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Sex Differences in Math Performance: The Role of Children's Approach to Schoolwork

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This research examined whether the tendency for girls to outperform boys in the classroom is due to differences in how girls and boys approach schoolwork. In 5th grade and then again in 7th grade, children ($N = 518$) reported on how they approach schoolwork (i.e., achievement goals and classroom behavior), their learning strategies, and their self-efficacy in math; math grades and achievement test scores were also collected. Girls were more likely than boys to hold mastery over performance goals and to refrain from disruptive classroom behavior, which predicted girls' greater effortful learning over time. The sex difference in learning strategies accounted for girls' edge over boys in terms of grades. Girls did not do better on achievement tests, possibly because self-efficacy, for which there was also no sex difference, was the central predictor of performance on achievement tests.

Keywords: achievement, motivation, sex differences, math, longitudinal

Since the 1970s, much attention has been directed toward girls' vulnerabilities, particularly to internal distress. Culminating in the 1990s with works such as *Shortchanging Girls, Shortchanging America* (American Association of University Women, 1991) and *Reviving Ophelia* (Pipher, 1994), research has consistently shown that girls are more prone than are boys to feelings of low self-worth, particularly during adolescence (for a review, see Kling, Hyde, Showers, & Buswell, 1999). Girls also experience more anxiety symptoms (for a review, see Feingold, 1994) and, by adolescence, more depressive symptoms than do boys (for a review, see Nolen-Hoeksema, 1990). Recently, however, works such as *The War Against Boys* (Sommers, 2000) have drawn attention to areas in which girls surpass boys (for a review, see Weaver-Hightower, 2003). The most notable of these is in the classroom, where girls consistently receive better grades than do boys, even in stereotypically masculine subject areas, such as math and science (for reviews, see Dwyer & Johnson, 1997; Entwisle, Alexander, & Olson, 1997). Unfortunately, it is not clear why girls maintain such an advantage over boys.

Girls' edge over boys in terms of grades may be due in part, as some investigators have suggested, to teachers' biased perceptions of girls' and boys' behavior in the classroom (e.g., Bennett, Gottesman, Rock, & Cerullo, 1993). However, social (e.g., parents; see Higgins, 1991; Pomerantz & Ruble, 1998a) and biological (e.g., hormones; see Campbell & Eaton, 1999) forces may cause girls and boys to approach schoolwork differently. As a consequence, girls and boys may adopt different learning strategies (for a review, see Schunk & Zimmerman, 1994), which may underlie the sex difference in grades (see Higgins, 1991; Pomerantz & Ruble, 1998a, 1998b).[1] The major purpose of the current research was to explore the extent to which girls' and boys' approach to schoolwork accounts for girls getting better grades in school than do boys.

SEX DIFFERENCES IN ACADEMIC PERFORMANCE

A wealth of research has documented differences in the academic achievement of girls and boys (for reviews, see American Association of University Women, 1992, 1999; Dwyer & Johnson, 1997; Entwisle et al., 1997; Hyde, Fennema, & Lamon, 1990; Kimball, 1989). There is clear evidence that girls outperform boys in terms of their grades in school. This sex difference is evident in stereotypically feminine subject areas, such as reading, spelling, and writing (e.g., American College Testing Program, 1997; for reviews, see American Association of University Women, 1999; Dwyer & Johnson, 1997; Entwisle et al., 1997; Pomerantz, Altermatt, & Saxon, 2002). Moreover, despite stereotypical expecta-

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[1] The term "sex" is used throughout to refer to females and males.

tions to the contrary, girls also receive equal or higher grades than do boys in stereotypically masculine subject areas, such as math and science (e.g., American College Testing Program, 1997; Jacobs, 1991; Pomerantz et al., 2002; for reviews, see American Association of University Women, 1999; Dwyer & Johnson, 1997; Kimball, 1989). Hence, in terms of grades, girls outperform boys in both stereotypically feminine and masculine areas.

A somewhat different picture emerges when the performance of girls and boys on achievement tests is examined. As is the case for grades, girls outperform their male counterparts on achievement tests in stereotypically feminine subject areas (e.g., U.S. Department of Education, 2000, 2003b; for reviews, see American Association of University Women, 1999; Entwisle et al., 1997). However, boys perform better than girls on achievement tests in the stereotypically masculine areas of math and science, although boys have recently lost their edge over girls on achievement tests in math, on which the two often obtain similar scores (e.g., U.S. Department of Education, 2000, 2003b; for reviews, see American Association of University Women, 1999; Hyde et al., 1990). Thus, although girls outperform boys on achievement tests in stereotypically feminine areas, they do not do so in stereotypically masculine areas.

SEX DIFFERENCES IN APPROACHES TO SCHOOLWORK

A number of investigators have argued that the manner in which girls approach their schoolwork is more likely than that of boys to interfere with performance in school (e.g., Dweck, 1986; Ruble, Greulich, Pomerantz, & Gochberg, 1993). However, several lines of theory and research suggest just the opposite (see Campbell & Eaton, 1999; Higgins, 1991; Pomerantz & Ruble, 1998a, 1998b). Indeed, both social and biological forces may actually lead girls to be more concerned than boys with mastering their schoolwork through increased effort and refraining from disruptive behavior in the classroom. As a consequence, girls may be more likely than boys to adopt learning strategies that enhance learning, and thereby performance, in school.

Differences in the practices that parents use with girls and boys may foster differences in how the two regulate their progress toward their goals, such that girls regulate their progress more closely than do boys (e.g., Higgins, 1991; Hoffman, 1972; Pomerantz & Ruble, 1998a, 1998b; Pomerantz, Saxon, & Kenney, 2001). Although the research is not entirely consistent (see Lytton & Romney, 1991), there is evidence indicating that parents more closely monitor girls' progress than that of boys, correct girls' mistakes more than those of boys, and make decisions for girls more than they do for boys (e.g., Bumpus, Crouter, & McHale, 2001; Pomerantz & Ruble, 1998b; for a review, see Higgins, 1991). Parents also see girls' performance in math as due to their effort but see boys' performance in this area as due to their abilities (Eccles, Jacobs, & Harold, 1990). Such practices and beliefs may communicate to girls the importance of exerting heightened attention and effort as a way to increase knowledge and understanding. Consequently, girls may be more concerned with working hard to develop their skills (i.e., a mastery goal) than with outperforming others (i.e., a performance-approach goal) or appearing unable (i.e., a performance-avoidance goal). Moreover, the practices parents use with girls more than boys may lead girls to become more accustomed to considering the demands of others, particularly those with authority. Consequently, girls may be likely to place greater importance on attending to the teacher, thereby engaging in less disruptive behavior than do boys.

There is also evidence for the possibility that biological forces lead girls and boys to take different approaches to their schoolwork, particularly in terms of their behavior in the classroom. It has been well documented that girls have lower activity levels than do boys before birth (e.g., DiPietro, Hodgson, Costigan, Hilton, & Johnson, 1996) and throughout infancy (e.g., Eaton & Enns, 1986; for a review, see Campbell & Eaton, 1999). In addition, research focusing on girls with congenital adrenal hyperplasia, a genetic disorder causing production of unusually high levels of the male hormone androgen, has shown that these girls engage in heightened levels of activity, including more rough-and-tumble play, than do noncongenital adrenal hyperplasia girls (e.g., Ehrhardt & Baker, 1974; Hines & Kaufman, 1994; for an alternative interpretation, see Huston, 1983). Such a decreased propensity for activity may continue as children enter school, making it easier for girls than for boys to pay attention in class, leading them to engage in less disruptive classroom behavior.

Much research supports the idea that girls and boys approach schoolwork differently, with girls being more mastery and less performance oriented than are boys and engaging in less disruptive behavior in the classroom than do boys. Although some studies have not reported a significant sex difference in the endorsement of mastery goals (e.g., Patrick, Ryan, & Pintrich, 1999; Ryan & Pintrich, 1997), studies that have found a difference consistently indicate that girls focus more on learning and mastery than do boys (e.g., Ablard & Lipschultz, 1998; Meece & Holt, 1993; Nolen, 1988). Research has also shown that boys are more concerned than girls with how smart relative to others they appear to classmates as evidenced by their endorsement of performance goals (e.g., E. M. Anderman & Midgley, 1997; Roeser, Midgley, & Urdan, 1996; Ryan, Hicks, & Midgley, 1997; Stipek & Gralinski, 1996). There are a few exceptions, however, where no differences are significant (e.g., Ablard & Lipschultz, 1998; Meece & Holt, 1993). In terms of disruptive behavior, boys are less compliant with teachers' requests than are girls (e.g., Feingold, 1994; Maccoby, 1990); boys also engage in more disruptive behavior, such as talking to others or annoying the teacher, in the classroom (e.g., Achenbach, Dumenci, & Rescorla, 2002; Bennett et al., 1993; Kaplan & Maehr, 1999; Molins & Clopton, 2002).

