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Self-regulation, motivation, and math achievement in middle school: Variations across grade level and math context☆

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Abstract

The current study examined grade level, achievement group, and math-course-type differences in student self-regulation and motivation in a sample of 880 suburban middle-school students. Analysis of variance was utilized to assess group differences in student self-regulation and motivation, and linear regression analysis was used to identify variables that best predicted students' use of regulatory strategies. A key finding was that although seventh graders exhibited a more maladaptive self-regulation and motivation profile than sixth graders, achievement groups in seventh grade (high, moderate, low) were more clearly differentiated across both self-regulation and motivation than achievement groups in sixth grade. The pattern of achievement group differences also varied across math course type, as self-regulation and motivation processes more consistently differentiated achievement groups in advanced classes than regular math courses. Finally, task interest was shown to be the primary motivational predictor of students' use of regulatory strategies during math

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learning. The study highlights the importance of identifying shifting student motivation and self-regulation during the early middle school years and the potential role that context may have on these processes.

Keywords: Self-regulation strategies; Motivation; Learning context; Math achievement; Middle school

The middle school years represent a distinct developmental period whereby students are expected to develop a firm sense of self, establish and maintain a positive social support network, and effectively balance social, academic, and personal demands. For many students, the transition to middle school is a particularly daunting event because of the shift in emphasis from the supportive, mastery-based orientation typical of elementary schools to a performance-focused setting characterized by increased expectations for academic productivity, more intensive and teacher-directed instruction, and a greater focus on normative comparisons and high-stakes outcomes (Eccles et al., 1993; Midgley & Edelin, 1998; Schunk & Miller, 2002; Zimmerman, 2002). Furthermore, as students enter these grade levels, they are often called upon to complete more intensive or comprehensive assignments and projects, which require them to become more self-directed and regulated outside of school (Zimmerman, 2002). Examining student motivation and self-regulation is an important undertaking because these processes have consistently been shown to predict adaptive classroom and academic outcomes (Bandura, 1997; Butler, 1998; Eccles & Wigfield, 2002; Graham & Harris, 2005). The current study adds to the literature base by examining whether the importance of these processes relative to student math achievement varies across the early middle school years and level of math course.

Definition and features of self-regulated learning

Self-regulation is defined by social cognitive researchers as proactively initiated thoughts, feelings, and behaviors that are planned and cyclically adapted based on self-generated or performance feedback in order to attain personal goals (Zimmerman, 1989, 2000). It is a cyclical process in that feedback from prior task performance is used to evaluate and adjust one's methods of learning to optimize academic outcomes. This cyclical feedback loop consists of three sequential phases: forethought (i.e., processes that precede efforts to learn or perform), performance control (i.e., processes occurring during learning efforts), and self-reflection (i.e., processes occurring after learning or performance; Zimmerman, 2000). Embedded within each of these three phases are several inter-related sub-processes. For example, forethought involves processes that both guide and motivate learning such as goal-setting, strategic planning, and adaptive self-motivation beliefs such as high levels of task interest and perceived instrumentality. These forethought processes initiate a proactive, mindful approach to learning and influence students' behaviors during the performance control phase, such as implementing task-specific learning strategies, attention, and monitoring one's learning. Ultimately, the information that an individual gathers during the performance control phase is used by an individual to engage in self-reflection, including evaluating goal progress, identifying causes of the successes and failures, and deciding upon more adaptive courses of actions if one's goals were not attained.

To optimize the effectiveness of these regulatory processes, students will often enlist the use of various self-regulation strategies (i.e., tactics or sequences of activities), such as making a study schedule, developing self-tests to assess learning progress, or recording the types of information that one cannot easily recite from memory during studying (Gettinger & Seibert, 2002; Weinstein, Husman, & Dierking, 2000). These tactics or strategies are the key tools by which students can learn effectively in a relatively short period of time and are of particular importance because of their influence on several processes within the cyclical feedback loop (Schunk, 2001; Weinstein et al., 2000). In other words, self-regulation strategies facilitate students' planning and goal-setting prior to learning (forethought), enhance their attention-focusing and self-monitoring processes during learning or task performance (performance control), and enable them to evaluate the effectiveness of their learning methods after task performance (self-reflection).

Influences of motivational beliefs and context on self-regulation

Knowledge of self-regulatory strategies does not necessarily mean that one will be skilled or motivated to efficiently use them in authentic situations. From a social–cognitive perspective, most self-motivational beliefs are subsumed within the forethought phase of the feedback loop and play a central role in promoting strategic and regulatory behaviors (Schunk, Pintrich, & Meece, 2008; Zimmerman, 2000). Self-motivational beliefs, such as task interest and perceived instrumentality, function to initiate and sustain students' engagement in the regulatory feedback loop, particularly as they encounter challenging learning materials or unsupportive classroom environments (Eccles et al., 1989; Pajares, 1996; Schunk & Ertmer, 2000). *Task interest* has been defined as the extent to which an individual enjoys or is interested in performing some task within a particular domain (e.g., studying for math tests), whereas *perceived instrumentality* or *task value* is a type of outcome expectation involving the extent to which an individual perceives a task to be important or valuable (Cleary, 2006; Eccles et al., 1989). Researchers have shown both of these motivational processes to be key predictors of students' motivated behavior, such as effort, persistence, and choice of behavior (Schunk et al., 2008; Simpkins, Davis-Kean, & Eccles, 2006).

In addition to forethought motivational beliefs (Pintrich, 2000), social–cognitive researchers also recognize the influence of self-reflection phase processes (e.g., self-evaluative standards and attributions) on students' strategic behaviors and regulatory processes (Bandura, 1997). Based on the cyclical feedback model, *self-standards* are a key part of the regulatory process because they specify the criterion or level of performance, such as answering 8 out of 10 questions correctly on a quiz, against which one derives a sense of accomplishment or satisfaction (Zimmerman, 2000). Students who set challenging self-standards of performance will typically be more motivated than those who exhibit lower evaluative standards or even students who make social comparative judgments (i.e., comparison to peer performance; Schunk, 2001; Zimmerman & Bandura, 1994). However, to the authors' knowledge, few studies have examined the relationship between self-evaluative standards and both forethought motivational beliefs and the use of self-regulation strategies.

