Journal of Educational Psychology
2012, Vol. 104, No. 3, 541–553


0022-0663/12/$12.00 DOI: 10.1037/a0029153

# Children's Early Literacy Growth in Relation to Classmates' Self-Regulation

Lori E. Skibbe
Michigan State University

Beth M. Phillips and Stephanie L. Day
Florida State University

Holly E. Brophy-Herb
Michigan State University

Carol M. Connor
Florida State University

Classmates' academic skill level (peer effects) is emerging as an important predictor of individual student achievement, particularly in the early grades. However, less is known about the influence of peer effects with regard to classmates' self-regulation skills and whether they are associated with students' academic gains. Examining this is the purpose of the current study. Using a direct measure of self-regulation, the head–toes–knees–shoulders (HTKS), which assesses students' ability to coordinate their attention, ability to inhibit and switch tasks, and working memory, the classroom mean HTKS was computed to represent peer effects. With 2 cohorts of 1st graders, the effect of peers' self-regulation on literacy outcomes was examined, controlling for individual student self-regulation. In Cohort 1, 445 participants from 46 1st grade classrooms in 10 schools were included. In Cohort 2, 633 students in 68 classrooms in 18 schools were included. Using hierarchical linear modeling, peer effects predicted children's growth in passage comprehension (Cohen's $d = 0.35$ for Cohort 1 and 0.31 for Cohort 2) as well as their vocabulary growth (Cohen's $d = 0.24$ for Cohort 1 and 0.16 for Cohort 2). These were independent effects above that of individual children's fall self-regulation and school-wide percentage of students qualifying for the U.S. free and reduced price lunch program, which were both significantly related to student literacy outcomes.

*Keywords:* literacy, self-regulation, classroom, peers

Literacy development, a critical component for success in school, is at the forefront of many educational initiatives (e.g., No Child Left Behind; U.S. Department of Education, 2001). Although there are a number of known influences on literacy development, such as exposure to written language and book sharing experiences, current initiatives are focusing on environmental contributors to literacy and on child attributes associated with literacy achievement (e.g., Gunn, Feil, Seeley, Severson, & Walker, 2006; Justice, Bowles, Pence Turnbull, & Skibbe, 2009). Accumulating evidence reveals that children's early self-regulation presents an important characteristic that may have long-term implications for their school success (Blair, 2010; Connor et al., 2010; McClelland, Cameron, Connor, et al., 2007; Schunk & Ertmer, 2000). For example, students with weak self-regulation typically demonstrate more behavior problems, weaker literacy skills, and weaker social skills than do their peers with stronger self-regulation. Additionally, new research indicates that children's cognitive development is influenced by classmates' skills (e.g., Justice, Petscher, Schatschneider, & Mashburn, 2011). It is conceivable that peer effects may also influence students' literacy achievement. For example, in a classroom where the proportion of students with poor self-regulation is high, it may be more difficult for the teacher to organize and manage her classroom (Day, Connor, & Schatschneider, 2012), which would reduce instruction time for all students. However, this hypothesis has not yet been fully tested. The purpose of this study is to examine peer self-regulation effects on students' literacy achievement in first grade.

## Self-Regulation

Self-regulation refers to the strategies and processes that allow children to pursue goals by maintaining or altering internal states and responses (McCabe, Cunnington, & Brooks-Gunn, 2004; Posner & Rothbart, 2000), and, at least for younger children, allows them to plan and manage their behavior (Ponitz et al., 2008). A wide body of literature suggests that self-regulation reflects physiological processes, such as heart rate and electrodermal responding (Wilson, Lengua, Tininenko, Taylor, & Trancik, 2009); cog-

This article was published Online First July 9, 2012.

Lori E. Skibbe, Human Development & Family Studies, Michigan State University; Beth M. Phillips and Stephanie L. Day, Department of Educational Psychology and Learning Systems, Florida State University; Holly E. Brophy-Herb, Human Development & Family Studies, Michigan State University; Carol M. Connor, Department of Psychology, Florida State University.

We gratefully acknowledge the support provided by Grants R305H04013 and R305B070074 from the U.S. Department of Education, Institute for Education Sciences; by Grant R01HD48539 from the National Institute for Child Health and Human Development; and, in part, by a predoctoral training grant, R305B04074, from the Institute of Education Sciences.

Correspondence concerning this article should be addressed to Lori E. Skibbe, Human Development & Family Studies, Michigan State University, 7 Human Ecology, East Lansing, MI 48824. E-mail: skibbelo@msu.edu

nitive processes involving working memory and attention (Bronson, 2000; Ponitz, McClelland, Matthews, & Morrison, 2009); motor processes influencing inhibitory control (Kochanska, Murray, Jacques, Koenig, & Vandegeest, 1996); and emotional processes reflecting management of emotions (Cole, Martin, & Dennis, 2004; John & Gross, 2007).

In this study we use a self-regulation assessment designed to tap the coordinated deployment of executive functions, specifically task inhibition, attention, and working memory, also called behavioral self-regulation (Ponitz et al., 2008, 2009). Behavioral regulation has been linked to academic achievement in kindergarteners (Howse, Calkins, Anastopoulos, Keane, & Shelton, 2003; McClelland, Morrison, & Holmes, 2000) and early elementary aged children (Howse, Lange, Farran, & Boyles, 2003). Recent studies also suggest that these relations hold longitudinally (Li-Grining, Votruba-Drzal, Maldonado-Carreño, & Haas, 2010; Monette, Bigras, & Guay, 2011). Children who are able to regulate their behaviors are generally more successful in staying on task and utilizing available learning strategies (Howse, Lange, et al., 2003). Likewise, children who are able to inhibit problematic behaviors and focus on the material presented in class may be in a better position to take advantage of educational opportunities presented to them (Duncan et al., 2007). For example, in a sample of children from low-income families, children's self-regulation skills were found to partially mediate the predictive value of children's literacy skills at 5 years of age on their observed reading at 14 years of age (Smith, Borkowski, & Whitman, 2008). Likewise, a multifaceted assessment of first grade students' classroom engagement, inclusive of persistence and on-task behavior, predicted achievement in fourth grade (Luo, Hughes, Liew, & Kwok, 2009). Self-regulation also appears to matter among elementary and middle school youth (Elias, 2005; Zins, Payton, Weissberg, & O'Brien, 2007) and high school and college-aged students (Ruban & McCoach, 2005) inasmuch as it predicts academic performance, as do cognitive and social-emotional skills.