THE ROLE OF APPROACHES TO SCHOOLWORK IN PERFORMANCE

The tendency for girls to be more mastery and less performance oriented than boys and to refrain from engaging in disruptive behavior more than do boys may enhance girls' grades because it fosters beneficial learning strategies. Children who hold mastery over performance goals and those who do not engage in disruptive behavior do well in school (e.g., Bennett et al., 1993; Kaplan & Maehr, 1999; Kurdek & Sinclair, 1988; Middleton & Midgley, 1997; Midgley & Urdan, 1995; Pintrich, 2000; Roeser et al., 1996). When children are concerned with mastery rather than with demonstrating superior ability or making mistakes, they are more likely to engage in focused and effective effort involving the use of beneficial learning strategies (e.g., Dweck & Leggett, 1988; Elliott

& Dweck, 1988; Grant & Dweck, 2003; Mueller & Dweck, 1998; Pintrich & De Groot, 1990; Wolters, Yu, & Pintrich, 1996). Similarly, when children do not engage in disruptive behavior in the classroom, they may have the resources to devote to developing and using effortful learning strategies (e.g., Greenwood, Horton, & Utley, 2002). Children's effortful learning strategies include attempts to plan, monitor, and regulate cognitions and study activities as well as a willingness to continue trying in the face of challenge (e.g., Garcia & Pintrich, 1994; Zimmerman & Martinez-Pons, 1990). Notably, students' use of such strategies is associated with enhanced performance in school (e.g., Corno, 1989; Zimmerman, 1989; for a review, see Zimmerman & Martinez-Pons, 1990), and girls are more likely to use them than are boys (e.g., Ablard & Lipschultz, 1998; Patrick et al., 1999; Zimmerman & Martinez-Pons, 1990). Hence, it is likely that girls' tendency to hold mastery over performance goals and to refrain from engaging in disruptive behavior enhances their grades in school because it fosters more effortful learning.

OVERVIEW OF THE CURRENT RESEARCH

The central goal of this research was to examine the idea that a key reason that girls outperform boys in terms of grades is because of how they approach schoolwork. To this end, students initially in fifth grade were followed into seventh grade. In both grades, children reported on their achievement goals—that is, mastery goals (i.e., concern with learning), performance-approach goals (i.e., concern with performing better than others), and performance-avoidance goals (i.e., concern with performing worse than others) in math. Because children often adopt multiple goals (e.g., Barron & Harackiewicz, 2001; Meece & Holt, 1993; Pintrich & Garcia, 1991), it may be important to take into account the relative strength with which they adopt these different goals. Indeed, holding performance goals may not be problematic if children hold mastery goals strongly (e.g., Bouffard, Boisvert, Vezeau, & Larouche, 1995; Pintrich, 2000). Similar to the methodological approach used by Dweck and colleagues (e.g., Cain & Dweck, 1995; Smiley & Dweck, 1994), in the current research, the relative strength of children's performance and mastery goals was taken into consideration because performance goals may be most detrimental when they are held more strongly than mastery goals. Children also reported on their disruptive classroom behavior and learning strategies in regard to math. Students' grades in math and their scores on math standardized achievement tests were obtained as well. The math domain was chosen because it represents a unique opportunity to explore sex differences in an area in which girls are stereotypically expected to do worse than boys, but actually do better in terms of their grades. As shown in Figure 1, it was hypothesized that girls would be more likely than boys to adopt mastery over performance goals and to refrain from engaging in disruptive behavior in the classroom. It was further hypothesized that this would foster learning strategies that lead girls to obtain better grades than those obtained by boys, thereby accounting for girls' edge over boys in terms of grades.

Given that girls outperform boys in terms of their grades in math but not achievement test scores in this area, the extent to which the effects of children's approaches to schoolwork generalize to performance on achievement tests was also explored. Although both grades and achievement test scores reflect children's learning, and indeed are frequently used separately and in tandem as assessments thereof, they also are context-specific reflections of learning. Indeed, because of the nature of the testing situation, when children take achievement tests, girls' edge over boys may be suppressed, particularly when the test is in a stereotypically masculine domain. Prior research has suggested that despite their lead over boys in terms of grades, girls may have lower self-efficacy in stereotypically masculine domains, such as math (e.g., Eccles, 1984; Ruble et al., 1993). Because the achievement test setting represents a one-time assessment of current knowledge without the possibility of improvement through effort, feelings of self-efficacy may be more salient in this context than in that of the everyday

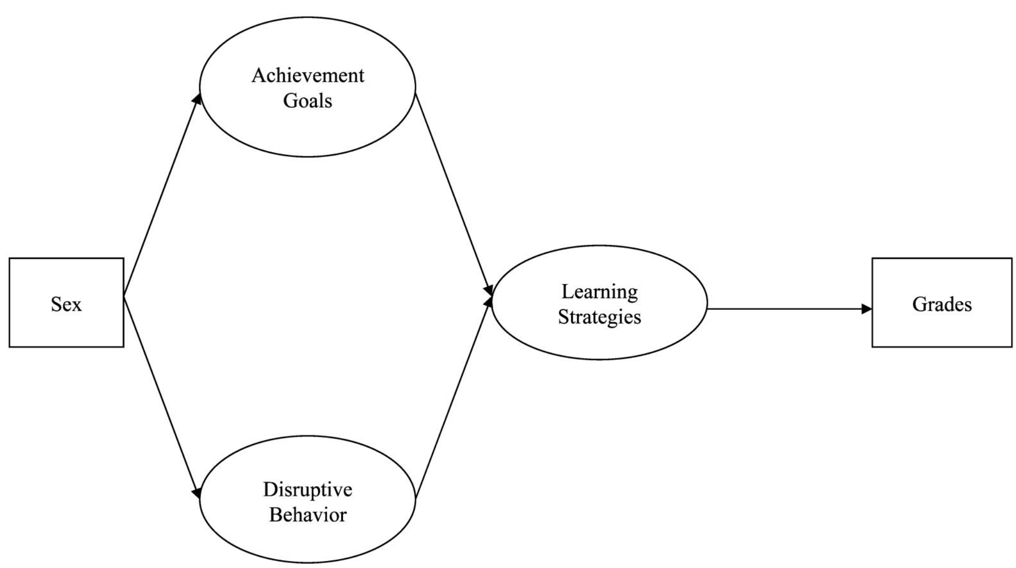

Figure 1. Proposed model.

classroom where a mastery over performance goal orientation may lead girls to focus on increasing their understanding over time through heightened effort. Thus, it was expected that, as in prior research (e.g., Bandura, Barbaranelli, Caprara, & Pastorelli, 1996; for a review, see Eccles & Wigfield, 2002), self-efficacy would play a role in both grades and achievement test scores, but because girls typically have lower self-efficacy than do boys in stereotypically masculine areas, it was not expected that self-efficacy would explain the sex difference in grades in math.

METHOD

Participants

The data were collected as part of the Young Adolescents' Motivation in Math Project. Participants attended one of three primarily White, middle- to upper middle-class school districts in Illinois. Free lunch eligibility ranged from 5% to 12% across the districts. Students participated in two waves of data collection, the first while in fifth grade and the second while in seventh grade. The predominantly White (over 95%) sample consisted of 518 students (265 girls, 253 boys) who participated in both waves of data collection. (Two participants who took part in both waves were dropped from the sample because they were missing data from all of the key predictor variables in fifth grade. Within the resulting sample of 518, the number of participants varies from analysis to analysis as a result of children missing other data.) In two of the school districts, students were in elementary school in fifth grade and entered their respective middle school in sixth grade. Students in the third district were in the same school building in seventh grade that they attended in fifth grade but were in a separate wing of the building after fifth grade.

At each wave, 2 to 3 weeks prior to data collection, letters describing the project were given to all students in the target grades in the participating school districts to take home to their parents. If parents did not want their children to participate in the study, they were instructed to have their children return an attached form to the teacher, call the school, or call the researchers at the university number provided on the letter. Less than 3% of the parents declined to have their children participate in either wave of the study. The decision to use opt-out consent procedures (i.e., parents were notified about the research and given opportunities to exclude their children from the study) was appropriate given the nature of the research and importance of having a representative sample. The study involved minimal risk for children in that they reported on achievement beliefs and behaviors that are a regular part of their school experience. A representative sample was necessary to gather accurate information about the existence and magnitude of sex differences in motivational and achievement variables. Prior research suggests that opt-in consent procedures (i.e., parents provide written consent for their children to participate) may result in a biased sample with underrepresentation of less involved and lower achieving students (C. Anderman et al., 1995), which could artificially alter any observed sex differences in these areas. The decision to use the opt-out consent procedures was supported by the participating schools' personnel and the University of Illinois Institutional Review Board. The attrition rate between waves was 16% (due primarily to children moving out of the school district), yielding the sample described above.