Although students' self-motivational beliefs and cognition play a key role in self-regulation accounts, environmental factors and learning contexts often influence the extent to which individuals regulate their behaviors in school (Ames, 1992; Perry, 1998; Schunk

et al., 2008). Most current perspectives of self-regulation and motivation recognize that social and classroom factors, such as type of course content and expectations, teacher grading practices, and quality of feedback, influence students' engagement and strategic behaviors (Eccles et al., 1993; Hadwin, Winne, Stockley, Nesbit, & Woszczyna, 2001; Perry, 1998; Reeve & Jang, 2006). An important implication of this line of research is that students may proactively enlist the use of regulatory skills in one context but not others. Thus, although a student may employ and adapt specific learning strategies to attain self-set goals in math, his or her approach in other courses such as social studies or science may be quite different (Hadwin et al., 2001). Studying self-regulated learning processes across varying academic contexts is of particular relevance in middle-school settings because of the unique changes and challenges that students experience during this transition. For example, research has shown that the goal structures and instructional practices in middle-school classrooms differ substantially from those in elementary schools in that the former typically emphasizes a performance goal orientation (e.g., emphasis on normative comparison and course grades) and provide fewer opportunities for choice and autonomous decision-making by students during classroom activities (Midgley & Edelin, 1998; Urdan & Midgley, 2003). Unfortunately, when students evaluate their sense of competency based on peer performance and also experience a decreased sense of autonomy, they are more likely to exhibit maladaptive motivational behaviors, such as poor effort and persistence (Reeve & Jang, 2006; Zimmerman, 2000). Ultimately, how students react to and interpret these environmental and curriculum changes should be an important factor predicting their academic attainments in middle school. Interestingly, to the authors' knowledge, very few studies have concurrently examined students' motivational beliefs and regulatory behaviors during the early middle school years and across specific math course contexts within middle school. Along the same lines, minimal attention has been placed on examining whether the relation between self-regulation strategy use and motivation processes with students' math achievement in middle school is dependent on the specific context in which students learn.

Purposes of current study

The current study involved three primary objectives. First, we examined differences in students' self-regulation strategy use and motivational beliefs across grade level and math course type. We elected to focus on math as the primary content area in this study because of the recent increased interest in math self-regulation interventions for middle school and secondary school students and the potential of this study to complement this literature base (Butler, Beckingham, & Lauscher, 2005; Montague, 2007; Xin, Jitendra, & Deatline-Buchman, 2005). Although many researchers have examined shifts in students' motivational processes during the transition to middle school and during the early middle school years (Fredericks & Eccles, 2002; Urdan & Midgley, 2003), few research studies have concurrently examined student motivation and regulatory strategies across both developmental and contextual variables. Based on prior developmental research as well as studies linking motivation and self-regulation strategies (Cleary, 2006; Urdan & Midgley, 2003; Zimmerman & Bandura, 1994; Zimmerman & Martinez-Pons, 1990), we hypothesized that the older cohort (i.e., seventh-grade students) as well as those in "regular" math classes would exhibit less adaptive motivation and self-regulatory strategy use than the younger cohort (i.e., sixth-

grade students) and those enrolled in advanced courses, respectively. It should be underscored that although research supports the general premise that the sophistication of students' self-regulatory strategies will typically increase over broad developmental periods (e.g., from middle school to high school), we did not expect to observe an increase in the frequency of students' regulatory strategies across consecutive grade levels because of an anticipated decrease in students' motivational beliefs. Furthermore, given that prior research has shown boys and girls to often differ in their motivation beliefs, particularly in content areas such as science and math (Fredericks & Eccles, 2002; Jacobs, Lanza, Osgood, Eccles, & Wigfield, 2002), we elected to include gender in our analyses to examine whether the developmental and contextual changes varied by gender.

In addition to examining general trends in motivation and self-regulation, we also investigated whether the importance of these processes relative to math achievement varied across grade level and math course type. More specifically, our second objective involved assessing whether students' self-regulation strategies and motivation processes differentiated achievement groups and whether these results varied based on grade level and math course type. Expected differences between grade levels and course types led us to hypothesize that use of self-regulatory strategies and adaptive motivational beliefs would more clearly differentiate achievement groups in contexts that were more intensive and demanding, such as seventh grade and advanced math courses.

The final objective involved identifying the variables that most strongly predicted students' use of self-regulated strategies. This line of inquiry is important because the use of self-regulation strategies assumes a central role in most accounts of self-regulation (Butler, 1998; Zimmerman, 2000) and because they facilitate learning and the acquisition and transformation of knowledge (Weinstein et al., 2000; Wood, Woloshyn, & Willoughby, 1995). Theoretical models of self-regulation posit that self-motivational beliefs influence the extent to which students will engage in and utilize self-regulatory strategies during learning (Butler, 1998; Eccles & Wigfield, 2002; Zimmerman, 2000). Although researchers have consistently linked some motivational beliefs to self-regulation strategies, there is a paucity of studies that have targeted both forethought motivational beliefs (i.e., task interest, perceived instrumentality) and self-reflection motivation processes (i.e., self-standards) in relation to middle school students' strategic behaviors in math. In order to identify the unique variance accounted for by these motivational beliefs, we included grade level and gender in our analyses because such variables have been linked to differences in regulatory behaviors (Zimmerman & Martinez-Pons, 1990).

Method

Sample

School characteristics and curriculum

The participating middle school is located in a suburban school district in the Northeastern part of the United States. This middle school can be considered upper-middle-class, as evidenced by the low percentage of students receiving free or reduced lunch (6.1%; National Center for Educational Achievement, 2006). It consists of approximately 2,100 students in the sixth, seventh, and eighth grades. The percentage of middle school students

who have attained academic proficiency in language arts (i.e., 74% – 80%) and math (75%–86%) exceeds state averages (New York State Education Department, 2007).

Interviews with school administrators and the math department chair revealed important structural and expectation differences between grade levels (i.e., sixth versus seventh) and types of math courses (i.e., advanced versus regular). In general, seventh-grade math classes were reported to be more intensive and demanding of regulatory skills than sixth-grade classes. Although the school district diligently follows the State's math learning standards, administrators seek to lessen the burden experienced by sixth graders as they transition from elementary school by housing most of their classes in a specific part of the expansive school building. In terms of course and grading expectations, sixth-grade students typically spend a large portion of the first semester reviewing many concepts and skills that were taught in the elementary school, whereas the seventh graders are expected to learn more novel and abstract or high-level concepts. Tests also typically account for a greater proportion of course grades in seventh grade than in sixth-grade math courses. Relative to the purposes of the current study, this is a particularly important difference because successful test performance typically necessitates a higher level of sustained effort and self-management of learning activities outside of the school setting.

Math classes in the target school also varied in the quantity and complexity of course content and expected pace of learning. We were primarily interested in examining differences among seventh-grade math courses because sixth-grade classes were generally similar in course content and expectations. The seventh-grade math courses were grouped into one of two broad course categories, *advanced* and *regular*. The advanced category consisted of students taking academically rigorous math courses (i.e., honors or enriched classes) involving both seventh-grade and eighth-grade math curricula. As a result, these courses involved higher-level math content, more fast-paced learning expectations, and more frequent and intensive homework assignments than those for the regular math classes. Students in these courses took teacher-made final exams customized to specific course content. The second course category consisted of all math classes covering only the seventh-grade math curriculum and for which a general final exam is offered at the end of the school year. This latter group excluded students who were enrolled in self-contained special education classes ($n=81$).