## Peer Effects and Self-Regulation Among Classmates

Explicating the impact of peer effects has been helpful in better understanding sources of influence on children's development. For example, recent research (Justice et al., 2011) has shown that classmates' language skills predicted preschoolers' language gains, particularly among students with weaker initial language skills. Although research generally has indicated that children's own self-regulation affects later reading-related outcomes (Liew, McTigue, Barrois, & Hughes, 2008; McClelland et al., 2000; Smith et al., 2008), less is known about whether children's self-regulation skills affect classmates' self-regulation or literacy development during children's first years in school. Given findings that high concentrations of children with behavioral problems in classrooms have a negative relation with children's later social adjustment (e.g., Kellam, Ling, Merisca, Brown, & Ialongo, 1998), one might anticipate a comparable impact of peers' weaker self-regulation on academic outcomes. Indeed, one recent study indicated that even a higher concentration of children with attention-deficit/hyperactivity disorder in a school is associated with poorer reading performance among the school's students (Stone, Brown, & Hinshaw, 2010).

When surveyed, teachers have reported that approximately half of children enter kindergarten without the academic or behavioral skills necessary to be successful in school (Rimm-Kaufman, Pianta, & Cox, 2000). Children who do not exhibit age-appropriate behavioral skills at school entry, such as children with low self-regulation, are often more difficult to instruct than children with higher levels of self-regulation (Vitaro, Brendgen, Larose, & Tremblay, 2005) and appear to be less able to participate constructively in instructional opportunities (Gunn et al., 2006). As well, children with low self-regulation tend to spend more time in off-task behavior and cause more disruptions during instruction time (Rimm-Kaufman, La Paro, Downer, & Pianta, 2005). They are also more likely to display delinquent behaviors, impulsivity, aggression, and behavioral disorders (McCabe & Brooks-Gunn, 2007). It is likely that such disruptions in the classroom from one or more children with poorly regulated behavior will interrupt the learning and instructional time for peers.

Children's self-regulatory skills appear to be particularly susceptible to the biological and environmental risk factors associated with living in poverty (Brody & Flor, 1997; Evans, Gonnella, Marcynyszyn, Gentile, & Salpekar, 2005; Raver, 2004). Consideration of the broader ecological context may be illustrative when investigating how income links to self-regulation. Specific poverty-related risk factors (e.g., high levels of familial stress, prenatal drug exposure, and/or maternal depression) have been shown to disrupt children's regulatory processes during infancy (Beeghly & Tronick, 1994) and early childhood (Evans & English, 2002; Sektnan, McClelland, Acock, & Morrison, 2010). Zalot, Jones, Forehand, and Brody (2007) found that living in high-poverty neighborhoods exacerbated the risk for conduct problems among youth with poor self-regulation. In addition, children living in poverty tend to have homes that are more chaotic (Evans et al., 2005), which is significantly related, likely through the way that parents interact with their children, to children's ability to regulate their behaviors (Moilanen, Shaw, Dishion, Gardner, & Wilson, 2010; Valiente, Lemery-Chalfant, & Reiser, 2007). Although specific classroom and instructional practices can serve to enhance self-regulation among young children (e.g., Connor et al., 2010; Greenberg, Kusche, Cook, & Quamma, 1995), many children living in low-income environments fail to receive the environmental supports needed to support their self-regulation development. Indeed, just by attending schools where a greater proportion of children are from low-income homes puts a child at risk for underachievement (Neal & Schanzenbach, 2007). The lower levels of self-regulation exhibited by many low-income children may serve to explain some of the academic difficulties these children face (Evans & Rosenbaum, 2008; Sektnan et al., 2010). Such findings also suggest that students at high-poverty schools are more likely to have classmates with poor self-regulation. If peer effects are evident for self-regulation, this may help to explain why higher poverty schools can be such risky environments for students.

## Research Questions and Hypotheses

The specific aims for this study were to examine (a) whether classmates' self-regulation (i.e., the classroom-mean self-regulation) predicted gains in students' literacy achievement, controlling for their individual self-regulation and (b) whether classroom-mean self-regulation varied by the percentage of children attending the school who qualified for the U.S. free and reduced price lunch program—a frequently used marker of socioeconomic status (i.e., school FARL). Hence, we asked two research questions:

*Research Question 1:* Does classmates' self-regulation predict students' literacy outcomes overall?

*Research Question 2:* Does classroom mean self-regulation vary by school FARL?

We hypothesized that students in classrooms with higher classroom mean self-regulation would make greater gains in literacy skills than would first graders in classrooms with lower classroom mean self-regulation. We also hypothesized that average classroom self-regulation would be closely related to school FARL.

# Method

## Participants

Student and teacher participants in this study were from two cohorts. Students and teachers were part of an intervention study designed to help teachers learn how to individualize their reading instruction. Teachers in the intervention condition also received training on how to be more organized in planning and managing their instruction. Cohort 1 students attended first grade in 2005–2006 and included 445 first graders (47% girls) from 46 classrooms in 10 schools. Cohort 2 students included 633 students (50% girls) in 68 classrooms in 18 schools. Schools were located in a midsized city from one school district in Florida that was highly diverse ethnically and also varied in socioeconomic status.

Forty-seven teachers volunteered to participate in the Cohort 1 study (24 control, 22 treatment), and 68 volunteered in the Cohort 2 study (11 control, 57 treatment). All of their students were invited to join the study. Although two Cohort 1 teachers team-taught one classroom, data for this classroom were also included in the study (so for purposes of the analyses, $n = 46$ classrooms in Cohort 1). With one exception, Cohort 1 teachers completed a background questionnaire at the beginning of the study. In both cohorts, the majority of teachers were female (87% and 97% in Cohorts 1 and 2, respectively). Additional teacher characteristics are shown in Table 1. Missing data analyses for Cohort 1 suggested that student achievement for the teacher with missing background information did not differ significantly from teachers who completed the questionnaire.

Table 1
*Teacher Demographic Information*

| Variable | Cohort 1 | Cohort 2 |
|---|---|---|
| Teacher education, *n* (%) | | |
| Less than bachelor's degree | 1.00 (2.17) | 0.00 (0.00) |
| Bachelor's degree | 33.00 (71.74) | 45.00 (63.24) |
| Master's degree | 11.00 (23.91) | 25.00 (36.76) |
| Unreported | 1.00 (2.17) | 0.00 (0.00) |
| Years of experience, *M* (*SD*) | 11.26 (9.91) | 12.57 (10.47) |
| Years teaching first grade, *M* (*SD*) | 5.05 (5.54) | 6.38 (5.81) |

The number of students in classrooms ranged from 17 to 21 and was consistent across schools and cohorts. Of the potential student participants, 75% in Cohort 1 and 83% in Cohort 2 were recruited. Of these children, a subset was randomly selected to receive an extended battery of assessments, including self-regulation (described below), and all children whose self-regulation in either year of the study was assessed as part of this intervention were included in the present study. Target students were selected in classrooms where more than 12 students were recruited (24% in Cohort 1; 34% in Cohort 2) because of resource limitations. Students were rank ordered by reading skill and four each from the top, middle, and lower third quantiles were randomly selected. Because we are interested in peer effects, the number of students recruited per classroom is relevant. Class size ranged from 17 to 21 students following state requirements and our sample included at least nine (or about 50%) of the students in 67% of the classrooms in Cohort 1 and 72% of the classrooms in Cohort 2. The fewest number of students recruited per classroom was four, and this was the case for only five classrooms (5%). See Tables 2A and 2B for additional descriptive information about children's literacy skills and social competencies. Eleven percent of the students left the district before the end of the school year. Missing data analyses revealed no significant differences in beginning of the year achievement between these children and children included in this sample.