Measures

Surveys were administered to students during their math class in the spring of the school year during both fifth and seventh grade by a trained research assistant. With the exception of one school in the first wave of data collection, instructions and items were read aloud while students read along and responded. In the remaining school, information about the study and instructions was provided in written form. Upon completion, each student sealed his or her survey into an envelope that was collected later by a researcher. All measures referred specifically to math class. Students responded to items on a 5-point scale ranging from 1 (*not at all true*) to 5 (*very true*). Table 1 provides a summary of the internal reliability and temporal stability of the measures. Table 2 provides the means and standard deviations of all the measures by grade and sex.

Math Performance

Math Grades

Students' math grades from fifth and seventh grade were collected from their school records. Letter grades were converted to numerical values (F = 1 to A+ = 13).

Math Achievement Test Scores

Students' scores on the math section of standardized tests taken in fifth and seventh grades were collected from their school records. In fifth grade, all students in each of the three school districts took the Illinois Standardized Achievement Test. In seventh grade, students in each school district took a different standardized test (Stanford Achievement Test, Iowa Basic Achievement Test, or Illinois Learning Standards Battery from Scholastic Testing Service). For the purposes of comparison in analysis, all achievement test scores were standardized within grade and type of test. Thus, a negative achievement test score represents a lower than average performance on a particular achievement test in a given year, whereas a positive achievement test score represents a better than average performance.

Approaches to Schoolwork

Achievement Goals

Students' achievement goals in math class were assessed with the Patterns of Adaptive Learning Survey (Midgley et al., 1997). The Mastery Goal Scale, consisting of six items, assessed the extent to which students endorsed doing their math work to develop their competence (e.g., "An important reason I do my math work is because I want to improve my skills" and "I like math work I'll learn from, even if I make a lot of mistakes"). Two types of performance goals were assessed. The Performance-Approach Goal Scale, consisting of five items, assessed the extent to which students endorsed doing their math work to demonstrate their competence relative to other students in the class (e.g., "An important reason I do my math work is because I want to show my teacher that I'm smarter than the other students in my class" and "I would feel successful in math if I did better than most of the other students"). The Performance-Avoidance Goal Scale, consisting of five items, assessed the extent to

Table 1
Measure Characteristics

	Internal reliability		Temporal stability
Variable	5th grade	7th grade	5th to 7th grade
Grades			.56***
Achievement test scores			.77***
Achievement goals	.83	.78	.43***
Disruptive behavior	.86	.91	.52***
Learning strategies	.83	.85	.36***
Self-efficacy	.85	.87	.37***

*** $p < .001$.

Table 2
Sex Differences by Grade

Variable	5th grade Girls *M*	*SD*	Boys *M*	*SD*	95% CI	*d*	7th grade Girls *M*	*SD*	Boys *M*	*SD*	95% CI	*d*
Grades	8.88_a	1.90	8.51_b	2.03	0.20 to 0.54	.19	9.49_c	2.72	8.47_b	2.97	0.77 to 1.27	.35
Achievement test scores	-0.04_a	0.92	$.05_a$	1.08	−1.26 to 1.08	−.01	0.01_a	0.89	-0.01_a	1.11	−0.07 to 0.11	.02
Achievement goals	0.25_a	1.31	$-.28_b$	1.58	0.40 to 0.66	.36	0.23_a	1.30	-0.20_b	1.24	0.32 to 0.54	.33
Disruptive behavior	1.40_a	0.56	1.98_b	0.99	−0.65 to −0.51	−.68	1.50_c	0.68	2.41_d	1.20	−1.00 to −0.82	−.85
Learning strategies	3.99_a	0.62	3.69_b	0.76	0.24 to 0.36	.42	3.53_b	0.67	3.18_c	0.86	0.28 to 0.42	.45
Self-efficacy	3.93_a	0.78	3.91_{ab}	0.90	−0.05 to 0.09	.02	3.86_b	0.79	3.81_c	0.97	−0.03 to 0.13	.06

Note. Different subscripts within each row indicate significant ($p < .05$) differences. Cohen's (1992) conventions for *d* are that .20 reflects a small effect size, .50 reflects a medium effect size, and .80 reflects a large effect size. CI = confidence interval.

which students endorsed doing their math work to avoid looking inferior relative to other students in the class (e.g., "An important reason I do my schoolwork is so that the teacher doesn't think I know less than others" and "One reason I might not participate in class is to avoid looking dumb"). The items for each scale were averaged to create a mean score for each. Consistent with the original research validating the achievement goal items in the Patterns of Adaptive Learning Survey (Midgley et al., 1998), factor analyses of the items yielded three factors with eigenvalues over one; each type of goal orientation was clearly represented by a single factor. Notably, however, higher order factor analyses of the three scales yielded only one factor with an eigenvalue over one; the Mastery Goal Scale loaded negatively and the two performance goal scales loaded positively on the factor. Thus, although separate orthogonal factors in their own right, the three goal orientations appear to be part of the same superordinate construct of achievement goals in which a concern with mastery is inversely related to a concern with performance.

Several strategies have been used to examine the adoption of multiple goals (e.g., median splits, cluster analysis, and interaction terms). For example, Bouffard et al. (1995) and Pintrich (2000) created four groups based on whether participants fell above or below the median in terms of their endorsement of mastery and performance goals. Meece and Holt (1993) and Pintrich and Garcia (1991) used cluster analysis to form groups varying on their endorsement of mastery and performance goals. Because these are categorical strategies, however, they were not appropriate for the data-analytic strategies used in the current research (e.g., structural equation modeling [SEM]). Hence, in the current research, a continuous composite of the three goals was created. This strategy is similar, although not identical, to that used by Dweck and colleagues (e.g., Cain & Dweck, 1995; Smiley & Dweck, 1994) in that the composite represents the extent to which children were concerned with mastery over performance. The composite also takes into account whether children's performance goals are avoidance or approach oriented. Although performance-avoidance goals appear to have negative effects on children (e.g., Elliot & Harackiewicz, 1996; Grant & Dweck, 2003; Middleton & Midgley, 1997; Skaalvik, 1997), performance-approach goals appear to have no effects or even positive effects (e.g., Elliot & McGregor, 1999; Middleton & Midgley, 1997; Roeser et al., 1996; Skaalvik, 1997; Wolters et al., 1996), particularly when adopted in conjunction with mastery goals (e.g., Bouffard et al., 1995; Pintrich, 2000). Consequently, holding performance-avoidance goals more strongly than mastery goals may be more detrimental than holding performance-approach goals more strongly. Thus, in creating the composite, we weighted performance-avoidance goals twice as negatively as performance-approach goals.

This strategy has several noteworthy qualities. First, it takes into account the relative strength with which children endorse the different goals—thus, this is a within-participants approach. Second, and relatedly, this strategy represents a holistic approach in that it takes into account all three goals simultaneously. Third, it can be used with ease in such data analyses as SEM, without creating problems of multicollinearity or loss of power. A composite index representing students' overall achievement goals was created by standardizing each type of goal and then weighting performance-avoidance goals by two thirds and performance-approach goals by one third. The weighted performance goals were combined and subtracted from the standardized mastery goals, with numbers higher than zero representing a greater concern with mastery than performance, zero representing an equal concern with the two, and numbers less than zero representing a greater concern with performance than mastery. (Preliminary analyses were conducted on the separate achievement goals indicating significant sex differences and associations with other key variables in accordance with hypotheses. Moreover, no significant interactions were found among the separate achievement goals. Details regarding these analyses may be obtained from Gwen A. Kenney-Benson.)

Disruptive Behavior

Students' disruptive behavior in class was assessed with the five-item measure developed by Kaplan (e.g., Kaplan & Maehr, 1999). Items asked about students' disruptive behavior and negative conduct during math class (e.g., "I disturb the lesson in math class" and "I behave in a way that annoys my math teacher"). The validity of the measure has been demonstrated in research finding that the more children report their behavior as disruptive, the more official discipline referrals children received (Kaplan & Maehr, 1999). In addition, children's reports of disruptive behavior, as assessed with this measure, are lower when teachers use effective management practices than when teachers do not do so (Patrick, Turner, Meyer, & Midgley, 2003). The five items were averaged such that higher numbers reflect greater disruptive behavior in class.

Learning Strategies

Two aspects of students' positive learning strategies were assessed: self-regulated learning and lack of persistence. To assess children's self-regulated learning, a six-item scale (see Middleton & Midgely, 1997; Ryan & Patrick, 2001; Turner, Meyer, Midgley, & Patrick, 2003) was used. The items comprising this scale were adapted from the Motivated Strategies for Learning Questionnaire (Pintrich, Smith, Garcia, & McKeachie, 1993) and measures developed by Zimmerman and Martinez-Pons (1988). Items assessed the extent to which students planned, monitored, and regulated their cognitions and classwork (e.g., "Before I begin my math work, I think about the things I will need to do" and "When I notice that I haven't been listening to my math teacher, I try to concentrate harder"). Prior research has provided evidence for the validity of this measure (e.g., Middleton &

Midgley, 1997; Turner et al., 2003). For example, students engaged in higher levels of self-regulated learning are more likely to seek help from others in an attempt to improve their understanding of classroom material (Middleton & Midgley, 1997). The five items assessing students' lack of persistence (adapted from the avoidance of help-seeking measure developed by Ryan and colleagues; see Ryan & Pintrich, 1997) referred to instances when students encountered challenging situations in their academic work and chose to quit rather than work on a solution (e.g., "When I don't understand my math work, I often guess at the answers" and "If part of my math work is really hard I just quit working on it"). After reverse scoring the lack of persistence items, all items were averaged together to create a single scale such that higher numbers represent more positive learning strategies.