Students

Participants included 880 middle school students sampled from the sixth ($n=468$; 53%) and seventh grades ($n=412$; 47%). Eighth-grade students were not included in this study because administrators revealed that these students were required to take a large number of school-wide and state-wide tests during the school year and did not want to expose them to additional assessments. The sample was comprised of a comparable number of girls (51%) and boys (49%). The majority of the sample was White (80.0%). Other participants were Asian (12.2%), Hispanic (5.6%), Black (2.2%), and Native American (0.1%).[1] The ethnic characteristics of this sample were highly similar to those of the entire middle school. We conducted preliminary analysis using *t*-tests and chi-square tests of independence to

[1] The ethnicity category of Hispanic was included along with the racial categories of White, Asian, Black, and Native American.

identify the presence of grade-level differences in the total sample for math achievement (i.e., second-quarter math grades), ethnicity, and gender; no significant differences were found (see Table 1).

Measures

Self-Regulation Strategy Inventory-Self-Report (SRSI-SR)

The SRSI-SR is a context-specific self-report scale that was initially developed to assess students' use of various self-regulation strategies during studying and homework completion in science class (see Cleary, 2006, for details on scale development and content validity). Initial principal component analysis yielded a 28-item scale consisting of three primary factors: environment and behavior management (12 items: $\alpha = .88$), seeking/learning information (8 items: $\alpha = .84$), and maladaptive regulatory behaviors (8 items: $\alpha = .72$). Because the first two factors measure two types of adaptive regulatory strategies, a composite score of these 20 items was used in this study. Examples of items include the following: "I make sure no on disturbs me when I study," "I quiz myself to see how much I am learning," and "I ask my math teacher about the topics that will appear on a test." The third factor measures maladaptive regulatory behaviors and includes items such as "I avoid asking questions in class about things I don't understand" and "I wait to the last minute to study for math tests." Items in the maladaptive scale were reverse coded so that high scores represent the absence of these negative behaviors. The SRSI-SR has also been shown to differentiate gender, grade, and achievement groups and thus was consistent with the purposes of the current study (Cleary, 2006).

The SRSI-SR was adapted in the current study in order to measure students' studying and homework self-regulation behaviors relative to math class. Furthermore, pilot testing revealed that a 5-item Likert scale ranging from 1 (*almost never*) to 5 (*almost always*) with labels for each scale unit would be easier for sixth and seventh graders to understand than the original 7-point scale. Thus, the 5-point format was used for the current study. The

Table 1
Demographic characteristics across sixth and seventh grades.

	Sixth grade ($n = 468$)	Seventh grade ($n = 412$)
Gender		
Boys	236 (50.4%)	194 (47.1%)
Girls	232 (49.6%)	218 (52.9%)
Ethnicity		
White	374 (79.9%)	330 (80.1%)
African American	11 (2.4%)	8 (1.9%)
Hispanic	27 (5.8%)	22 (5.3%)
Asian	55 (11.8%)	52 (12.6%)
Native American	1 (.2%)	0 (0%)
Math achievement		
M	10.34	10.28
SD	2.06	2.48

Note. Math achievement scores represented students' second-quarter math course grades. Grades ranged from 1 (F) to 13 (A+).

coefficient alpha values for self-regulation strategy composite and maladaptive regulatory factor in this study were $\alpha = .89$ and $\alpha = .67$, respectively.

Task Interest Inventory (TII)

A 4-item measure of task interest was used to measure students' level of interest and enjoyment when engaged in math-related activities (Cleary, 2006). The TII was based on a 5-point Likert scale ranging from 1 (*strongly disagree*) to 5 (*strongly agree*). Two of the items were worded positively, whereas two items were worded negatively. The latter two items were reverse-scored so that high scores were reflective of high levels of interest. An example of a positively worded item was "I like studying math topics" whereas a negatively worded item included "I think math is boring." The overall coefficient alpha in this study was .87, which surpasses estimates reported in prior research ($\alpha = .75$; Cleary, 2006). The TII was relevant to the purposes of this study because it has been shown to differentiate high and low achievers, and to correlate with other motivational beliefs (Cleary, 2006).

Perceived Instrumentality Inventory (PII)

A 4-item measure of perceived instrumentality or task value was used to assess students' perceptions of the importance of studying and learning math (Cleary, 2006). The PII was based on a 5-point scale similar to the TII scale and had two negatively worded and two positively worded items. The two negative items were reversed- scored so that high scores on the measure were reflective of positive beliefs about the value or importance of math to students' overall success. The coefficient alpha for this measure in this study was .71, which also surpassed estimates found in previous research ($\alpha = .60$; Cleary, 2006). Similar to the TII, the PII has been shown to correlate significantly with other motivational belief measures and has reliably differentiated achievement and gender groups (Cleary, 2006).

Self-standards

A one-item measure of self-evaluative standards was developed based on social–cognitive definitions and was derived from an established self-evaluative standards scale (Zimmerman & Bandura, 1994). We elected to use a one-item scale because we were specifically interested in examining the standards that students set for their second-quarter math course grades. Researchers have used similar one-item microanalytic measures of self-regulatory processes to differentiate groups across achievement and performance outcomes (Cleary & Zimmerman, 2001; Kitsantas & Zimmerman, 2002). In this study, students were asked to convey the math course grade that would make them feel completely satisfied. They were instructed to check one of 13 grades that ranged from A to F (i.e., scale scores between 13 and 1). Higher grades were representative of higher standards for performance. The average grade ($M = 9.6$, $SD = 1.7$) in which students expressed satisfaction ranged between a B+ (i.e., 10) and B (i.e., 9).

Procedure

Students were sampled from sixth-and seventh-grade classrooms from the target middle school. Only students who returned signed parental consent forms were allowed to participate in this study. A total of 1023 students were asked to participate and 960 signed

parental consent forms were returned. The total response rate for this study was 71.5%. Of those students who returned consent forms, 51 did not complete the surveys because they were either absent from school on the day the surveys were administered or they elected not to participate. A total of 909 students completed the surveys, but an additional 29 students were dropped prior to data analysis because of missing math course grades. The second author and two graduate students administered the four surveys to students during a single class period over the course of a 3-week period. The data collection period occurred at the beginning of the students' second quarterly marking period. Information regarding students' math grades, course type, gender, and ethnicity were collected from student records and provided to the authors by the participating school district.

