mean-centered self-regulation = 0.08). RoS analyses with respect to children's self-regulation skills revealed a lower bound of −0.76 suggesting that the simple slopes for children with lower peer competence were significant at levels of self-regulation about – 1.5 SD below the mean or lower (i.e., the gray shading in Figure 1). The RoS upper bound with respect to children's self-regulation skills was at the outside range of our data.

## Discussion

In this study we employed observational methods to investigate how the combination of children's self-regulation and peer competence in a preschool setting were related to academic achievement at the transition to formal schooling. We found that observed self-regulation was positively associated with academic achievement, in terms of both reading and math performance, at the transition to kindergarten. This finding is consistent with the results of prior research, but expands upon these findings in two ways. First, prior research demonstrating an association between self-regulation and early academic achievement has generally employed direct assessments of children's behavior (cf., Blair & Razza, 2007; Nesbitt, Baker-Ward, & Willoughby, 2013). The results of the present study contribute to a smaller body of research that has yielded parallel results while employing global ratings of children's self-regulation (Smith-Donald et al., 2007). Interestingly, self-regulation predicted both reading and math performance accounting for variation in peer competence, which itself did not directly influence these outcomes. Consistent with extant theory and research, these findings provide some confirmation that self-regulation and peer competence are separate phenomena, and add further support for the important contribution children's self-regulation makes to their academic achievement.

Second, we found that peer competence was a protective factor for math performance among children who demonstrate poorer self-regulation. Specifically, we find that children who display higher levels of self-regulation perform better academically than do those children who display lower levels, presumably in part due to their ability to leverage their self-regulatory capacities to take advantage of the learning opportunities afforded in the classroom. However, we also find that high levels of peer competence are protective for children with low self-regulation. Given this, it is possible that these children rely on their peers to scaffold or support their own self-regulation in the classroom setting. Indeed, research suggests important links between children's self-regulation and social skills, with one study demonstrating that the links between children's self-regulation and academic achievement in preschool is mediated by their social skills (Montroy et al., 2014).

Although the current study does not assess children's self-regulation during peer interactions, the global approach to characterizing the wide range of children's regulatory capacities does allow for the generalization of these effects across contexts. One implication of the current findings is that children with high peer competence but low self-regulation differ meaningfully from children low on both peer competence and self-regulation in academic settings. This view is partially consistent with other research demonstrating that aspects of the classroom environment are of particular importance among children with poor regulatory skills. For example, Coffman and colleagues (Coffman et al., 2018) demonstrated that highly self-regulated learners evidenced more sophisticated cognitive strategies regardless of their teachers' use of cognitively- and metacognitively-demanding language. In contrast, the performance of students who were rated low on self-regulated learning was largely dependent on their teachers' use of this language. A long history of developmental science research has documented that self-regulation, particularly in early life, is best understood as a transactional process between the individual and their environment (Eisenberg et al., 2010; Nigg, 2016). Although the onus of regulation transfers to the individual over development, competent peer interactions continue to support regulatory capacities through the modeling of positive behaviors and the provision of emotional support and guidance (Hamre & Pianta, 2001; Ladd & Burgess, 2001), and can promote the use of positive regulatory strategies (Fredricks et al., 2004). Our findings add to this body of literature suggesting that aspects of the peer environment may be particularly important for supporting academic achievement among children who demonstrate poor self-regulation.

There is strong evidence that self-regulation predicts academic achievement, even controlling for baseline achievement levels, child IQ, and demographic variables (Blair & Razza, 2007; McClelland et al., 2014; Montroy et al., 2014). However, contrary to our hypotheses, peer competence did not moderate the relationship between self-regulation and children's reading achievement. This null finding differs somewhat from prior research reporting that children's social skills (as assessed by their teacher) mediated the relationship between self-regulation and literacy growth over a year of preschool (Montroy et al., 2014), and research showing that trajectories of chidlren's self-reguation impacts literacy and language achievement from preschool through second grade (Skibbe et al., 2019). It may be the case that the measure of self-regulation implemented in the current study, which focuses heavily on children's inhibitory control (a foundational precursor to cognitive flexibility; Diamond, 2013), is more closely related to math than reading performance at this age, or that in early education settings, cooperative learning strategies (e.g., group work, stations) are implemented more often in math-related contexts than in reading-related contexts, which are often teacher-directed. Although speculative, at the very least the current study should promote future research on the topic in service of providing greater insight into the breadth of the impact of children's peer competence on academic achievement.