Math Self-Efficacy

Students' judgment of their capability to complete their math work successfully—that is, math self-efficacy—was assessed with five items from the Patterns of Adaptive Learning Survey (Midgley et al., 1997). Two sample items are "I can do even the hardest work in my math class if I try" and "I'm certain I can figure out how to do even the most difficult math work." Items were averaged together such that higher numbers represent greater feelings of self-efficacy in math.

RESULTS

Sex Differences

Math Performance

To examine whether there was a sex difference in children's math performance and whether this difference changed over time, children's performance in math was submitted to a Sex × Grade (fifth and seventh) × Type of Performance (grades and achievement test scores) mixed-model multivariate analysis of variance. As shown in Table 2, and consistent with evidence indicating that girls outperform boys in math in terms of their grades but not their achievement tests scores, there was a Sex × Type of Performance interaction, $F(1, 495) = 22.91$, $p < .001$. Girls' grades in math were higher than those of boys, $F(1, 508) = 13.64$, $p < .001$, but their achievement test scores in math were not, $F(1, 498) < 1$. Moreover, girls' advantage over boys in terms of their grades intensified over time, as indicated by a Sex × Grade × Type of Performance interaction, $F(1, 495) = 6.51$, $p < .05$. Girls' grades increased over time, $t(263) = 4.24$, $p < .001$, whereas boys' grades remained the same, $t(246) < 1$.

Achievement-Related Processes

It was expected that the sex difference in children's grades would be paralleled by sex differences in their approaches to schoolwork, learning strategies, and self-efficacy. These achievement-related processes were submitted to a Sex × Grade × Type of Achievement-Related Process mixed-model multivariate analysis of variance. There was a Sex × Type of Achievement-Related Process interaction, $F(3, 512) = 37.73$, $p < .001$. As shown in Table 2, girls endorsed mastery over performance goals to a greater extent, $F(1, 515) = 22.22$, $p < .001$; engaged in less disruptive behavior, $F(1, 514) = 125.73$, $p < .001$; and used more effortful learning strategies than did boys, $F(1, 514) = 38.36$, $p < .001$. However, there was no sex difference in children's feelings of self-efficacy, $F(1, 515) < 1$. There was also a Grade × Type of Achievement-Related Process interaction, $F(3, 512) = 58.42$, $p < .001$. With the exception of achievement goals, $F(1, 515) < 1$, children's achievement-related processes became more negative over time: disruptive behavior, $F(1, 514) = 40.66$, $p < .001$; learning strategies, $F(1, 514) = 168.31$, $p < .001$; and self-efficacy, $F(1, 515) = 3.85$, $p = .05$. A Sex × Grade × Type of Achievement-Related Process interaction, $F(3, 512) = 3.75$, $p < .05$, indicated that for disruptive behavior, this effect was moderated by sex, $F(1, 514) = 16.86$, $p < .001$. Boys' behavior in class worsened over time, $t(251) = -6.16$, $p < .001$, more than did girls' behavior, $t(263) = -2.09$, $p < .05$.

Explaining the Sex Difference in Grades

In our next set of analyses, we investigated whether the tendency of girls to outperform boys in terms of their grades is accounted for by their more positive achievement-related processes. Essential to this endeavor was the initial step of determining whether the key constructs in the proposed model (see Figure 1) were associated with one another as anticipated. To this end, we examined their associations concurrently and longitudinally with bivariate correlations within each wave and across waves (see Table 3 and Table 4). Consistent with prior research, heightened mastery over performance goals, positive learning strategies, and feelings of self-efficacy were associated with better grades and achievement test scores, both concurrently and over time. Conversely, heightened disruptive behavior was associated with poorer grades and achievement test scores, both concurrently and over time. Children's achievement goals and disruptive behavior were also both associated with children's learning strategies concurrently and over time. To investigate the proposed model, two subsequent sets of analyses were performed. First, simultaneous multiple regression (SMR) analyses were conducted to identify the direction of effects. Second, SEM was used to investigate the hypothesized mediational pathways over time, with particular attention to whether girls' tendency to outperform boys in terms of their grades is accounted for by their more positive achievement-related processes.

Direction of Effects: Simultaneous Multiple Regression

SMR analyses were used to examine the extent to which children's approaches to schoolwork in fifth grade predicted their math achievement in seventh grade, while adjusting for their math achievement in fifth grade. Directionality of effects was explored in two ways. First, all analyses adjusted for the prior occurrence of the predicted construct, thereby accounting for the substantial stability of constructs over time (see Table 1). Because of the high stability of the constructs, particularly for the indicators of math performance, it is important to note that this conservative approach is likely to yield small effects. Second, analyses examining the reverse direction of influence to that hypothesized were conducted for each association over time. Together these analytical approaches provided evidence for the direction of effects.

Predicting Math Performance

Achievement goals. In line with predictions, as shown in Table 5, achievement goals predicted grades over time, adjusting for

Table 3
Correlations Between Central Variables

Measure	5th grade 1	2	3	4	5	6	7th grade 1	2	3	4	5	6
5th grade												
1. Grades	—											
2. Achievement test scores	.55	—										
3. Achievement goals	.30	.14	—									
4. Disruptive behavior	−.31	−.16	−.41	—								
5. Learning strategies	.33	.22	.61	−.58	—							
6. Self-efficacy	.44	.37	.48	−.25	.54	—						
7th grade												
1. Grades	.56	.47	.25	−.30	.27	.29	—					
2. Achievement test scores	.54	.77	.21	−.21	.25	.37	.58	—				
3. Achievement goals	.17	.09	.43	−.20	.20	.17	.25	.16	—			
4. Disruptive behavior	−.15	−.01	−.30	.52	−.26	−.10	−.29	−.11	−.29	—		
5. Learning strategies	.22	.15	.40	−.34	.36	.28	.39	.26	.54	−.56	—	
6. Self-efficacy	.29	.31	.29	−.23	.28	.37	.47	.39	.44	−.27	.50	—

Note. Correlations greater than |.09| are significant at the .05 level. Correlations greater than |.12| are significant at the .01 level. Correlations greater than |.15| are significant at the .001 level. Cohen's (1992) conventions for *r* are that .10 reflects a small effect size, .30 reflects a medium effect size, and .50 reflects a large effect size.

earlier grades, $t(508) = 1.98$, $p < .05$, and achievement test scores, adjusting for earlier achievement test scores, $t(498) = 3.69$, $p < .001$: The more children adopted mastery over performance goals in fifth grade, the better their performance in seventh grade. There was no evidence of effects in the reverse direction. Neither grades, $t(508) = 1.16$, *ns*, nor achievement test scores, $t(506) < 1$, predicted achievement goals over time when adjusting for earlier achievement goals.

Disruptive behavior. As anticipated, disruptive behavior in fifth grade predicted decreased grades, $t(508) = -3.44$, $p < .01$, and achievement test scores in seventh grade, adjusting for earlier performance, $t(498) = -2.49$, $p < .05$ (see Table 5). In exploring the reverse direction of effects, we found that math grades did not predict disruptive behavior over time, $t(507) < 1$. In addition, without adjusting for prior disruptive behavior, achievement test scores did not predict disruptive behavior, $t(505) < 1$. Surprisingly, however, when adjusting for prior disruptive behavior, achievement test scores predicted disruptive behavior, $t(505) = 2.13$, $p < .05$, such that the better achievement test scores were, the more disruptive behavior was over time.