Results

Initial data screening

Before conducting any formal analyses, we examined the frequency and patterns of missing data, the presence of outliers, and linearity and normality of the data. Regarding missing data, no student exhibited more than 3 missing items on the total SRSI scale, and no missing data for TII, PII, or the self-standards scale were observed. We also examined the prevalence of missing scores for each SRSI item and found that all items had an extremely low rate of missing values (i.e., between only 0 to 1.1% missing data). These results are within Kline's (2005) general recommendations for examining missing data across cases and individual items. However, in order to further demonstrate the randomness of the missing data, we conducted a series of chi-square tests of independence to determine if the patterns of missing data were related to other important variables, such as gender, grade level, and ethnicity. In short, we found that there was no relationship between the proportion of missing responses and non-missing responses across each level of these variables, and thus the data appear to be missing completely at random (Howell, 2008). Missing values were replaced using a regression multiple imputation procedure in LISREL 8.54 rather than mean substitution because the former approach takes into account individual responses to other items and does not distort the distribution of the data.

Data screening procedures revealed minimal problems with the distribution of the dataset, except for mild negative skewness for the PII measure. Although ANOVA tends to be robust with respect to non-normal distributions, we conducted ANOVA and regression results using both the mean PII score from the original scale and a transformation of the mean PII score (i.e., squared transformation; Howell, 2002). These results were virtually identical, and thus the original PII scores were presented in order to facilitate interpretation with other scales. We also examined homogeneity of variance across groups for all ANOVA analyses; these results are presented in the subsequent sections.

Prior to conducting formal analyses, we evaluated a two-level hierarchical model using the computer software package, HLM 6 Hierarchical Linear and Nonlinear Modeling, to examine if students nested in classrooms accounted for significant variation in the primary dependent variables. The intraclass correlation coefficients (ICC) were small across the dependent measures, indicating minimal clustering for the teacher/classroom (self-

regulation strategies, ICC = .018; maladaptive regulation, ICC = .028; task interest, ICC = .021; perceived instrumentality, ICC = .013; self-standards, ICC = .081).

Grade level, achievement group, and gender differences in motivation and self-regulation

Descriptive statistics for self-regulation (i.e., use of strategies and maladaptive regulation) and motivation variables (i.e., task interest, perceived instrumentality, and self-standards) are presented for achievement group status by grade level (see Table 2). The achievement groups were developed based on students' second quarter math report card grades (Cleary, 2006). Students' second-quarter math grades were used as the criterion for achievement group selection rather than specific math tests because the course grades provided a more global composite of students' current math performance. This criterion was selected in lieu of a more global achievement index (e.g., final math course grades) because our self-standards measure was worded specifically in reference to second-quarter math course grades, and we were most interested in examining the relation between students' reports of self-regulation and motivation processes with a proximal achievement indicator.

Achievement categories were used because of our primary interest in examining and interpreting achievement group differences and because the achievement variable was largely ordinal in nature. In short, students who earned an A+, A, or A− were placed into the high achieving group; students earning a B+, B, or B− were placed into the moderate achieving group; and all students earning below a C+ or lower were placed into the low achieving group. Similar procedures have been used in prior research (Cleary, 2006).

Table 2
Self-regulation and motivation means and standard deviations by grade and achievement level.

	Sixth grade			Seventh grade		
	HA (n=244)	MA (n=176)	LA (n=48)	HA (n=222)	MA (n=123)	LA (n=67)
Self-regulation						
M	3.49	3.52	3.41	3.33	3.09	2.94
(SD)	(.68)	(.65)	(.69)	(.67)	(.68)	(.72)
Maladaptive [a]						
M	4.23	4.16	4.03	4.25	3.99	3.86
(SD)	(.53)	(.58)	(.71)	(.48)	(.54)	(.62)
Task interest						
M	3.74	3.66	3.61	3.54	3.19	2.83
(SD)	(.82)	(.82)	(.94)	(.79)	(.87)	(.96)
Instrumentality						
M	4.56	4.55	4.53	4.40	4.30	4.19
(SD)	(.47)	(.51)	(.57)	(.53)	(.56)	(.72)
Self-standards						
M	10.11	9.27	8.33	10.27	9.08	8.52
(SD)	(1.45)	(1.39)	(1.73)	(1.37)	(1.61)	(1.63)

Note. HA = High Achievers. MA = Moderate Achievers. LA = Low Achievers.
[a]Items were reverse- scored. High scores on the Maladaptive Regulation measure reflect *less* maladaptive or negative behaviors.

Separate 2 (sixth and seventh grade) × 2 (girls and boys) × 3 (high achievers, moderate achievers, and low achievers) ANOVAs were used to examine group differences across five measures: self-regulation strategy use, maladaptive regulatory behaviors, task interest, perceived instrumentality, and self-standards. Although our first research question was primarily focused on examining grade level and achievement level main and interaction effects, we included gender as a crossing variable to enhance the generalizability of the findings. An alpha level of .05 was used for all statistical tests unless otherwise noted.

Group differences in self-regulation

Regarding interaction effects, a significant effect occurred between grade and achievement group for self-regulation strategy use, $F(2,868)=4.5$, $p=.01$, $\eta^2=.01$, but not for maladaptive regulatory behaviors. These results indicate that self-regulation differences between sixth-and seventh-grade students were not consistent across achievement groups. Based on the group means presented in Table 2, the difference between high achieving sixth- and seventh-grade students was smaller than the grade differences across moderate and low achievers. No other interaction effects emerged among the three factors.

Significant main effects were only examined if they were not involved in the interaction term. Seventh-grade students reported significantly more frequent maladaptive regulatory behaviors, $F(1,868)=5.6$, $p=.018$, $\eta^2=.01$, such as avoidance and forgetfulness, than the sixth-grade cohort. This effect is considered -small (Cohen, 1988). A significant main effect was also observed for achievement group across maladaptive regulatory behaviors, $F(2,868)=15.6$, $p<.001$, $\eta^2=.03$. Based on Cohen's effect size benchmarks, this effect is small-medium. Regarding gender differences, a significant effect emerged for strategy use, $F(1,868)=12.2$, $p=.001$, $\eta^2=.01$, but not for maladaptive regulation. In general, girls reported more frequent use of self-regulation strategies ($M=3.46$, SD = .67) during studying for math and completing math homework assignments than boys ($M=3.24$, SD = .71). This effect is considered small.

Group differences across motivation processes

The same 2 (sixth and seventh grade) × 2 (girls and boys) × 3 (high achievers, moderate achievers, and low achievers) ANOVA model was used to examine main and interaction effects relative to students' self-motivational beliefs (i.e., task interest, perceived instrumentality, and self-standards). In terms of interaction effects, a significant finding emerged between grade level and achievement group across task interest, $F(2,868)=5.5$, $p=.004$, $\eta^2=.01$. Inspection of group means suggests that the difference between task interest of high achievers in sixth grade and seventh grades was smaller than differences observed across grade levels for low and moderate achievers. No other interaction effects were observed across any of the other motivational variables.