School socioeconomic status was based on the publically available school-wide percentage of students who qualified for the free and reduced price lunch program (FARL). The school-level FARL percentage for Cohort 1 ranged from 24% to 96%. Children's ethnicity was available either though school records or parent reports for 87% of the Cohort 1 children. Of these, 47% of children were African American, 35% were Caucasian, and 19% were of other ethnicities, including Hispanic and Asian American. The average age of the students was approximately 7 years (ages ranged from 6 to 10 years old; $SD = 0.82$). This range of ages reflected the districts' retention policy; students could not move to second grade until they achieved a minimum score on the state-mandated achievement test. Of the Cohort 1 mothers, 60% had received a high school diploma, 47% had attained a bachelor's degree, and 27% had received a graduate degree.

Cohort 2 schools included the 10 schools that participated in Cohort 1 plus eight more. Thus, children in Cohort 2 attended schools with a greater range of school FARL—from 4% to 96% with a mean of 49.8% across schools. For Cohort 2, ethnicity was available for 83% of the first graders. Of these, 34% were African American, 41% were Caucasian, and the remaining children belonged to other ethnicities. Ages ranged from 6 to 9 years with a mean of 7.13 years ($SD = 0.37$). Twenty-eight percent of the mothers in Cohort 2 reported that they had attended some high school, 29% had graduated from high school or earned their graduation equivalent diploma, 13% had earned a 2-year college degree, and 30% had earned a 4-year bachelor's degree; 15% of these mothers had earned a graduate degree. See Tables 2A and 2B for more demographic information about children and their families.

## Procedure

Trained research assistants administered a battery of tests designed to evaluate children's literacy development and self-regulation skills in the fall and spring of the school year; children were assessed individually in a quiet room or hallway. Testing

Table 2
*Additional Descriptive Information for Children and Schools in Cohorts 1 and 2*

| Variable | Minimum | Maximum | *M* (*SD*) |
|---|---|---|---|
| | A. Cohort 1 | | |
| Children's literacy skills | | | |
| Fall WJ–III PC *W* score | 377.00 | 497.00 | 449.56 (21.03) |
| Fall WJ–III PV *W* score | 442.00 | 513.00 | 478.92 (10.93) |
| Spring WJ–III PC *W* score | 404.00 | 506.00 | 466.33 (15.48) |
| Spring WJ–III PV *W* score | 456.00 | 528.00 | 483.36 (10.80) |
| Children's self-regulation | | | |
| Fall HTKS total score | 0.00 | 40.00 | 31.74 (7.56) |
| Spring HTKS total score | 0.00 | 40.00 | 33.81 (5.64) |
| Classroom characteristics, % | | | |
| School-wide FARL | 24.00 | 96.00 | 62.00 (24.99) |
| Class mean fall HTKS RS | 22.29 | 36.08 | 31.33 (3.49) |
| | B. Cohort 2 | | |
| Children's literacy skills | | | |
| Fall WJ–III PC *W* score | 358.00 | 500.00 | 444.05 (24.87) |
| Fall WJ–III PV *W* score | 444.00 | 513.00 | 480.39 (10.85) |
| Spring WJ–III PC *W* score | 405.00 | 509.00 | 470.58 (16.15) |
| Spring WJ–III PV *W* score | 444.00 | 521.00 | 485.95 (11.01) |
| Children's self-regulation | | | |
| Fall HTKS total score | 0.00 | 40.00 | 32.23 (7.33) |
| Spring HTKS total score | 0.00 | 40.00 | 34.83 (5.38) |
| Classroom characteristics, % | | | |
| School-wide FARL | 4.00 | 96.00 | 49.83 (28.95) |
| Class mean fall HTKS RS | 22.25 | 38.58 | 31.97 (2.93) |

*Note.* WJ–III = Woodcock–Johnson III; PV = Picture Vocabulary; PC = Passage Comprehension; HTKS = head–toes–knees–shoulders task; FARL = free and reduced price lunch program; RS = raw score.

lasted approximately 50 min per child divided between two sessions.

## Measures

**Literacy development.** Two subtests from the Woodcock-Johnson Achievement Tests III (WJ–III; Woodcock & Mather, 2001) were used to evaluate children's literacy skills: Passage Comprehension (PC) and Picture Vocabulary (PV). For the present study, children's literacy scores are presented using *W* scores, which are similar to Rasch scores. *W* scores use an equal-interval scale that accounts for item difficulty as well as children's age, allowing for interpretation of growth in specific skills, rather than changes in relative position within a certain age group (Jaffe, 2009). Normative data for this measure were computed using a representative sample of children from over 100 communities in the United States. Sampling strategies were employed to create a sample that was representative of different races and localities (e.g., rural and urban) to minimize test bias that may occur due to differences in race, gender, or origin. Given the demographic characteristics of the present sample, it is important to note that previous research has indicated that the factor structure of the WJ–III is almost identical for African Americans and Caucasians; thus, scores for these two groups of children can be interpreted similarly (Edwards & Oakland, 2006).

PC, a measure of reading comprehension that evaluates children's understanding of text and their verbal language comprehension using a cloze procedure, was administered to the target children in Cohort 1 ($n$ = 434) and Cohort 2 ($n$ = 488). Data were missing completely at random, and missing data analyses revealed no significant differences in school or child variables for children with and without missing data. For younger children, this measure has been used successfully, although it is important to note that the simple passages used as part of the PC subtest rely heavily on children's decoding knowledge in addition to their reading comprehension (Keenan, Betjemann, & Olson, 2008). Median test–retest reliabilities for this measure were .83 for children ages 5–19 years. For 6-year-olds in the normative sample provided by Woodcock and Mather (2001), average *W* scores on this measure were 436.76 ($SD$ = 28.87); for 7-year-olds, average *W* scores were 471.30 ($SD$ = 24.60).

PV assesses children's expressive vocabulary knowledge by asking children to label pictorial representations of objects. Overall internal reliability for this measure was .77 for children aged 5–19. Six-year-olds in the normative sample received *W* scores of 478.28 ($SD$ = 15.26), on average, for this measure, and 7-year-olds had average *W* scores of 484.99 ($SD$ = 14.99; Woodcock & Mather, 2001).