Learning strategies. As shown in Table 5, consistent with expectations, when adjusting for prior performance, more positive learning strategies predicted better math performance over time, both for grades, $t(508) = 2.48$, $p < .05$, and achievement test scores, $t(498) = 2.72$, $p < .01$. Analyses exploring the extent to which math performance predicted learning strategies over time adjusting for prior learning strategies indicated that grades predicted learning strategies over time, $t(507) = 2.61$,

Table 4
Correlations Between Central Variables Within Sex

Measure	5th grade 1	2	3	4	5	6	7th grade 1	2	3	4	5	6
5th grade												
1. Grades	—	.55	.24	−.24	.32	.41	.55	.56	.11	−.03	.23	.26
2. Achievement test scores	.57	—	.13	−.11	.18	.35	.45	.75	.05	.06	.15	.24
3. Achievement goals	.32	.16	—	−.31	.60	.47	.20	.13	.44	−.08	.30	.20
4. Disruptive behavior	−.34	−.23	−.42	—	−.47	−.19	−.14	−.14	−.18	.31	−.21	−.12
5. Learning strategies	.31	.28	.59	−.60	—	.56	.18	.18	.24	−.09	.30	.16
6. Self-efficacy	.48	.39	.49	−.31	.54	—	.24	.29	.19	.04	.22	.28
7th grade												
1. Grades	.57	.52	.24	−.33	.29	.34	—	.58	.25	−.11	.37	.46
2. Achievement test scores	.58	.79	.27	−.26	.30	.42	.60	—	.15	−.02	.21	.35
3. Achievement goals	.20	.14	.40	−.21	.18	.22	.21	.17	—	−.23	.55	.46
4. Disruptive behavior	−.18	−.07	−.35	.48	−.24	−.18	−.32	−.16	−.27	—	−.42	−.18
5. Learning strategies	.19	.17	.42	−.33	.35	.33	.37	.29	.52	−.59	—	.45
6. Self-efficacy	.31	.37	.36	−.29	.37	.43	.47	.42	.43	−.34	.54	—

Note. Correlations greater than |.11| are significant at the .05 level. Correlations greater than |.16| are significant at the .01 level. Correlations greater than |.19| are significant at the .001 level. Correlations for boys are in the lower triangle; correlations for girls are in the upper triangle. Cohen's (1992) conventions for *r* are that .10 reflects a small effect size, .30 reflects a medium effect size, and .50 reflects a large effect size.

Table 5
Predicting Math Performance Over Time

	Math performance							
	Grades				Achievement test scores			
Independent variable	*B*	*SE*	95% CI	f^2	*B*	*SE*	95% CI	f^2
Achievement goals	.15*	.08	.001 to .30	.01	.07***	.02	.03 to .11	.03
Disruptive behavior	−.44**	.13	−.70 to −.19	.02	−.08*	−.03	−.15 to −.02	.01
Learning strategies	.39*	.16	.08 to .70	.01	.11**	.04	.03 to .19	.01
Self-efficacy	.16	.06	−.12 to .44	.00	.12**	.04	.05 to .19	.02

Note. All statistics reflect the regression model adjusting for the corresponding assessment of math performance in fifth grade. Cohen's (1992) conventions for f^2 are that .02 reflects a small effect size, .15 reflects a medium effect size, and .35 reflects a large effect size. CI = confidence interval.
* $p < .05$. ** $p < .01$. *** $p < .001$.

$p < .05$, but that achievement test scores did not, $t(505) = 1.67$, *ns*.

Self-efficacy. Surprisingly, self-efficacy did not predict grades over time once analyses adjusted for earlier grades, $t(508) = 1.14$, *ns* (see Table 5). Heightened feelings of self-efficacy did, however, predict better achievement test scores over time when adjusting for prior achievement test scores, $t(498) = 3.39$, $p < .01$. Analyses predicting self-efficacy from math performance adjusting for earlier self-efficacy indicated that heightened feelings of self-efficacy were predicted over time by both higher grades, $t(508) = 3.44$, $p < .01$, and higher achievement test scores, $t(506) = 4.57$, $p < .001$.

Predicting Learning Strategies

It was proposed that achievement goals and disruptive behavior would both influence achievement by affecting learning strategies over time. In line with this proposal, more positive learning strategies were predicted over time by more mastery-focused achievement goals, $t(515) = 5.56$, $p < .001$, and less disruptive behavior, $t(515) = -4.01$, $p < .001$, after adjusting for prior learning strategies. The reverse direction of effects was not evident (*t*s $<$ 1.40, *ns*).

Summary

Overall, the data were supportive of the direction of effects proposed (see Figure 1). As predicted, achievement goals, disruptive behavior, and learning strategies predicted both math grades and achievement test scores over time. Moreover, the general pattern of results from the analyses predicting effects in the reverse direction from that hypothesized did not provide consistent evidence to support this alternative. Only the link between learning strategies and math grades appeared to be reciprocal. Moreover, achievement goals and disruptive behavior each predicted learning strategies over time, but the reverse was not evident. Taken together, these findings are consistent with the proposed direction of effects. Surprisingly, given prior research, self-efficacy did not predict grades over time, but it did predict achievement test scores; this link appeared to be reciprocal as achievement test scores (and grades) also predicted self-efficacy over time.

Mediational Pathways: SEM

To investigate the mediational pathways proposed in the hypothesized model, SEM was used, following Baron and Kenny's (1986) guidelines for detecting mediation (see also Kenny, Kashy, & Bolger, 1998). Baron and Kenny outlined three requirements for mediation. First, there must be a relation between the independent variable (i.e., sex) and the mediator variable (e.g., achievement goals). Second, the mediator variable and the dependent variable (e.g., math grades) must be related when analyses adjust for the independent variable. Third, the direct relation between the independent variable and the dependent variable must be reduced once analyses adjust for the mediator variable. The first of these three criteria—a sex difference in each of the three possible mediators—was already established (see Table 2). To provide evidence for the second and third criteria, SEM was used, which allowed for both the exploration of the mediational pathways and consideration of how well the proposed model fit the data. By taking into account possible measurement error, SEM produces more accurate estimates than SMR. Moreover, when using SEM, mediation is evident if the model including the direct path between the independent and dependent variables does not fit the model better than the model excluding the path. Clogg, Petkova, and Haritou's (1995) procedures for testing the significance of mediation were used. This procedure involves the comparison of the coefficients for the direct paths from the model that includes the mediators with the model that excludes them.

Math Grades

Amos Version 4.0 (Arbuckle, 1997) was used to conduct the SEM analyses. As shown in Figure 2, sex was included as an observed variable predicting the two latent variables of achievement goals and disruptive behavior in fifth grade. The latent variable of achievement goals was based on two subscales, each composed of half of the items from each of the three weighted achievement goal scales (i.e., Mastery, Performance-Approach, and Performance-Avoidance). The latent variable of disruptive behavior was also based on two subscales: one composed of two of the disruptive behavior items and the other composed of the remaining three items. Because children's achievement goals and disruptive behavior were expected to be associated—indeed, the two were correlated (see Table 3)—their errors were correlated in the model. These two variables were set to predict the latent variable of learning strategies, also in fifth grade. This latent variable was based on the measures of self-regulated learning and persistence. Learning strategies was set to predict grades in sev-