Significant main effects were only examined if they were not involved in the interaction term. Seventh-grade students exhibited lower perceived instrumentality, $F(1868)=31.8$, $p<.001$, $\eta^2=.03$, than sixth-grade students. This effect size is in the small-medium range of Cohen's (1988) effect size benchmarks. No grade level differences were found for self-standards. Achievement group difference emerged for self-standards, $F(2,868)=82.8$, $p<.001$, $\eta^2=.16$, but not for perceived instrumentality. The effect for self-standards is

considered large. Finally, in comparing girls and boys, only task interest differentiated between gender groups, $F(1,868)=5.6$, $p=.018$, $\eta^2=.01$, with girls displaying higher levels of interest ($M=3.61$, SD=.67) than boys ($M=3.43$, SD=.91).

Patterns of achievement group differences by grade level

Consistent with our second research question, we conducted simple main effect and post-hoc tests to examine achievement group differences separately for each grade level. These analyses yielded information about the specific patterns of achievement group differences for each grade level and thus enabled us to identify whether the motivation and self-regulation variables differentiated achievement groupings across sixth and seventh grade. It should be noted that the *F*-ratio presented for the simple effects test utilized the denominator of the *F*-ratio from the original 3-way ANOVA. For the post-hoc tests, we typically utilized the Šidák–Bonferroni correction applied to the alpha level, but we also used Dunnettt's T3 procedures when the assumption of homogeneity of variance was violated.

In terms of the self-regulation variables, the achievement groups for the seventh-grade cohort exhibited significant differences across both self-regulation strategy use, $F(2,409)=10.9$, $p<.001$, $\eta^2=.05$, and maladaptive regulatory behaviors, Welch's $F(2,409)=16.6$, $p<.001$, $\eta^2=.08$. The magnitude of these effects falls in the medium range of effect size benchmarks (Cohen, 1988). Post-hoc tests showed that high achievers exhibited significantly greater strategy use and less maladaptive regulation than both moderate achievers and low achievers, but there were no differences between moderate and low achievers. Conversely, the achievement groups in sixth grade were not differentiated by either self-regulation strategy or maladaptive regulatory behaviors (see Table 3).

The pattern of motivation differences across achievement groups at each grade level was also examined. For the seventh-grade students, significant achievement group differences were found across two motivation variables: task interest, Welch's $F(2,409)=18.3$, $p<.001$, $\eta^2=.09$, and self-standards, $F(2,409)=48.9$, $p<.001$, $\eta^2=.19$. The effects for task interest

Table 3
Post hoc pair-wise comparisons examining self-regulation and motivation differences across achievement level by grade.

Dependent measures	Grade level	
	Sixth	Seventh
Self-regulation strategies	–[a]	HA>MA, LA
Maladaptive regulation[b]	–[a]	HA>MA, LA[c]
Task interest	–[a]	HA>MA>LA[c]
Perceived instrumentality	–[a]	–[a, c]
Self-standards	HA>MA>LA	HA>MA>LA

Note. Šidák–Bonferroni correction for the alpha coefficient procedures were used for all pair-wise comparisons when homogeneity of variance assumption was met. Dunnettt's T3 correction was used when the homogeneity of variance assumption was violated. HA = High Achievers; MA = Moderate Achievers; LA = Low Achievers.

[a] Pairwise mean differences were not statistically significant.

[b] High scores on maladaptive regulation measure reflect *less* maladaptive or negative behaviors.

[c] Dunnettt's T3 correction was used.

and self-standards were medium and large, respectively. Post-hoc tests revealed that high achievers exhibited a more adaptive motivation profile than both moderate and low achievers, with moderate achievers surpassing low achievers on both motivation variables. For the sixth-grade cohort, the achievement groups were differentiated only across self-standards, $F(2,465) = 37.2$, $p < .001$, $\eta^2 = .14$. Post-hoc comparisons showed that high achievers set significantly higher self-standards than both moderate and low achievers, with moderate achievers also showing significantly more stringent self-standards than the low achievers. There were no group differences across task interest and perceived instrumentality (see Table 3).

Math course type and achievement group differences in self-regulation and motivation

To examine math course type differences and potential interaction effects between math course type and achievement on student self-regulation and motivation, we focused exclusively on the seventh-grade cohort. In the seventh grade at the target school, there are many math courses that vary across course expectations and the quantity and complexity of math course content. All seventh-grade students taking honors or enriched classes were grouped into the advanced group because both of these types of classes (a) exposed students to both seventh and eighth grade math concepts, (b) involve greater expectations for learning math content at a fast pace, and (c) required students to complete more frequent and intensive homework assignments. The second math course type category, regular classes, consisted of all math classes covering only seventh-grade math curriculum and for which a uniform final exam is offered at the end of the school year. This group did not include students who were enrolled in self-contained special education classes. Descriptive statistics on students' self-regulation strategies and motivational beliefs are provided across achievement group separately by math course type (i.e., advanced and regular; see Table 4).

Group differences in self-regulation

A 2 (advanced and regular) × 2 (high and moderate/low) ANOVA was used to examine main effects of math course type and the interaction between course type and achievement level. For these analyses, the moderate- and low- achieving groups were combined because of the small sample size for low achievers enrolled in advanced math courses ($n = 9$). No main effect of course type or an interaction between course type and achievement group was observed across self-regulation strategy use and maladaptive regulatory behaviors.

Group differences motivation processes

The same 2 (advanced and regular) × 2 (high and moderate/low) ANOVA was used to examine main effects of math course type and the interaction between course type and achievement level on students' motivational beliefs. In terms of math course type, a main effect was observed for self-standards, $F(1,325) = 33.3$, $p < .001$, $\eta^2 = .08$, which was of medium size (Cohen, 1988). Students in the advanced courses reported higher standards than students in less demanding math courses. No other main effects or interaction effects were observed.

Table 4
Self-regulation and motivation means and standard deviations by math course type and achievement level.

	Regular		Advanced	
	HA (n=43)	MA/LA (n=78)	HA (n=148)	MA/LA (n=62)
Self-regulation				
M	3.12	3.05	3.35	3.06
(SD)	(.71)	(.71)	(.62)	(.67)
Maladaptive[a]				
M	4.13	3.99	4.28	4.01
(SD)	(.52)	(.56)	(.44)	(.56)
Task interest				
M	3.56	3.03	3.55	3.13
(SD)	(.78)	(.87)	(.73)	(.93)
Instrumentality				
M	4.24	4.31	4.44	4.27
(SD)	(.59)	(.63)	(.47)	(.66)
Self-standards				
M	9.51	8.63	10.65	9.45
(SD)	(1.45)	(1.77)	(1.09)	(1.50)

Note. HA = High Achievers; MA/LA = combination of Moderate and Low Achievers.
[a]High scores on maladaptive regulation measure reflect *less* maladaptive or negative behaviors.