**Self-regulatory skills.** A modified version of the head-to-toes task was used to measure self-regulation skills, called the head–toes–knees–shoulders (HTKS; Matthews, Ponitz, & Morrison, 2009; McClelland, Cameron, Wanless, & Murray, 2007; Ponitz et al., 2008, 2009). The HTKS requires children to inhibit a dominant response for directions and instead display a subdominant gross motor response. Specifically, children were first instructed to follow what the tester said ("touch your head," "touch your toes," or "touch your shoulders," "touch your knees"). Students were then instructed to do the opposite of what the tester said (e.g., touch their toes when instructed to touch their head). On each of 20 items, children received a score of 0, 1, or 2, based on whether they responded incorrectly, self-corrected their first incorrect response, or responded correctly initially. Possible summed raw scores, which were used in all models, ranged from 0 to 40, with higher scores indicating a greater degree of self-regulation. With first graders (Connor et al., 2010), interrater reliability for this measure was very high (.98 overall) and scores obtained from this task were moderately correlated with teacher report of the Social Skills Rating System in this sample ($r$ = .31; Gresham & Elliott, 1990). See recent articles by Ponitz et al. (2008, 2009) for further information about the reliability and validity of this measure. Self-regulation was measured in the fall, prior to intervention activities in most classrooms. Published studies with similar children have indicated an average score in the low 30s at the end of kindergarten and beginning of first grade (Connor et al., 2010; Matthews et al., 2009). The average fall scores reported in the current study align with this prior research (Cohort 1, $M$ = 31.74, $SD$ = 7.56; Cohort 2, $M$ = 32.23, $SD$ = 7.33).

**Class self-regulation.** To test the effect of peers' self-regulation, we created a variable to represent the general self-regulation skills of the participants in the classroom as a whole. Similar to methods used in other recent studies of peer effects (e.g., Justice et al., 2011), we did this by computing the mean fall HTKS score for each classroom. Classroom scores did not differ between treatment and control classrooms for Cohort 1 (treatment $M$ = 30.60, control $M$ = 32.74), $t(44)$ = 1.17, $p$ = .250, or Cohort 2 (treatment $M$ = 31.84, control $M$ = 32.63), $t(66)$ = 0.816, $p$ = .418.

## Results

Overall, children in the study demonstrated significant gains in vocabulary and passage comprehension skills from fall to spring of first grade. In addition, mean self-regulation scores increased from 32 to 34 points for Cohort 1 and from 32 to 35 points for Cohort 2. See Tables 2A and 2B for more information about children's literacy and self-regulation skills. To examine the relations among the class self-regulation and teacher and school demographics, we examined zero-order correlations (see Tables 3A and 3B). Overall, teachers' education and experience were not related to class self-regulation in either cohort and, thus, were not included in final models.

As described earlier, we hypothesized that variability in mean classroom self-regulation across classrooms would be related to school FARL, which was supported. Classrooms were more likely to have lower class self-regulation as the school percentage of children qualifying for FARL increased. To test this further, in subsequent models, we controlled for the school-wide percentage of children receiving FARL (i.e., school FARL). To examine whether student- and class-level self-regulation predicted student outcomes, we used hierarchical linear modeling (HLM), a technique that is useful when children are nested within classrooms and, thus, may have shared class variance, as is the case in the present study. Specifically, students (Level 1) were nested in classrooms (Level 2), which were nested in schools (Level 3; Raudenbush & Bryk, 2002). Initial three-level models revealed no significant difference between school variance once school FARL was added to the model. Furthermore, the results from the three-

Table 3
*Correlations Among Teacher and Classroom Characteristics in Cohorts 1 and 2*

| Variable | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| A. Cohort 1 | | | | | | | | | | | |
| 1. School-wide FARL percentage | — | | | | | | | | | | |
| 2. Teacher master's degree or higher (1 = *yes*, 0 = *no*) | .09 | — | | | | | | | | | |
| 3. Years teaching experience | −.04 | .18$^{**}$ | — | | | | | | | | |
| 4. Years teaching Grade 1 | −.20$^{**}$ | −.03 | .64$^{**}$ | — | | | | | | | |
| 5. Fall HTKS class mean | −.45$^{**}$ | −.20$^{**}$ | −.23$^{**}$ | .02 | — | | | | | | |
| 6. Fall HTKS individual total score | −.18$^{**}$ | −.10$^{*}$ | −.09 | −.02 | .37$^{**}$ | — | | | | | |
| 7. Spring HTKS individual total score | −.12$^{**}$ | −.08 | −.06 | .07 | .13$^{**}$ | .33$^{**}$ | — | | | | |
| 8. Fall WJ–III PV *W* score | −.39$^{**}$ | −.08 | .01 | .15$^{**}$ | .19$^{**}$ | .21$^{**}$ | .14$^{**}$ | — | | | |
| 9. Fall WJ–III PC *W* score | −.24$^{**}$ | −.16$^{**}$ | .01 | .10 | .24$^{**}$ | .35$^{**}$ | .18$^{**}$ | .36$^{**}$ | — | | |
| 10. Spring WJ–III PV *W* score | −.36$^{**}$ | −.13$^{**}$ | −.03 | .10$^{*}$ | .24$^{**}$ | .29$^{**}$ | .21$^{**}$ | .73$^{**}$ | .40$^{**}$ | — | |
| 11. Spring WJ–III PC *W* score | −.29$^{**}$ | −.14$^{**}$ | .01 | .09 | .27$^{**}$ | .36$^{**}$ | .18$^{**}$ | .40$^{**}$ | .69$^{**}$ | .49$^{**}$ | — |
| B. Cohort 2 | | | | | | | | | | | |
| 1. School-wide FARL percentage | — | | | | | | | | | | |
| 2. Teacher master's degree or higher (1 = *yes*, 0 = *no*) | −.25$^{**}$ | — | | | | | | | | | |
| 3. Years teaching experience | −.28$^{**}$ | .27$^{**}$ | — | | | | | | | | |
| 4. Years teaching Grade 1 | −.29$^{**}$ | .16$^{**}$ | .80$^{**}$ | — | | | | | | | |
| 5. Fall HTKS class mean | −.52$^{**}$ | .26$^{**}$ | .31$^{**}$ | .27$^{**}$ | — | | | | | | |
| 6. Fall HTKS individual total score | −.19$^{**}$ | .11 | .12$^{*}$ | .11$^{*}$ | .36$^{**}$ | — | | | | | |
| 7. Spring HTKS individual total score | −.21$^{**}$ | −.03 | .00 | .02 | .25$^{**}$ | .47$^{**}$ | — | | | | |
| 8. Fall WJ–III PV *W* score | −.34$^{**}$ | .08 | .14$^{*}$ | .16$^{**}$ | .28$^{**}$ | .27$^{**}$ | .24$^{**}$ | — | | | |
| 9. Fall WJ–III PC *W* score | −.29$^{**}$ | .09 | .04 | .11 | .23$^{**}$ | .31$^{**}$ | .39$^{**}$ | .41$^{**}$ | — | | |
| 10. Spring WJ–III PV *W* score | −.38$^{**}$ | .10 | .14$^{*}$ | .16$^{**}$ | .25$^{**}$ | .24$^{**}$ | .25$^{**}$ | .79$^{**}$ | .46$^{**}$ | — | |
| 11. Spring WJ–III PC *W* score | −.33$^{**}$ | .10 | .08 | .15$^{**}$ | .26$^{**}$ | .30$^{**}$ | .36$^{**}$ | .44$^{**}$ | .71$^{**}$ | .52$^{**}$ | — |