## Limitations and Future Directions

This study makes a unique contribution to the literature on self-regulation and peer competence in the early school context. However, the findings and impact of this study should be considered in the context of the following limitations. First, while the observational assessment of children's self-regulation is a strength, the inclusion of a

broader range of measurement approaches would deepen our understanding of the links between self-regulation, peer competence, and academic achievement. For example, indices of parasympathetic nervous system-mediated cardiac control, such as respiratory sinus arrhythmia (RSA), have emerged as reliable peripheral biomarkers of children's self-regulation (Beauchaine, 2015; Holochwost et al., in press; Miller, Kahle, & Hastings, 2016; Wagner et al., 2015). The inclusion of correlates of children's self-regulation measured at multiple levels of influence would provide greater insight into the mechanisms underlying the findings reported in this study. Furthermore, this study assessed academic achievement at one point in time, and therefore future research would benefit from examining the relation between regulation and peer competence over the course of preschool and into kindergarten. The importance of examining these processes longitudinally is driven home by recent research demonstrating that the age at which children demonstrate consolidated and effective self-regulation, as well as how children's self-regulation develops over time, has important implications for academic achievement (Skibbe et al., 2019).

While a robust and detailed approach to characterizing children's peer competence in the classroom was used in the current study, only one aspect of the classroom environment was examined. Moreover, the measure of self-regulation used in the current study was collected outside of the context of peer interactions in the classroom, which may have contributed to the fact that bivariate associations between peer competence and self-regulation were not significant. The classroom is a complex environment and, in addition to future research examining self-regulation in the context of peer interactions, the influences of other relationships and experiences should also be considered to gain a better understanding of how qualities of the environment moderate the relations between children's self-regulation and academic achievement.

It is important to note that the measures of both peer competence and self-regulation used in the current study focus on individual characteristics of the child. As such, in addition to including information about the broader classroom environment, one important avenue for future research may be to examine how a child's own self-regulation and their classmates' self-regulation interactively contribute to academic achievement. Interesting research by Skibbe and colleagues (2012) shows that classmates' self-regulation directly supports children's early literacy growth, suggesting that the transactional nature of the influence of self-regulation on achievement resides not only at the level of the individual child, but that the self-regulatory skills of each child in the classroom interact across different educational settings. We contend that the current findings suggest that children may rely on their social environment for external regulation at times when their own self-regulation falters, and, taken together with the aforementioned research (Skibbe et al., 2012), examining the interplay between classmates' self-regulation would be an important next step for future research.

This study draws from theoretical and empirical literature highlighting how a child's social environment may serve to provide extrinsic regulatory support, particularly when children's own self-regulatory skills falter (Nigg, 2016; A. Sameroff, 2010; Skibbe et al., 2019), but it is the first to our knowledge to demonstrate the protective quality of peer competence for academic performance using observational methods collected in preschools. Not only do the

findings of this study highlight the important role that peer relationships play in supporting children's academic success, but this study should also promote future research that considers how various aspects of the broader classroom environment can support children who may be at risk for poor social and academic outcomes. This study adds to the growing body of literature that leverages the power of observational measurement approaches in school settings and, in so doing, identifies children's peer competence as one potential mechanism that supports positive academic outcomes in preschool classrooms.

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## Highlights

- Children's self-regulation is critical for early success in school.
- Competently navigating the social environment is an important contributor to success.
- Children's self-regulation predicted both reading and math performance.
- Peer competence is a protective factor for math achievement.
- High peer competence may allow children to rely on their classmates to scaffold their own self-regulation.