Patterns of achievement group differences by math course type

Consistent with our second research objective in this study, simple main effect tests were conducted to examine patterns of achievement group differences in self-regulation and motivation separately for the different math courses. For students taking advanced math courses, a significant overall effect was observed across both self-regulation strategies, $F(1,208)=8.3$, $p=.004$, $\eta^2=.04$, and maladaptive regulatory behaviors, $F(1,208)=12.9$, $p<.001$, $\eta^2=.07$. These effects are considered to be small-medium and medium, respectively. High achievers exhibited significantly greater use of self-regulation strategies and less maladaptive regulatory behaviors than students earning B's or lower. Interestingly, the achievement groups from the regular math courses were not differentiated across either self-regulation strategy or maladaptive regulation (See Table 5).

Students' motivation beliefs differentiated achievement groups for both types of math courses. For the advanced math course, high achievers and moderate/low achievers were differentiated across all three variables: task interest, Welch's $F(1,208)=9.9$, $p=.002$, $\eta^2=.05$; perceived instrumentality, $F(1,208)=3.8$, $p=.05$, $\eta^2=.02$; and self-standards, Welch's $F(1,208)=32.3$, $p<.001$, $\eta^2=.17$. The effect sizes for task interest, instrumentality, and self-standards are considered medium, small, and large, respectively. In short, high achievers exhibited significantly higher interest, perceived value of math, and standards than the lower achieving group. In terms of the regular math courses, task interest, $F(1,119)=12.2$, $p<.001$, $\eta^2=.09$, and self-standards, $F(1,119)=11.1$, $p=.001$, $\eta^2=.06$, distinguished the achievement groupings but no differences were observed for perceived instrumentality. Although this pattern of results was similar to that in the advances courses, the overall effect sizes obtained for the regular math course cohort were smaller than for the advanced group and no significant effect was observed for perceived instrumentality (see Table 5).

Table 5
Patterns of achievement group differences across math course type in seventh-grade students.

Dependent measures	Math course type	
	Regular (n=121)	Advanced (n=210)
Self-regulation strategies	–[a]	HA>MA/LA
Maladaptive regulation	–[a]	HA>MA/LA
Task interest	HA>MA/LA	HA>MA/LA
Perceived instrumentality	–[a]	HA>MA/LA
Self-standards	HA>MA/LA	HA>MA/LA

Note. The moderate and low achieving groups were combined in this analysis due to the low number of students who were enrolled in advanced math courses and of low achieving status. HA=High Achievers; MA/LA=combination of Moderate and Low Achievers.

[a] Mean differences were not statistically significant.

Relations among motivation and self-regulation processes

The third research question involved examining the motivation variables that best predicted students' use of self-regulation strategies and maladaptive regulatory behaviors. Hierarchical regression analyses were performed to examine the relation between students' motivational beliefs and their use of self-regulation strategies and maladaptive regulatory behaviors after controlling for gender and grade level. The SPSS linear regression program was used to examine whether the three motivation variables (i.e., task interest, perceived instrumentality, self-standards) were predictive of self-regulation strategy use and maladaptive regulatory behaviors after gender and grade level were controlled. Gender and grade level were entered simultaneously as the first block of predictors; task interest, perceived instrumentality, and self-standards were entered simultaneously as the second block. The results showed that students' task interest and perceived instrumentality accounted for unique variance in their regulatory behaviors over and above that accounted for by gender and grade level, $\Delta R^2 = .28$, $F(3,874) = 127.4$, $p < .001$ (see Table 6). That is, students who were more interested in or enjoyed learning math and perceived math to be valuable to their future goals were more likely to use regulatory strategies during learning. Similar results were obtained for maladaptive regulatory behaviors, except that all three motivation variables were found to be significant predicators, $\Delta R^2 = .19$, $F(3,874) = 66.8$, $p < .001$. In short, as the motivational profile of students becomes more adaptive, students tend to exhibit less maladaptive regulatory behaviors.

In order to examine the specific contribution of each predictor variable, we used hierarchical regression analyses to control for all other variables. For example, in order to examine the unique contribution of task interest to self-regulation strategy use and maladaptive regulation, we entered gender, grade, perceived instrumentality, and self-standards simultaneously as the first block followed by task interest as the second block. Thus, the change in R^2 for Step 2 represents the amount of unique variance attributable to the variable (e.g., task interest) entered in the second block. Based on the results presented in Table 6, the majority of the variance in both self-regulation strategy use and maladaptive regulation was accounted for by task interest. For example, this variable explained 14% of the variance in self-regulation and 9% of the variance in maladaptive regulation,

Table 6
Hierarchical regression analysis for demographic and motivation predictors of adaptive and maladaptive self-regulation in total sample ($N=880$).

Predictor variables	Self-regulation strategy use					Maladaptive regulatory behaviors				
	B	SE *B*	β	*t*-value	ΔR^2	*B*	SE *B*	β	*t*-value	ΔR^2
Step 1					.07*					.01*
Gender	.23	.05	.16	4.9*		.08	.04	.07	2.2*	
Grade	.31	.05	.22	6.7*		.08	.04	.07	2.0*	
Step 2					.28*					.19*
Gender	.15	.04	.11	3.9*	.01*	.04	.03	.04	1.1	.00
Grade	.11	.04	.08	2.9*	.01*	.03	.04	.03	.9	.00
Task interest	.33	.01	.04	13.9*	.14*	.21	.02	.33	10.0*	.09*
Instrumentality	.31	.02	.41	8.1*	.05*	.14	.03	.13	4.0*	.02*
Self-standards	.02	.04	.24	1.3	.00	.05	.01	.14	4.4*	.02*

Note. The total ΔR^2 values reported in rows for Steps 1 and 2 represent the total amount of variance accounted for by all variables within each block, respectively. The ΔR^2 values for each predictor in Step 2 represent the unique contribution of each variable after controlling for all other variables.
* $p<.05$.

respectively. Perceived instrumentality also accounted for a significant amount variation in the dependent variables, although the amount of variance was smaller than for task interest (5% and 2%, respectively).

Discussion

Social–cognitive theory espouses the premise that both environmental factors, such as classroom structures and expectations, and students' motivational beliefs, such as task interest and self-standards, exert deterministic influences on students' cognitive and behavioral engagement in school (Bandura, 1997; Zimmerman, 2000). Although emerging research supports a dynamic or context-specific perspective of motivation and self-regulation (Hadwin et al., 2001; Perry & Winne, 2006; Reeve & Jang, 2006; Schunk et al., 2008), much less attention has been devoted to linking developmental trends or contextual variations in students' self-regulatory behaviors and motivational beliefs with their actual achievement, particularly with regard to math achievement during the middle school years. The current study examined and found support for the general premise that student motivation and use of self-regulation strategies vary across grade level and math course type, but that the importance of these processes, relative to math achievement, will increase in settings which involve greater regulatory demands or course expectations.