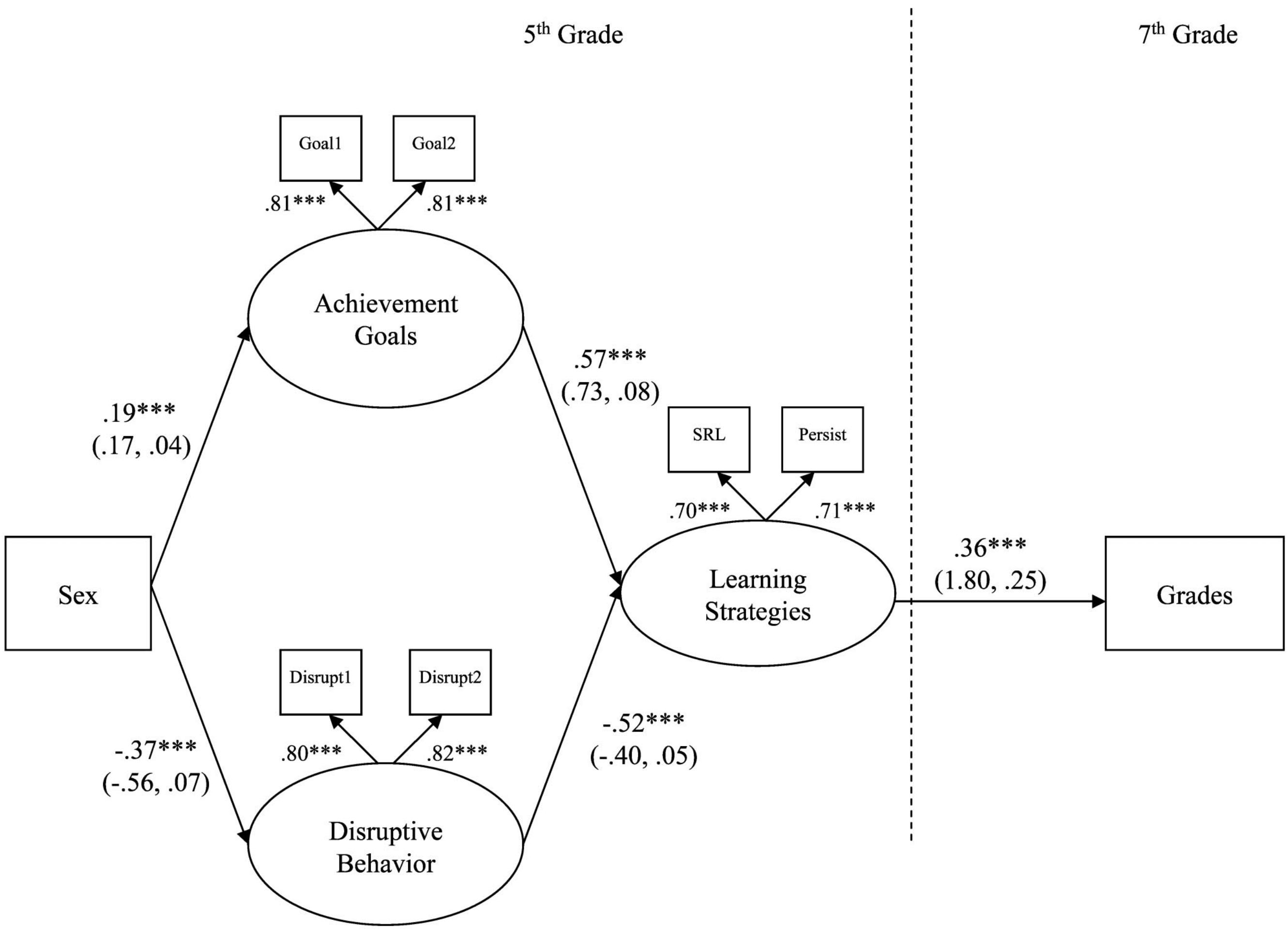

Figure 2. Structural equation model for math grades. Sex: 1 = girls, 0 = boys. Values in parentheses reflect the unstandardized regression weights followed by the standard error of the regression weight. SRL = self-regulated learning. ***$p < .001$.

enth grade. We did not include grades from fifth grade as an additional predictor because we were interested in the extent to which the other factors explained the maintenance of the sex difference in grades over time, not the change in such a sex difference. Additionally, self-efficacy was not incorporated into this model because it was not expected to account for the sex difference in grades. It is also of note that in the regression analyses, self-efficacy did not predict grades over time, once earlier grades were taken into account.

The model fit the data well, $\chi^2(16, N = 518) = 66.25$, $p < .001$, adjusted goodness-of-fit index (AGFI) = .93, root-mean-square error of approximation (RMSEA) = .08, comparative fit index (CFI) = .96. As shown in Figure 2 and consistent with the prior analyses, sex predicted both achievement goals and disruptive behavior, such that girls adopted mastery over performance achievement goals and engaged in less disruptive behavior than did boys. In turn, high mastery-focused achievement goals and low disruptive behavior predicted better learning strategies, which predicted better grades over time.

Mediation within the model was tested in three stages. First, the extent to which achievement goals and disruptive behavior mediated the sex difference in learning strategies was explored. The model including the direct effect between sex and learning strategies did not yield a better fit than the model without the direct effect, $\chi^2_{\text{diff}}(1, N = 518) = 1$, *ns*. In addition, once achievement goals and disruptive behavior were taken into account, the link between sex and learning strategies ($\gamma = .23$, $p < .01$) was reduced to nonsignificance ($\gamma = -.04$, *ns*), with this reduction being significant, $t(514) = 10.16$, $p < .001$. Notably, the links between achievement goals and learning strategies and between disruptive behavior and learning strategies remained after adjusting for sex, $|\gamma|\text{s} > .53$, $p\text{s} < .001$.

Second, the extent to which learning strategies mediated the separate effects of achievement goals and disruptive behavior on grades was explored. For achievement goals, the model including the direct effect between achievement goals and grades did not yield a better fit than the model without the direct effect, $\chi^2_{\text{diff}}(1, N = 518) = 1.6$, *ns*. Once learning strategies were taken into account in the model, the link between achievement goals and grades ($\gamma = .27$, $p < .001$) was reduced to nonsignificance ($\gamma = -.15$, *ns*); this was a significant reduction, $t(515) = 4.42$, $p < .001$. Notably, the link between learning strategies and grades remained when adjusting for achievement goals ($\gamma = .49$, $p < .001$). The model including the direct effect between disruptive behavior and grades did not yield a better fit than the model without the direct effect, $\chi^2_{\text{diff}}(1, N = 518) = 2.96$, *ns*. Once learning strategies were taken into account, the link between disruptive behavior and grades ($\gamma = -.33$, $p < .001$) was reduced to marginal significance ($\gamma = -.16$, $p = .08$), which was a significant reduction, $t(515) = 2.58$, $p < .05$. The link between learning strategies and grades remained after adjusting for disruptive behavior ($\gamma = .22$, $p < .05$).

Last, mediation of the sex difference in math grades was explored. The model including the direct effect between sex and grades did not yield a better fit than the model without the direct effect, $\chi^2_{\text{diff}}(1, N = 518) = 3.47$, *ns*. In addition, once achievement goals, disruptive behavior, and learning strategies were taken into account, the link between sex and grades ($\gamma = .18$, $p < .001$) was reduced to marginal significance ($\gamma = .08$, $p = .06$). Notably, this was a significant reduction, $t(513) = 6.98$, $p < .001$. Moreover, the link between learning strategies and grades remained when adjusting for sex ($\gamma = .33$, $p < .001$), suggesting that the sex differences in children's approaches to schoolwork and learning strategies partially underlie the sex difference in math grades. In sum, it appears that in contrast to boys, girls adopt heightened mastery over performance goals and engage in less disruptive classroom behavior, which may foster enhanced learning strategies, thereby giving girls an edge over boys in terms of grades.

The proposed model was also tested on only the fifth-grade data and only the seventh-grade data. As was the case with the model spanning the two grades, mediation of the sex difference in math grades was evident. The model from the fifth-grade data fit the data adequately, $\chi^2(16, N = 510) = 70.26$, $p < .001$, AGFI = .92, RMSEA = .08, CFI = .96. The model including the direct effect between sex and grades did not yield a better fit than the model without the direct effect, $\chi^2_{\text{diff}}(1, N = 510) < 1$. In addition, once achievement goals, disruptive behavior, and learning strategies were taken into account, the link between sex and grades ($\gamma = .09$, $p < .05$) was reduced to nonsignificance ($\gamma = -.03$, *ns*). Notably, this was a significant reduction, $t(505) = 7.27$, $p < .001$; and the link between learning strategies and grades remained when adjusting for sex ($\gamma = .42$, $p < .001$). The model from the seventh-grade data also fit the data, $\chi^2(16, N = 516) = 57.85$, $p < .001$, AGFI = .94, RMSEA = .07, CFI = .98. The model including the direct effect between sex and grades did not yield a better fit than the model without the direct effect, $\chi^2_{\text{diff}}(1, N = 516) = 1.56$, *ns*. Once achievement goals, disruptive behavior, and learning strategies were taken into account, the link between sex and grades ($\gamma = .18$, $p < .001$) was reduced to nonsignificance ($\gamma = .05$, *ns*). Notably, this was a significant reduction, $t(511) = 7.23$, $p < .001$; and the link between learning strategies and grades remained when adjusting for sex ($\gamma = .41$, $p < .001$).

Math Achievement Test Scores

To examine whether the processes involved in children's performance in the classroom generalized to their performance on achievement tests, we ran a model predicting achievement test scores in seventh grade similar to that predicting grades. Children's sex was not included in the model, however, because, in line with prior research, no sex difference in achievement test scores was apparent in the earlier analyses. The model fit the data well, $\chi^2(11, N = 510) = 40.76$, $p < .001$, AGFI = .94, RMSEA = .07, CFI = .98. Similar to the model predicting grades, heightened mastery-focused achievement goals and dampened disruptive behavior predicted better learning strategies, which predicted better performance on achievement tests over time.

In this model, mediation analyses were conducted to examine the extent to which learning strategies mediated the separate effects of achievement goals and disruptive behavior on achievement test scores. For achievement goals, the model including the direct effect between achievement goals and achievement test scores did not yield a better fit than the model without the direct effect, $\chi^2_{\text{diff}}(1, N = 510) < 1$. Once learning strategies were taken into account in the model, the link between achievement goals and achievement test scores ($\gamma = .23$, $p < .001$) was reduced to nonsignificance ($\gamma = -.06$, *ns*), which was a significant reduction, $t(507) = 3.00$, $p < .001$. Notably, the link between learning strategies and achievement test scores remained when adjusting for achievement goals ($\gamma = .35$, $p < .001$). For disruptive behavior, the model including the direct effect between disruptive behavior and achievement test scores did not yield a better fit than the model without the direct effect, $\chi^2_{\text{diff}}(1, N = 510) < 1$. Once learning strategies were taken into account, the link between disruptive behavior and achievement test scores ($\gamma = -.17$, $p < .001$) was reduced to nonsignificance ($\gamma = -.01$, *ns*), which was a significant reduction, $t(507) = 3.08$, $p < .001$. The link between learning strategies and achievement test scores also remained when adjusting for disruptive behavior ($\gamma = .29$, $p < .01$). These findings suggest that the same processes that influence children's grades over time also influence their achievement tests scores.