*Note.* Pearson's $r$ was used for continuous variables and phi was used for categorical varaibles. FARL = free and reduced price lunch program; HTKS = head–toes–knees–shoulders task; WJ–III = Woodcock-Johnson III; PV = Picture Vocabulary; PC = Passage Comprehension.
$^{*}p < .05$. $^{**}p < .01$ (two tailed).

level and two-level models were not substantively different. Thus, we used the more parsimonious two-level models and added school FARL to the classroom level (i.e., Level 2) of the models. Models were built systematically starting with an unconditional model, which was used to compute the intraclass correlation (ICC), which is the proportion of variance falling between classrooms. ICCs were .17 for spring passage comprehension and .16 for spring vocabulary.

We then added the following student-level variables: fall self-regulation, fall passage comprehension, and fall vocabulary. Student-level variables of fall passage comprehension, vocabulary, and self-regulation were group (or classroom) mean centered (Enders & Tofighi, 2007). Although centering data using the group mean from our sample does not affect the conclusions that may be drawn from the data, this approach has been recommended for ease of interpretation (Singer & Willett, 2003). Specifically, the intercepts provided for the current study represent average values within our sample on our predictor measures, allowing us to interpret parameter estimates as person-level effects within each specific classroom. Next, school FARL and class self-regulation variables were added at the classroom level, and finally the student by classroom variable interactions were tested. As an example, the final model (without interaction terms) for passage comprehension for Cohort 2 was as follows:

$$Y_{ij} = \beta_{0j} + \beta j{*}(\text{vocabulary}_{ij}) + \beta_{2j}{*}(\text{passage comprehension}_{ij}) + \beta_{3j}{*}(\text{self-regulation}_{ij}) + r_{ij}$$

$$\beta_{0j} = \gamma_{00} + \gamma_{01}{*}(\text{school FARL}_j) + \gamma_{02}{*}(\text{class self-regulation}_j) + u_{0j}$$

$$\beta_{1j} = \gamma_{10}$$

$$\beta_{2j} = \gamma_{20}$$

$$\beta_{3j} = \gamma_{30}$$

where $Y_{ij}$, the spring passage comprehension score for child $i$ in classroom $j$, is a function of his or her fall vocabulary, passage comprehension, and self-regulation scores; school FARL; and class self-regulation. Results of the models for each cohort are provided in Tables 4A and 4B. $\gamma_{00}$ represents the fitted score for a student whose fall scores are at the mean of the classroom and who attends a classroom with mean class self-regulation and a school with mean school FARL. The models for vocabulary were run and interpreted in the same way (see Tables 5A and 5B).

As hypothesized, children in classrooms with lower class self-regulation generally achieved weaker passage comprehension skill gains (i.e., residualized change) than did children in classrooms with higher class self-regulation for both Cohorts 1 and 2 (see Tables 4A and 4B). Results varied somewhat for Cohorts 1 and 2 because the child by classroom variable interactions differed, so we present each model separately.

For Cohort 1, there were significant interactions such that school FARL moderated the effects of students' fall passage comprehension and self-regulation on their spring passage comprehension

Table 4

*Effects of Child and Classroom Characteristics on Students' Spring Passage Comprehension W Scores*

| Variable | Coefficient | Variance | *SE* | $\chi^2$ | *df* | *p* |
|---|---|---|---|---|---|---|
| Cohort 1 | | | | | | |
| Spring Passage Comprehension | 465.29 | | 0.79 | | 42 | <.001 |
| Child-level variables | | | | | | |
| Fall Passage Comprehension | 0.43 | | 0.03 | | 427 | <.001 |
| Fall self-regulation | 0.26 | | 0.08 | | 427 | .001 |
| Classroom-level variables | | | | | | |
| School FARL | −0.13 | | 0.04 | | 42 | .002 |
| Class self-regulation | 1.12 | | 0.27 | | 42 | <.001 |
| Child × Classroom Level interactions | | | | | | |
| Fall Passage Comprehension × School FARL | 0.00 | | 0.00 | | 427 | .036 |
| Fall Self-Regulation × School FARL | −0.01 | | 0.00 | | 427 | .028 |
| Random effects | | | | | | |
| Classroom-level variance ($u_{0j}$) | | 18.88 | | 113.80 | 42 | <.001 |
| Student-level variance ($r_{ij}$) | | 108.75 | | | | |
| Deviance = 3,335.93 | | | | | | |
| Cohort 2 | | | | | | |
| Spring Passage Comprehension | 470.11 | | 0.78 | | 65 | <.001 |
| Child-level variables | | | | | | |
| Fall Passage Comprehension | 0.43 | | 0.03 | | 483 | <.001 |
| Fall self-regulation | 0.26 | | 0.09 | | 483 | .003 |
| Classroom-level variables | | | | | | |
| School FARL | −0.12 | | 0.03 | | 65 | <.001 |
| Class self-regulation | 1.17 | | 0.37 | | 65 | .003 |
| Random effects | | | | | | |
| Classroom-level variance ($u_{0j}$) | | 23.08 | | 157.55 | 65 | <.001 |
| Student-level variance ($r_{ij}$) | | 121.96 | | | | |
| Deviance = 3,792.00 | | | | | | |

*Note.* FARL = free and reduced price lunch program.