Self-regulation and motivation differences across grade level and math course type

The first objective of this study involved examining whether students in different grade levels (i.e., sixth versus seventh grade) and math courses (i.e., advanced versus regular math course) showed varying patterns of strategic behaviors and motivational beliefs. In contrast

to cross-sectional research examining students' regulatory and motivation processes over broad developmental periods (e.g., fifth grade, eighth grade, and eleventh grade; Zimmerman & Martinez-Pons, 1990), we elected to study these processes across consecutive grade levels in middle school due to the vast changes that typically occur during these years and because school administrators identified key contextual and classroom differences between the seventh and sixth grades at the target school. We also were interested in studying differences in students' self-regulation strategies and motivational beliefs across distinct math contexts, such as students taking honors or enriched math courses versus more basic or regular math courses. These qualitative differences were important to consider because of our interest in examining differences in students' use of regulatory strategies and motivation processes and for examining whether these strategies and beliefs correlate more strongly to achievement in settings with more stringent expectations.

Regarding grade-level effects, we expected that students in seventh grade would exhibit a less adaptive regulatory and motivation profile than their younger peers. This hypothesis was largely supported. Students in the seventh grade reported less frequent use of regulatory strategies and more frequent displays of maladaptive behaviors than their younger peers. They were also less interested in math activities and actually perceived math to be less valuable to their future academic pursuits than the sixth-grade cohort. These results are highly consistent with reports by developmental researchers that students often will exhibit declines in their self-directedness and intrinsic desire to engage in learning during the early middle school years (Eccles et al., 1989; Fredericks & Eccles, 2002).

We also evaluated whether these grade differences would generalize across gender. A significant gender effect, albeit small, was observed, but there was no interaction between grade and gender. Thus, girls exhibited a slightly more adaptive self-regulation profile, such as more frequent use of positive strategies (e.g., time management and help seeking) and greater interest in and enjoyment of math than boys regardless of grade level. Although examining gender effects was not a primary aspect of this study, our results are interesting because girls have traditionally been portrayed to exhibit less positive attitudes and interest in the stereotypical "male-dominated" domains, such as sports, math, and science. However, developmental researchers have shown that whereas gender differences in language arts often continue into adolescence, the gap observed in math is decreasing, with many studies showing equal levels between the genders across task interest and instrumentality in pre-adolescence and adolescence (Jacobs et al., 2002; Lupart, Cannon, & Telfer, 2004; Meece, Wigfield, & Eccles, 1990).

In terms of math course effects, we hypothesized that students in advanced math classes would exhibit greater use of regulatory strategies when learning math and more positive motivational beliefs than those in regular math courses. We reasoned that students who enroll in more complex or demanding learning environments will either naturally possess strong regulatory skills or will be prompted to engage more fully and strategically in their learning. However, this hypothesis was only minimally supported. The only variable to distinguish students across the two types of courses was self-standards, with students in advanced courses reporting higher standards than students in regular math classes. This latter finding makes sense because students in the more advanced courses probably attained high levels of math success during their academic careers and thus developed high

standards for success over time. Collectively, however, these findings suggest that simply attending advanced math classes does not necessarily prompt or induce seventh-grade students to use more adaptive regulatory skills. In order to understand more fully the self-regulation and motivation differences for the math course type and grade level, we investigated the specific pattern of achievement group differences in self-regulation and motivation separately for grade and course type.

Achievement group differences across grade level and math course content

Although the interaction between achievement level and both grade and course type were significant across a couple of dependent variables, we were most interested in focusing on the patterns of achievement group differences observed separately for each grade level and course type. We hypothesized that in course settings or grade levels that are more complex or demanding in nature, such as taking advanced math courses or entering seventh grade, students' motivational beliefs and strategic behaviors would more consistently distinguish their achievement status.

In terms of grade level, we found that high achievers in the seventh grade exemplified a more adaptive motivation and regulatory profile across virtually all measures used in this study: adaptive and maladaptive regulatory behaviors, interest in math, and self-standards (see Table 3). Conversely, for the sixth-grade cohort, the only variable to distinguish achievement groups was self-standards. Thus, the frequency with which sixth-grade students reported using self-regulation strategies as well as their personal beliefs of interest and valuing of math were not related to their actual math performance. Although one cannot draw any causal inferences regarding the effects of structural and expectation differences across grade levels on students' use of self-regulation strategies and motivational beliefs, it does appear that as students enter seventh grade, many of them, and in particular moderate and low achievers, will exhibit a less adaptive profile of motivation and self-regulation even though these processes begin to show a more significant relation to their math outcomes.

The results for math course type also support the premise that self-reported strategy use and motivation processes are more closely related to student achievement in more intensive academic settings. In short, these processes clearly distinguished high achievers (i.e., an A-or higher) from those attaining less success in academically rigorous advanced math classes across both regulatory measures as well as task interest and self-standards. The observed effect sizes across these variables were medium to large. Conversely, when examining these trends for the students in regular math courses, higher achievers were distinguished from the less successful students across only task interest and self-standards and these effects were only small to medium. Based on these findings, the relationship between self-reported self-regulation strategy use and motivation variables with math achievement was stronger in contexts that were operationally defined to be more academically rigorous and demanding. However, as pointed out earlier, simply enrolling in these more challenging learning environments does not mean that students, on average, will spontaneously exhibit more adaptive regulatory and motivation skills than those in regular classes.

Relation between motivation beliefs and self-regulation

Our final objective involved examining the extent to which demographic and motivation variables significantly predicted students' reported use of regulatory strategies during math learning activities. We also examined the precise amount of variance in strategy use accounted for by each of the self-motivation beliefs. The current study showed that even though gender and grade level accounted for a small amount of variance in students' reported adaptive regulation (e.g., help seeking, environmental structuring, and use of learning tactics) and maladaptive regulation (e.g., avoidance and forgetfulness), the combination of task interest, perceived instrumentality, and self-standards accounted for an additional 27% of the variance in self-regulation and approximately 19% of the variance for maladaptive behaviors. Consistent with the task interest and perceived instrumentality (i.e., task value) literature (Eccles et al., 1989; Fredericks & Eccles, 2002; Urdan & Midgley, 2003; Zimmerman, 2000), students who are interested in or enjoy specific academic activities and perceive those activities to have high utility are more likely to engage in those activities or to employ strategies to optimize their performance.

Another point of particular interest was the dominant role that task interest played in the prediction of both regulatory measures. Students' level of interest or enjoyment in math was a significant predictor of their reports of strategy use and maladaptive regulatory behaviors, accounting for approximately 14% and 9% of the variance, respectively. Although one cannot infer a causal link between these motivation variables and students' use of self-regulation strategies in this study, these results are interesting nonetheless because they are consistent with the motivation literature showing that making academic tasks more interesting is a key component in enhancing students' behavioral and cognitive engagement (Fredericks & Eccles, 2002; Reeve & Jang, 2006; Simpkins et al., 2006).