Because the regression analyses indicated that self-efficacy predicted achievement test scores over time, the role of self-efficacy was examined. The latent variable of self-efficacy (based on a two-item and three-item subscale of the self-efficacy items) in fifth grade was added to this model as a predictor of children's achievement test scores (see Figure 3). Because of the fact that self-efficacy was also correlated with achievement goals, disruptive behavior, and learning strategies (see Table 3), the errors from the latent variable of self-efficacy and each of the other latent variables were correlated. This model fit the data adequately, $\chi^2(20, N = 509) = 92.15$, $p < .001$, AGFI = .91, RMSEA = .08, CFI = .96 (see Figure 3). Heightened feelings of self-efficacy predicted better achievement test scores over time ($\gamma = .32$, $p < .001$). Notably, however, with the inclusion of self-efficacy in the model, the link between learning strategies and achievement test scores ($\gamma = .30$, $p < .001$) was reduced to nonsignificance ($\gamma = .10$, *ns*). Thus, although achievement goals, disruptive behavior, and learning strategies may play a role in children's performance on achievement tests, this role may be superseded to some extent by self-efficacy.

The model including self-efficacy was replicated within the fifth and seventh grades. In fifth grade, the model fit the data adequately, $\chi^2(20, N = 507) = 80.23$, $p < .001$, AGFI = .92, RMSEA = .08, CFI = .97. Heightened feelings of self-efficacy predicted better achievement test scores ($\gamma = .40$, $p < .001$). With the inclusion of self-efficacy in the model, the link between learning strategies and achievement test scores ($\gamma = .24$, $p < .001$) was reduced to nonsignificance ($\gamma = -.01$, *ns*). In seventh grade, the model also fit the data well, $\chi^2(20, N = 508) = 46.29$, $p < .001$,

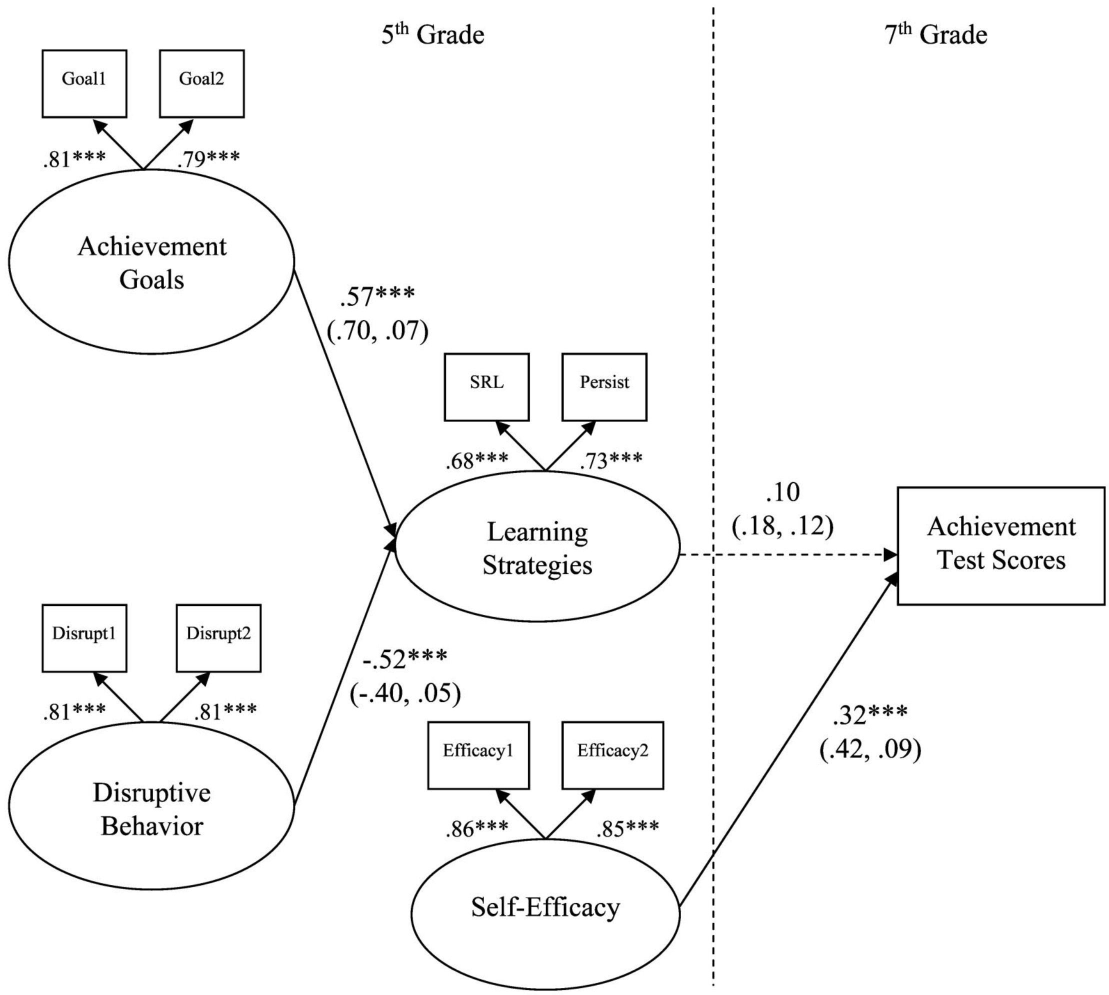

Figure 3. The role of self-efficacy in predicting achievement test scores. Values in parentheses reflect the unstandardized regression weights followed by the standard error of the regression weight. SRL = self-regulated learning. ***$p < .001$.

AGFI = .96, RMSEA = .05, CFI = .99. Again, heightened feelings of self-efficacy predicted better achievement test scores ($\gamma = .43$, $p < .001$). With the inclusion of self-efficacy in the model, the link between learning strategies and achievement test scores ($\gamma = .25$, $p < .001$) was reduced to nonsignificance ($\gamma = -.01$, *ns*).

DISCUSSION

Although much attention has been devoted to girls' vulnerabilities, such as their proneness to depression, relatively little is known about their strengths. There is consistent evidence that girls outperform boys in terms of their grades in all subject areas (e.g., American College Testing Program, 1997; Jacobs, 1991; Pomerantz et al., 2002; for reviews, see American Association of University Women, 1999; Dwyer & Johnson, 1997; Kimball, 1989). However, there has been little investigation into what underlies this advantage. To explore this issue, the current research focused on sex differences in how children approach schoolwork. Consistent with theory and research suggesting that girls are more likely than boys to approach their schoolwork in a manner that enhances their grades (e.g., Campbell & Eaton, 1999; Higgins, 1991; Hoffman, 1972; Pomerantz & Ruble, 1998a), the findings of the current research suggest that sex differences in children's achievement goals and disruptive classroom behavior influence their learning strategies, which underlie the sex difference in grades. However, girls' edge over boys does not appear to extend to performance on achievement tests, despite the fact that how children approach schoolwork and their ensuing use of learning strategies also predict achievement test scores. This may be due to the fact that girls do not experience an edge over boys in their self-efficacy, a factor that appears to play a larger role in determining children's performance on achievement tests than in the classroom. Indeed, children's self-efficacy accounted for the effect of how children approach school and their ensuing use of learning strategies. It is possible that performance in the testing situation may draw on different motivational resources than performance in the classroom, with the former drawing on self-efficacy and the latter drawing on learning strategies. As a consequence, the testing situation may underestimate girls' abilities, but the classroom may underestimate boys' abilities.

The current research took a step toward elucidating the nature of the difference in girls' and boys' math grades by documenting that there is a parallel difference in how girls and boys approach math. Girls adopted mastery over performance goals and tended to refrain from disrupting the classroom, which, in turn, was associated with their increased use of positive learning strategies over time. In contrast, boys adopted performance over mastery goals and tended to be disruptive in the classroom, which was associated with their decreased use of positive learning strategies over time. Girls' heightened positive learning strategies may launch them on to a particularly positive achievement trajectory, as such strategies predict enhanced grades over time, which in turn feed forward to predict enhanced learning strategies. The findings are in line with previous theoretical and empirical work suggesting that girls and boys may approach school differently because of social and biological influences. First, research on parental socialization suggests that girls may be more focused on regulating their progress toward their goals and more willing to put effort into meeting their goals because of parents' heightened monitoring of their daughters (see Higgins, 1991; Pomerantz et al., 2001). Second, research on activity levels suggests that boys possess a biological predisposition toward increased activity early in life (e.g., DiPietro et al., 1996; Hines & Kaufman, 1994), which may later make it more difficult for them to refrain from engaging in disruptive behavior in the classroom.