Table 5
*Effect of Child and Classroom Characteristics on Students' Spring Vocabulary W Scores*

| Variable | Coefficient | Variance | *SE* | $\chi^2$ | *df* | *p* |
|---|---|---|---|---|---|---|
| | Cohort 1 | | | | | |
| Spring vocabulary | 482.58 | | 0.50 | | 42 | <.001 |
| Child-level variables | | | | | | |
| Fall vocabulary | 0.68 | | 0.04 | | 427 | <.001 |
| Fall self-regulation | 0.17 | | 0.03 | | 440 | <.001 |
| Classroom-level variables | | | | | | |
| School FARL | −0.13 | | 0.02 | | 42 | <.001 |
| Class self-regulation | 0.52 | | 0.11 | | 42 | <.001 |
| Child × Classroom Level interactions | | | | | | |
| Fall Vocabulary × School FARL | 0.00 | | 0.00 | | 427 | .312 |
| Fall Self-Regulation × School FARL | 0.00 | | 0.00 | | 427 | .013 |
| Random effects | | | | | | |
| Classroom-level variance ($u_{0j}$) | | 7.11 | | 102.29 | 42 | <.001 |
| Student-level variance ($r_{ij}$) | | 48.37 | | | | |
| Deviance = 2,983.11 | | | | | | |
| | Cohort 2 | | | | | |
| Spring vocabulary (intercept) | 485.2 | | 0.39 | | 65 | <.001 |
| Child-level variables | | | | | | |
| Fall vocabulary | 0.76 | | 0.03 | | 628 | <.001 |
| Fall self-regulation | 0.06 | | 0.05 | | 628 | .206 |
| Classroom-level variables | | | | | | |
| School FARL | −0.13 | | 0.02 | | 65 | <.001 |
| Class self-regulation | 0.36 | | 0.14 | | 65 | .013 |
| Random effects | | | | | | |
| Classroom-level variance | | 5.74 | | 143.97 | 65 | <.001 |
| Student-level variance | | 43.95 | | | | |
| Deviance = 4,257.913 | | | | | | |

*Note.* FARL = free and reduced price lunch program.

skills. In general, students attending higher poverty schools exhibited weaker passage comprehension gains. However, their spring scores were higher if they attended a classroom where the class self-regulation score was higher and if they themselves had higher fall self-regulations scores. As depicted in Figure 1, the joint contributions of individual child- and classroom-level self-regulation are particularly notable at lower poverty schools, results that supported our second hypothesis.

For Cohort 2, although there were trends for the Fall Passage Comprehension × School FARL interactions, the model without interactions explained more of the variance in student outcomes and presented a better fit: variance–covariance test, $\chi^2(0) = 17.61$,

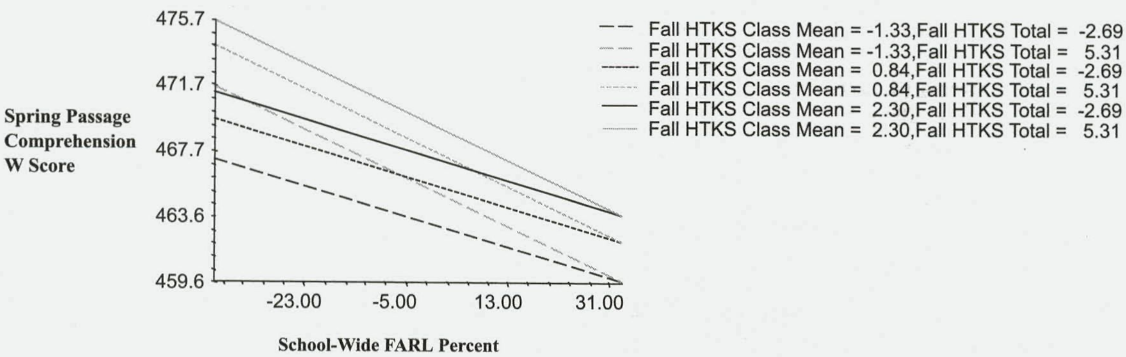


*Figure 1.* Child Self-Regulation × School FARL interactions for passage comprehension. School-wide FARL percentage ranges from the 10th to the 90th percentile of the sample and is centered at 63.73, which is the sample grand mean. The long dashed lines represent class self-regulation falling at the 25th percentile, the short dashed lines at the 50th percentile, and the solid lines at the 75th percentile of the sample (30, 32.2, and 33.6, respectively). The gray lines represent students' self-regulation modeled at the 75th percentile of the sample (37.0), and the black lines represent students' self-regulation modeled at the 25th percentile of the sample (29.0). FARL = free and reduced price lunch program; HTKS = head–toes–knees–shoulders task.

$p > .50$. Results are provided in Table 4B. Overall, children in classrooms with higher class self-regulation scores achieved stronger gains in passage comprehension. The effect size was moderate for a 1 *SD* change (Cohen's $d = 0.31$), keeping in mind that an effect size for a continuous variable changes so that the greater the differences in class self-regulation compared, the greater will be the computed effect size.

## Vocabulary

Class self-regulation significantly predicted children's vocabulary skill gains (i.e., residualized change) in both Cohorts 1 and 2. Again, we observed Child × Classroom Level interactions for Cohort 1 but not for Cohort 2 and so present the results separately.

For Cohort 1, there was an effect size (Cohen's *d*) of 0.24 for a 1 *SD* difference in class self-regulation. That is, students in classrooms with lower class self-regulation achieved smaller vocabulary gains than did students in classrooms with higher class self-regulation. Students' individual self-regulation score also predicted spring vocabulary, and this interacted with school FARL. In general, children with stronger self-regulation showed greater vocabulary gains than did children with weaker self-regulation, but only at more affluent schools (see Figure 2). As school FARL increased, the effect of children's self-regulation decreased such that at the highest poverty schools, no advantage for students with higher self-regulation was observed. Even after accounting for these interactions, however, average class self-regulation continued to relate to children's individual gains in vocabulary.

For Cohort 2, students in classrooms that had higher class self-regulation scores generally demonstrated stronger vocabulary gains. However, students' individual self-regulation score did not predict vocabulary gains. Again, students who attended higher poverty schools generally achieved smaller vocabulary gains compared with students who attended more affluent schools.

## Discussion

The purpose of the present study was to examine peer effects for self-regulation, represented by the aggregated mean self-regulation scores of students in the classroom, on students' reading and vocabulary gains. We also investigated whether school context, specifically the school-wide percentage of students qualifying for free and reduced price lunch (FARL), was associated with peer self-regulation effects on students' literacy gains. Class self-regulation varied significantly among classrooms and was significantly correlated with school FARL across two cohorts of children. Notably, in both cohorts, children who were in classrooms where their classmates generally had stronger self-regulation (i.e., higher class self-regulation) demonstrated stronger gains in passage comprehension and vocabulary skills than did children with similar self-regulation skills who attended classrooms where classmates had generally weaker self-regulation, controlling for school FARL.