It is also of interest that students' self-standards were not predictive of their use of adaptive regulatory strategies, yet they were related to both students' maladaptive academic behaviors and achievement levels. One potential implication is that all motivational beliefs may not be predictive of the same regulatory or performance processes. Clearly, setting high standards or expectations does not necessarily mean that one will become cognitively engaged or tuned in to the strategies needed to successfully perform a specific task. However, perceiving learning to be interesting or valuable appears to be related to students' tendency to become strategically engaged in that activity.

Limitations and areas of future research

A few limitations of this study and areas of future research should be noted. First, given the descriptive nature of this study, it is possible that grade cohort effects accounted for some of the observed grade level differences. However, as mentioned previously, we demonstrated that both grade cohorts were similar in terms of math grades, gender, and ethnicity. In addition, given the lack of developmental data regarding students' use of self-regulatory skills and motivational processes as well as the paucity of research examining how these processes relate to math achievement across the early middle school years and across math contexts, this study produced some interesting findings that can be viewed as a foundation for conducting more comprehensive and rigorous longitudinal evaluations of

these issues (Zeidner, Boekaerts, & Pintrich, 2000). Along the same lines, it might be fruitful for researchers to more closely examine how context-related variables, such as autonomy-supportive classrooms and or type of math content, impact students' motivation and regulatory behaviors across the developmental spectrum; in particular at key transition periods such as from elementary to middle school and from middle to high school.

Another limitation of the current study was that it did not examine students' perceptions of their learning environments or self-efficacy beliefs. Recent research has shown that students in the same grade or learning context will often interpret classroom goal structures or teacher expectations in divergent ways (Urdan & Midgley, 2003). This issue is important to consider because it suggests that student interpretations of the challenges or requirements of specific contexts and learning environments may be more important, at times, than actual contexts in which they are expected to learn (Hadwin et al., 2001). A fruitful area of future research involves examining the effects of different contexts concurrently with students' interpretations of those contexts on their regulatory and motivated behaviors. It is also important for future research to include measures of self-efficacy in order to understand how a broader range of motivational beliefs impact students' regulatory behaviors and achievement. Developing causal path models that integrate efficacy beliefs, task interest, goal orientation, and self-standards can yield important information about whether specific motivational beliefs exhibit direct or indirect effects on important academic outcomes and behaviors.

A third limitation of this study was the reliance on student self-reports as indicators of regulatory behavior—a form of assessment which may yield inconsistent or inaccurate information due to faulty memory or perhaps even response biases, such as social desirability (Perry & Winne, 2006). For example, it is possible that high-achieving students were more self-aware about their responses and wished to convey a positive profile of beliefs and behaviors. Although students were informed that their individual responses would not be examined separately or shared with their teachers and parents, future research can further examine this phenomenon by gathering data about these processes from multiple sources (e.g., parents and teachers) and multiple forms of assessment, such as direct observations or alternative assessment approaches (e.g., think-aloud protocols, trace methodology, or microanalytic assessment procedures; Azevedo, 2005; Winne & Perry, 2000, Zimmerman, 2008). Alternative assessment approaches are viewed by many educational psychologists as effective methods for capturing the dynamic nature of self-regulation because they generate information about student processes as they engage in a learning activity rather than retrospective accounts of prior learning or behavior (Azevedo, 2005; Perry & Winne, 2006).

A final limitation of this study involved the nature of the sample. The sample was selected from a high-achieving school district and involved predominately White students. Subsequently, the current results must be viewed cautiously until they can be replicated across diverse samples and contexts, particularly those involving minority students from urban settings.

Implications for educators

The importance of context in understanding students' self-regulation or strategic behaviors has been investigated by many researchers. For example, Hadwin et al. (2001)

conducted a study to examine whether students' self-reported use of self-regulation strategies varied across three types of academic tasks—reading for learning, completing a brief essay, and studying for an exam. The authors found that the students employed different strategies depending on the nature of the task and thus appeared to adapt their methods of learning to meet contextual demands and constraints. Similarly, Perry (1998) conducted a study to examine the effects of classroom contexts (i.e., high and low self-regulation classroom contexts) on elementary school students' beliefs, expectations, and regulatory behaviors. Students who were part of "high" self-regulated classrooms exhibited behaviors characteristic of self-directed learners, such as monitoring and evaluating their work, seeking help, using time management strategies, and engaging in a recursive regulatory cycle when performing a writing task. In contrast, students participating in "low" self-regulated classrooms were more likely to rely on teacher regulation of their writing, time, and resources and did not frequently engage in self-monitoring or self-reflection (Perry, 1998).

The current study expands on these research studies and the broader literature base because it suggests that sophisticated self-regulatory behaviors may not be necessary in all achievement contexts, and that these behaviors begin to demonstrate a stronger relationship with math achievement as contextual demands and expectations increase. Along these lines, it is important for school administrators and teachers to be aware of the contextual and curriculum shifts that occur in their respective schools and to identify the specific settings and developmental periods in which self-regulation and motivation processes become highly predictive of students' academic performance. In this study, seventh-grade students clearly exhibited a more maladaptive regulatory profile than their younger peers even though these processes were more predictive of their math achievement. Similarly, strong efforts to make learning intrinsically interesting or enjoyable for students should be an important focus of middle school administrators and teachers because these processes have important implications for the choices students make about becoming strategically and cognitively engaged in their learning (Midgley & Edelin, 1998; Reeve & Jang, 2006; Urdan & Midgley, 2003). Over the past couple of decades, several developmental and motivation researchers have advocated for reforming educational practices in middle school settings to include greater emphasis on mastery goal structures, de-emphasizing normative-based comparisons and providing students with more choice and autonomy during learning activities and classroom instruction (Ames, 1992; Dweck & Leggett, 1988; Midgley & Edelin, 1998). These ecologically sensitive initiatives are important because they correlate with increases in student academic performance and engagement in school (Reeve & Jang, 2006; Urdan & Midgley, 2003).

Many researchers have focused on improving the "will" of students, yet others have emphasized the importance of teaching students the necessary regulatory "skills" to meet the dynamic demands and expectations of middle school, high school, and beyond (Butler et al., 2005; Montague, 2007; Weinstein et al., 2000). For many students, particularly those with learning disabilities or poor histories of academic success, motivation interventions will often not be sufficient and will not automatically lead to more frequent or efficient use of self-regulation strategies (Graham & Harris, 2005; Swanson, Harris, & Graham, 2003). As a result, school reform efforts could involve implementing motivation enhancing practices along with self-regulation and skill-based intervention programs, particularly at

the grade levels or contexts when significant shifts in regulatory demands and expectations occur. Although our findings relate specifically to sixth-and seventh-grade students, we believe that it may be difficult to reliably make universal claims about the specific grades or specific contexts when self-regulation programs are of greatest value and importance to youth. What is most important, however, is to first identify when shifts towards greater expectations for student self-sufficiency and self-directedness occur in a particular school and then implement programs prior to and during this transition to help cultivate students' sense of personal agency and self-regulatory skill.

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