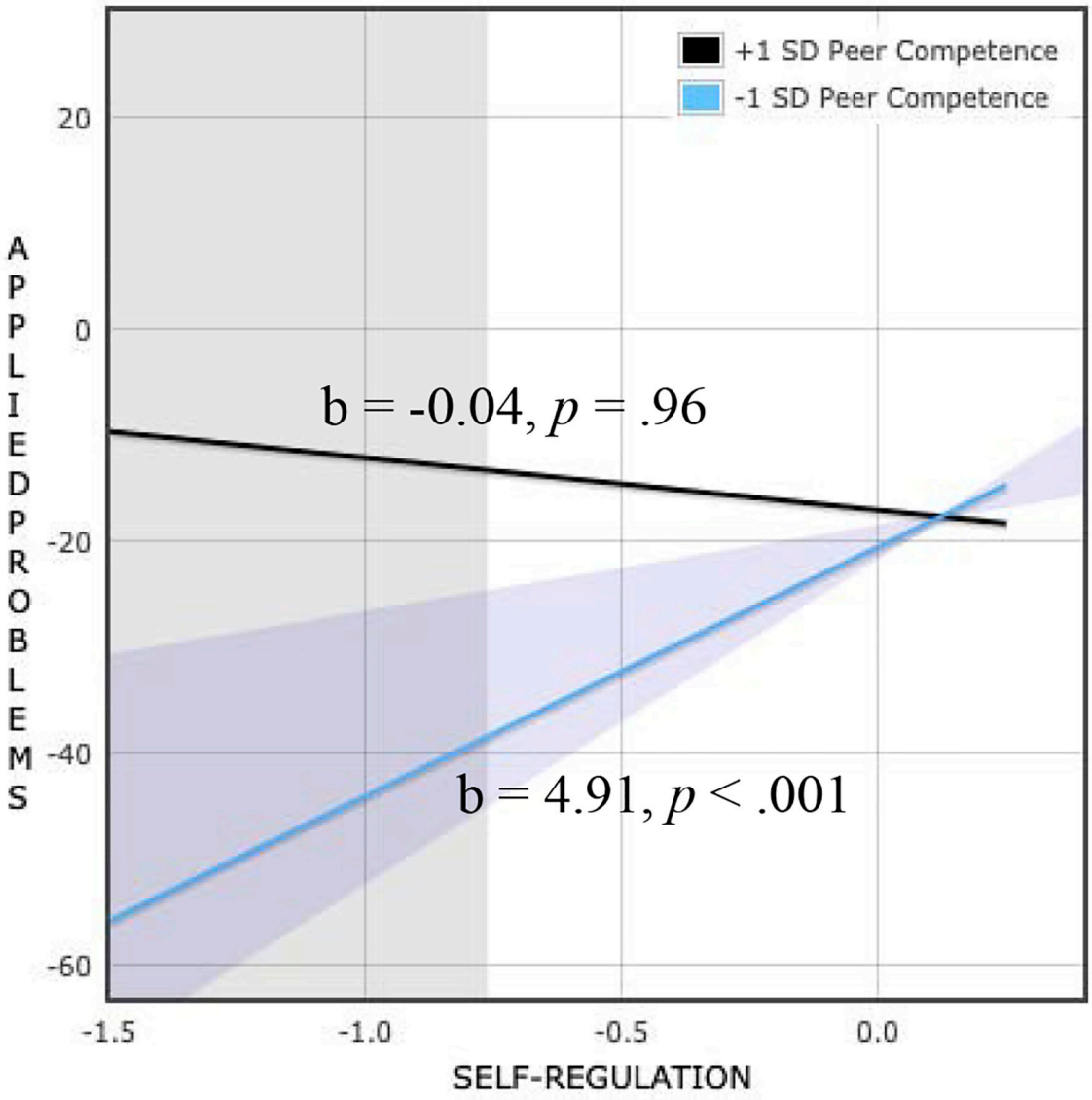


**Figure 1. Self-Regulation X Peer Competence.**

Regions of significance and simple slope estimates for the interaction between self-regulation and peer competence in the prediction of Woodcock-Johnson applied problem scores. The shaded areas represent the point at which self-regulation predicts lower applied problem scores for children demonstrating low peer competence.