### Self-Regulation and Literacy Growth

This study demonstrated that peer self-regulation was positively associated with literacy outcomes—both reading and vocabulary. There are several possible explanations for this finding. Children with low self-regulatory skills are more likely to interrupt overall classroom activities (Rimm-Kaufman et al., 2005) and to exhibit behavioral problems, such as aggression (McCabe & Brooks-Gunn, 2007), that need direct teacher intervention. Thus, the available time for instruction may be reduced in classrooms where more children have difficulties regulating their behavior or there are a few children who have very weak self-regulation skills (thus bringing the class self-regulation mean down). In addition, it is possible that off-task or disengaged behavior may follow a model of social contagion (e.g., Aarts, Gollwitzer, & Hassin, 2004; Friedman, Deci, Elliot, Moller, & Aarts, 2010). In this scenario, which

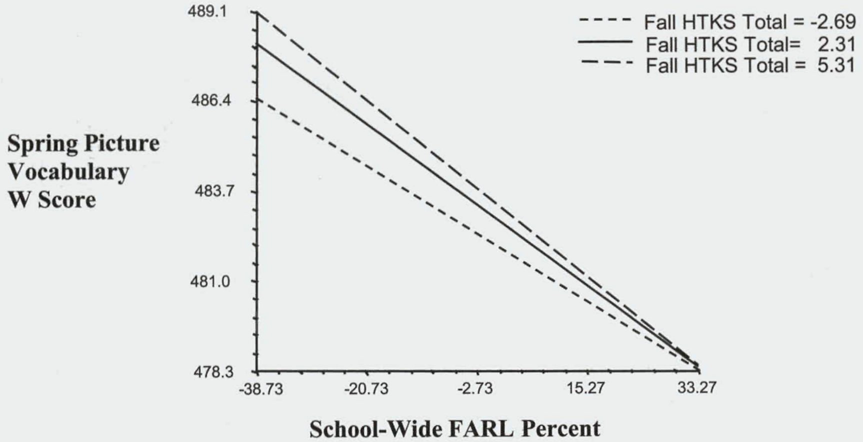


*Figure 2.* Child Self-Regulation × School FARL interactions for vocabulary. School-wide FARL percentage ranges from the 10th to the 90th percentile of the sample. The short-dotted line represents the fitted spring vocabulary score for a child whose self-regulation score falls at the 25th percentile of the sample (29), the solid line represents the 50th percentile (34), and the long-dotted line represents the 75th percentile (37) as a function of school socioeconomic status. FARL = free and reduced price lunch program; HTKS = head–toes–knees–shoulders task.

is consistent with parallel findings for aggression (e.g., Hanish, Martin, Fabes, Leonard, & Herzog, 2005) although yet untested specifically, one or more peers with low self-regulation may be associated with more disengagement even among students with average or higher individual self-regulatory capabilities, leading to less time for learning (but cf. Sage & Kindermann, 1999, for evidence that peer responses can also support learning engagement). Classroom instruction appears to be particularly important for early reading skills (Morrison, Griffith, & Alberts, 1997; Rayner, Foorman, Perfetti, Pesetsky, & Seidenberg, 2001). Explicit instruction in such literacy skills as decoding, text processing, and fluency in word recognition contributes to students' reading comprehension achievement (Keenan et al., 2008; Snow, 2002) and may be disrupted by children with low self-regulation.

## First Graders' Own Self-Regulation and Average Family Income Within Schools

As part of the present work, we considered two additional factors that could potentially explain the relation between classmates' self-regulation and children's literacy growth: children's own self-regulation and school poverty. Consistent with previous work (Connor et al., 2010; Liew et al., 2008; McClelland et al., 2000; Smith et al., 2008), children who began with stronger self-regulation at the beginning of the school year demonstrated stronger passage comprehension and, for Cohort 1, vocabulary gains than did children who began the school year with lower skill levels. The current work extends these previous findings by indicating that children's literacy growth is affected by classmates' self-regulation even when considering children's own self-regulation. Certainly, a wealth of literature has evidenced the importance of self-regulation to academic outcomes in young children (e.g., McClelland et al., 2000; Smith et al., 2008). Yet, research to date has generally focused on individual self-regulation with regard to literacy growth. Our findings suggest that classroom factors, such as the average self-regulation within the classroom, may play a role in children's literacy development, even for children with good regulatory skills. Although the current study design limits the causal links we can make, the results warrant further investigation. In fact, recent research has suggested that children with higher reading scores may be more negatively affected by disruptions, often caused by classmates' off-task behavior, than children with lower reading scores (Day et al., 2012). Thus, interventions and instructional strategies designed to promote self-regulation may serve to enhance each child's individual literacy development; such interventions could potentially improve the literacy development of all students within a given class.

Another potential mechanism for the peer self-regulation effects might be the connection between self-regulation and student engagement. Whereas typically engagement is seen as a marker of student motivation (Deci & Ryan, 1985; Fredricks, Blumenfeld, & Paris, 2004), recent studies (e.g., Urdan & Schoenfelder, 2006) have suggested that the tendency toward disengagement among multiple students with poor self-regulation may reciprocally influence the classroom's motivational climate, perhaps in part by lowering students' prioritization of engaged attention as a goal (Hofer, 2007; Kilian, Hofer, Fries, & Kuhnle, 2010). The relation between self-regulation and students' enactment of high-priority goals is likely mediated by how well they direct their attention (McClelland, Cameron, Connor, et al., 2007; Rothbart & Jones, 1998), yet volitional influences such as interest and motivation likely also play a role (Metallidou & Vlachou, 2007; Valiente, Lemery-Chalfant, & Castro, 2007). In the context of numerous peers modeling off-task behavior, there may be less motivation for other students to self-regulate their own attention and maintain engagement in learning. Research with older students suggests that peers who are off task or who encourage off-task behavior may provoke a motivational conflict between interpersonal values (e.g., peer affiliation) and learning values (e.g., achievement goals) in their classmates (Kilian et al., 2010). A larger number of classroom peers who model off-task behavior may increase the conflict and associated decrements in motivation even in students who maintain their engagement with instruction. At the same time, many of these studies were conducted with older students, and so more research is needed to investigate these pathways in younger students.

Another potential reason for our findings regarding peer self-regulation effects may be that low class self-regulation (either a few students with very poor scores or a large number of students with weaker scores) may put a strain on teachers' ability to organize and manage their classrooms. It is important to note that the data analyzed in this study were collected as part of a randomized control field trial (Connor, Morrison, Fishman, Schatschneider, & Underwood, 2007), which aimed to individualize student instruction by increasing teachers' classroom management skills. Despite the additional professional development that most teachers received, class self-regulation continued to predict children's passage comprehension and vocabulary gains over the course of the year. Future work exploring teachers' capabilities with behavioral management as well as instruction in the context of varying classroom contexts may be informative. For example, perhaps teachers can attenuate the impact of a high density of children with observable self-regulatory difficulty by concentrating on classroom routines and structure more explicitly in the beginning of the year (Bohn, Roehrig, & Pressley, 2004; Cameron, Connor, Morrison, & Jewkes, 2008).