**Table 1.**

Zero-order Bivariate Correlations Between Model Outcomes

| | 1 | 2 | 3 | 4 | 5 | 6 | | 8 | 9 | 10 | 11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. Sex (Female = 1) | - | | | | | | | | | | |
| 2. Minority Status (No = 1) | −0.05 | - | | | | | | | | | |
| 3. Age in Years | 0.116 | −0.157 | - | | | | | | | | |
| 4. Peer Sociability | −0.095 | −0.203 | 0.123 | - | | | | | | | |
| 5. Peer Communication | −0.057 | −0.220* | 0.165 | 0.812** | - | | | | | | |
| 6. Peer Assertiveness | 0.042 | −0.215* | 0.182 | 0.771** | 0.881** | - | | | | | |
| 7. Peer Conflict | −0.106 | −0.122 | 0.113 | 0.194 | 0.356** | 0.342** | - | | | | |
| 8. Peer Competence | −0.026 | −0.214* | 0.152 | 0.926** | 0.934** | 0.914** | 0.149 | - | | | |
| 9. Self-regulation | 0.227* | 0.115 | −0.034 | 0.14 | 0.123 | 0.005 | −0.182 | 0.136 | - | | |
| 10. Reading Performance | 0.063 | 0.052 | 0.002 | 0.141 | 0.095 | 0.119 | −0.103 | 0.149 | 0.444** | - | |
| 11. Math Performance | 0.018 | 0.220* | −0.009 | 0.028 | 0.016 | 0.047 | −0.245* | 0.076 | 0.406** | 0.597** | - |
| *N* | 101 | 102 | .02 | 88 | 88 | 88 | 88 | 88 | 87 | 87 | 87 |
| Mean | 0.53 | 0.50 | 4.82 | 3.61 | 2.84 | 2.32 | 1.36 | 3.85 | 2.46 | 369.9 | 423.9 |
| Standard Deviation | 0.50 | 0.50 | 0.46 | 1.05 | 1.04 | 0.89 | 0.48 | 0.67 | 0.49 | 32.27 | 17.11 |

Notes:

* $p \leq .05$,

** $p \leq .01$;

Peer competence is a composite of sociability, communication, assertiveness, and conflict; total N = 102.

**Table 2.**

Hierarchical Regression Models

| | Model 1 | | Model 2 | |
|---|---|---|---|---|
| | Reading Performance | Math Performance | Reading Performance | Math Performance |
| **Parameter** | **B (β)** | **B (β)** | **B (β)** | **B (β)** |
| Age in Years | 0.51 (0.01) | 1.22 (0.03) | 2.20 (0.03) | 3.50 (0.09) |
| Sex (Female = 1) | −2.27 (−0.03) | −2.55 (−0.75) | −2.42 (−0.03) | −2.75 (−0.08) |
| Minority Status (No = 1) | 1.32 (0.02) | 6.06 (0.19)$^{\wedge}$ | 1.29 (0.02) | 6.56 (0.19)$^{\wedge}$ |
| Peer Competence | 4.39 (0.09)$^{\wedge}$ | 1.48 (0.06) | 4.58 (0.09)$^{\wedge}$ | 1.75 (0.06) |
| Self-regulation | 28.27 (0.43)$^{**}$ | 13.44 (0.39)$^{**}$ | 25.16 (0.38)$^{**}$ | 9.26 (0.26)$^{*}$ |
| Peer Competence X Self-Regulation | - | - | −10.56 (−0.11) | −14.19 (−0.28)$^{*}$ |
| | $cov(\zeta_{LW}\zeta_{AP}) = .51$, $p < .001$ | | $cov(\zeta_{LW}\zeta_{AP}) = .50$, $p < .001$ | |

Notes:

$^{\wedge}p \leq .10$,

$^{*}p \leq .05$,

$^{**}p \leq .01$;

Model 2 continuous predictors centered.