The impact of classroom-level self-regulation, relative to individual self-regulation, appears to be particularly salient in high-poverty schools, at least within the first cohort, where the most affluent school was still a fairly high-poverty school (i.e., FARL = 24%), and more than half of the schools had FARL percentages of 50% or more. Even children with lower personal self-regulation who attended higher poverty schools were at an advantage when classrooms had higher average self-regulation. This finding suggests that classroom climate is an important consideration for literacy growth, perhaps because students who are generally on-task and readily compliant with teachers' requests may, collectively, be a buffer against the known adverse impacts of poverty and poor self-regulation. Classroom management and motivational interventions that can moderate the behavioral impact of children's self-regulation thus may hold some promise in closing the achievement gap—provided that teachers take advantage of this opportunity to teach in ways that maximize learning. Individual children's self-regulation, in contrast, appears somewhat more predictive, relative to classroom averages, in lower poverty schools. One explanation for this finding may be the differential instructional focus of teachers in classrooms where many more students are likely performing at or above grade level in literacy skills. For example, keeping in mind that half of the Cohort 1 and virtually all of the Cohort 2 teachers received professional development, teachers in these classrooms were taught to provide more opportunities for independent and peer learning opportunities, particularly related to comprehension, maintaining high amounts for students with strong fall skills and increasing amounts throughout the school year for students with weaker skills (Connor et al., 2010). Such activities appear to support developing self-regulation, particularly for students with initially weak self-regulation (Connor et al., 2010). In further support of this conjecture, other research has shown that children with weaker self-regulation are less likely to participate in these child-managed kinds of activities than are peers with strong self-regulation (Day et al., 2012).

Whereas most of the findings regarding the impact of socioeconomic status and self-regulation were consistent across cohorts, the interactions were significant only in the first cohort. Cohort 2 included a more affluent set of schools and a higher percentage (83%) of teachers receiving professional development, which included support for classroom planning, organization, and management. Although beyond the scope of this study, teachers' ability to support a child's developing self-regulation and the resulting potential impact on achievement for child and classmates alike is worth further study.

## Limitations and Future Research

Data limitations from the current study prevented the investigation of causal mechanisms associated with children's self-regulatory development. First, children were not randomly assigned to classrooms but were placed in classrooms through intentional decisions made by the educational leaders at the school and, most likely, with some parent input (personal communication, 2010). Thus, associations among self-regulation and achievement might be explained by other classroom, school, and district sources of influence. Regarding the classroom environment, teachers vary regarding the degree to which they are effective at organizing and managing classrooms (Cameron et al., 2008), which is important, given that the techniques that teachers use within the classroom are often related to children's self-regulatory behaviors (Connor et al., 2010; Downer, Rimm-Kaufman, & Pianta, 2007), but evaluating this was beyond the scope of the current investigation. Future research might investigate whether teachers use the same or different organizational and instructional techniques with different populations of students to understand how teachers' behaviors relate to students' self-regulatory behaviors within their classrooms.

In addition, the measure of free and reduced price lunch used in the present study represented the socioeconomic status of each school as a whole, so it was not possible to disentangle children's individual socioeconomic status in this sample. Researchers may wish to analyze socioeconomic status at the classroom or student level in order to measure the relations between low self-regulation and socioeconomic status more precisely. In addition, although many other studies (e.g., Matthews et al., 2009; McClelland, Cameron, Connor, et al., 2007; Ponitz et al., 2008, 2009) have used a single measure of self-regulation to investigate children's academic achievement, it is possible that other measures of self-regulation (e.g., ones focused on emotion regulation) would uncover different effects within the classroom. Future research might also consider studying other aspects of self-regulation as they relate to literacy growth.

Finally, these data were collected as part of a randomized control study where schools were randomly assigned to an intervention designed to support teachers' efforts to individualize literacy instruction based on assessment results. For Cohort 1, students with lower HTKS scores in the fall were more likely to show gains in HTKS by spring when their teacher implemented the intervention with high fidelity (i.e., there was a Student HTKS × Intervention interaction, Connor et al., 2010). Thus, it is possible that the self-regulation peer effects might be less influential for students in classrooms where the teacher individualized reading instruction with high fidelity. This should be considered when interpreting the results.

## Conclusion

Children's self-regulation appears to be affected by children's own developmental characteristics as well as the overall sociocultural environment to which they are exposed, including interactional patterns within the classroom and at home (Corno et al., 2002). Each child's self-regulation, in addition to being an important personal factor related to literacy growth, may also affect other children within a classroom. Findings from the current study align with a transactional model of development (e.g., Sameroff & Mackenzie, 2003), supporting the complex and reciprocal interplay of child and contextual characteristics that influence literacy development. This finding is relevant for a range of economic and school contexts, further confirming the importance of self-regulation during children's first years in school.

There are practical implications with regard to assigning students to classrooms. Such decisions are rarely random and are influenced by parents, school leaders, and teachers with varying motivations. One policy implication of peer effects is their potential impact on teachers' value-added scores (e.g., mean student achievement gains for the classroom are frequently used to indicate teacher value added). Increasingly, teachers' value-added scores are used to judge teacher performance and, in some cases, their pay (Blume, 2011; Chetty, Friedman, & Rockoff, 2012). These results suggest that the characteristics of the students in a classroom will influence value-added scores and that some teachers may be systematically disadvantaged in achieving higher value-added scores because their students are more difficult to teach. Our results and others indicate that a greater number of children are likely to achieve well when class assignments are made thoughtfully with attention to distributing students with very poor self-regulation among classrooms rather than concentrating them in the same classroom. The same appears to be the case for language skills (Justice et al., 2011). Such thoughtful assignment may provide more optimal learning environments for all children, especially for those students most at risk for academic underachievement.

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Received June 17, 2011
Revision received March 14, 2012
Accepted June 1, 2012 ■

## Correction to Lorch et al. (2010)

In the article, "Learning the Control of Variables Strategy in Higher and Lower Achieving Classrooms: Contributions of Explicit Instruction and Experimentation," by Robert F. Lorch Jr., Elizabeth P. Lorch, William J. Calderhead, Emily E. Dunlap, Emily C. Hodell, and Benjamin Dunham Freer (*Journal of Educational Psychology*, Vol. 102, No. 1, pp. 90–101), Table 4 contained data errors. The text accompanying Table 4 in the article describes the procedures followed for the exclusion of subject's data. The authors intended to omit the data of all students who demonstrated the mastery of the tested concept on a pretest (i.e. baseline). However, the means reported in Table 4 did not exclude this data; rather, reported means are based on the complete dataset. All means in the Higher Achieving column have been changed to reflect the excluded data. This correction does not affect the results or interpretation of the article. A corrected Table 4 is presented below.

Table 4
*Mean Proportion (and Standard Error) of Valid Ramps Experiments as a Function of Instructional Condition and School Achievement*

| Condition | Lower achieving | Higher achieving |
|---|---|---|
| Manipulate | | |
| Pretest | .072 (.022) | .098 (.036) |
| Posttest | .130 (.036) | .386 (.069) |
| Difference | .058 | .288 |
| Both | | |
| Pretest | .067 (.027) | .174 (.045) |
| Posttest | .512 (.075) | .843 (.047) |
| Difference | .445 | .669 |

DOI: 10.1037/a0029514