Similar to most effects in the social sciences and even in the medical sciences (Meyer et al., 2001), the sizes of the effects in the current research generally were between small and medium in magnitude according to Cohen's (1992) standards, except when predicting children's achievement over time and adjusting for their earlier achievement. Not surprisingly, given the stability of children's achievement over time, these latter effect sizes fell only into the small range. The modest size of the effects, particularly the latter ones, should not be taken to mean that they are not important. A number of investigators have argued that even extremely small effects may have significant practical implications (Abelson, 1985; Martell, Lane, & Emrich, 1996). The series of small- to medium-sized effects in the current research may accumulate over time so that they eventually lead women to pursue higher education at a greater rate than do men. Such a trend is indeed evident in the United States (U.S. Department of Education, 1999, 2003b) and is quite striking given the importance of a college education to later success.

It is striking that children's approaches to schoolwork predicted performance in terms of both their grades and achievement test scores over time. However, as in prior research, a sex difference appeared for grades but not for achievement test scores. The approach to schoolwork adopted by girls appeared to enhance both grades and achievement test scores, but girls did not perform better than boys on achievement tests. The differential role of self-efficacy in these two contexts provides some insight into this issue. Self-efficacy predicted better achievement test scores but not grades over time. In fact, the learning strategies ensuing from children's approaches to schoolwork no longer predicted their achievement test scores over time once children's self-efficacy was taken into account. Moreover, unlike children's approaches to schoolwork and their ensuing learning strategies, no sex difference was found in children's self-efficacy. Although girls should feel more efficacious than boys because of their better performance, girls often have lower self-efficacy in stereotypically masculine areas, such as math, than do boys (for a review, see Ruble et al., 1993). The current findings suggest that in the context of taking achievement tests, girls' self-efficacy may negate some of the positive effects of how they approach school.

The differential relevance of feelings of self-efficacy in the classroom and achievement test settings may be due to differences in the two environments. One possible difference may involve the extent to which children view the classroom and the achievement test setting as novel. In the classroom, children are able to establish a relationship with their teachers and come to know what to expect from them. In the context of achievement tests, however, children may not enjoy the same feeling of familiarity. Girls appear to respond more negatively to these types of novel, uncertain situations than do boys, increasing their experience of stress (see Ruble et al., 1993). Early research, noting the curvilinear relation between anxiety and performance, suggested that boys' anxiety in academic settings may be just high enough to push them toward optimal performance levels, whereas girls' anxiety may be so high as to interfere with their performance (see Maccoby & Jacklin, 1974). As a consequence, in the achievement test setting, although girls do not perform worse than boys, they do not perform up to their full potential. Increased levels of stress and anxiety are likely to heighten girls' awareness of their lack of confidence in their abilities, making it difficult to focus on the content of the test, and thus inhibiting performance. Indeed, math test anxiety is associated with performance on math achievement tests (Ma, 1999) but not with grades in school (Meece, Wigfield, & Eccles, 1990). However, test anxiety does not account for the tendency for boys to outperform girls on the Math SAT, but self-confidence does (Casey, Nuttall, & Pezaris, 1997). More research is needed to determine the relative importance of novelty, anxiety, and self-efficacy.

The two settings may also differ in regard to the nature of the exams themselves. Much research has explored the gender bias that may exist in such standardized tests as the SAT and ACT (see Willingham & Cole, 1997). The content of the questions on mathematical portions of these tests tends to focus more on mathematical reasoning than specific mathematical knowledge or skills essential to performance in the classroom, the latter being an area of strength for girls more than for boys (e.g., Bridgeman & Wendler, 1991). Moreover, the structure of these tests may create an underestimation of girls' knowledge in math. However, although some evidence exists to suggest that girls perform better on free response than multiple choice exams, these differences have rarely been found to account for sex differences in the math domain (for a review, see Willingham & Cole, 1997). Hence, more evidence is needed to determine the extent to which the nature of the exams themselves accounts for differences in math performance in the classroom and achievement test settings.

Another possible difference in these two settings may be that in the achievement test setting, but not in the classroom, girls may be vulnerable to negative stereotypes about girls' math ability—a phenomenon that has been labeled "stereotype threat" (Spencer, Steele, & Quinn, 1999; C. M. Steele, 1997). Girls may experience greater anxiety than do boys because they fear that they will be judged by the cultural stereotypes about girls' lack of ability in math. This heightened anxiety interferes with girls' ability to produce effective strategies and ultimately inhibits performance (e.g., Quinn & Spencer, 2001). In addition, for boys, the presence of positive stereotypes may actually enhance their performance in these conditions (e.g., Shih, Pittinsky, & Ambady, 1999). In the everyday classroom setting, however, children may be less likely to feel that they will be judged on the basis of their sex, believing that their individual behavior, knowledge, and effort will be the major determining factor in their grades. Hence, in the everyday classroom setting, gender stereotypes may be less salient, allowing girls to reap the benefits of their enhanced learning strategies more effectively.

In considering why there might be a sex difference in children's grades but not in achievement test scores in math, the question of what grades and test scores really assess is of import. The general assumption guiding the current research was that they both reflect learning, albeit in different contexts. Indeed, the two were strongly associated (see Table 3). However, there may also be differences between the two. We assumed that students earn grades in math on the basis mainly of their learning. It is also possible that teachers give grades in this domain on the basis of not only children's learning, but also their classroom behavior (e.g., compliance and observable effort). This could explain why girls do better than boys in terms of math grades but do not outperform them on math achievement tests where classroom behavior is not an issue. Consistent with this possibility, although children's disruptive behavior was significantly associated with both their grades and achievement test scores, it was more strongly associated with the former. However, girls outperform boys in other domains, such as language arts, in terms of both grades and achievement test scores. Thus, it is not clear that this can explain the pattern of sex differences in the domain of math. One approach to elucidating this issue is to examine whether the sex difference in grades is affected by the extent to which teachers take into account children's classroom behavior when determining grades.

The focus of the current study on the math domain may limit the generalizability of the conclusions. The math domain was chosen because girls outperform boys only in terms of grades in this stereotypically masculine subject, thus identifying girls' strengths in the classroom while at the same time highlighting potential vulnerabilities in the achievement test setting. In more stereotypically feminine domains, however, girls also outperform boys on achievement tests. This is not surprising in terms of stereotype threat or self-efficacy, because girls are expected to perform better and also tend to feel more confident about their abilities in these domains. In terms of the novelty of the achievement test setting and girls' more negative response to stress, however, it is possible that girls' performance on achievement tests may be somewhat impaired, even in stereotypically feminine subject domains. Moreover, boys' relative performance in terms of grades and achievement tests may be the opposite in stereotypically feminine domains. In these domains, stereotype threat should inhibit boys in the same way that it inhibits girls in math. Although stereotype threat theory has not been used to explain boys' worse performance on achievement tests in stereotypically feminine domains, the performance of White males on math tests has been found to be negatively affected by a stereotype threat comparing their performance with that of Asians (Smith & White, 2002). These same males may be adversely affected by stereotypes about boys' performance in language arts.

The generalizability of the findings is limited by other factors as well. First, although the sample is representative of the school districts from which it was drawn, it is not representative of the United States more broadly in that it is predominantly White and middle to upper middle class. Hence, caution is warranted in generalizing the findings to children of other backgrounds. Indeed, it is not clear that the sex difference in math grades exists among children who are not of European descent (see Demie, 2001; Hyde et al., 1990). For example, in their meta-analysis, Hyde et al. (1990) found no evidence for the sex difference in math performance in studies of African Americans, Hispanic Americans, or Asian Americans. Moreover, little is known as to the role of socioeconomic status in sex differences in achievement. Future research will need to explore the current model in a variety of ethnic, racial, and socioeconomic groups. Second, the current research relied on children's self-reports, rather than behavioral observations, of their disruptive behavior and learning strategies. Although this is a common approach to assessing these constructs (see Midgley et al., 1998; Schunk & Zimmerman, 1994), children may be biased in their reports. This may be particularly problematic in the current context, because gender stereotypes may lead girls to be less willing than boys to indicate that they engage in disruptive behavior and more willing to indicate that they engage in positive learning strategies.

Despite these limitations, the current findings regarding girls' and boys' approaches to schoolwork may have implications for their later aspirations and career choices. In the 1990s, college enrollment rates shifted such that more girls applied to and attended college than did boys (U.S. Department of Education, 1999, 2003a). In the current study, girls were more likely than boys to adopt mastery over performance goals and subsequently to use effortful learning strategies. This may be one reason for girls' heightened desire for higher education. However, men still significantly outnumber women in stereotypically masculine fields, such as science and engineering (see National Science Foundation, 1999; U.S. Department of Education, 1997). Some research has suggested that this may be due to women's experience of discrimination and stereotype threat in these fields (e.g., J. Steele, James, & Barnett, 2002). The current research suggests another factor. It is possible that the more competitive environment of these fields (see Griffin-Pierson, 1988; Hayden & Holloway, 1985) is not a good fit with how girls approach school (for a similar argument, see Cross & Vick, 2001). Consequently, even if the topic is of interest, girls' more mastery-oriented approach may not match this work environment, whereas the atmosphere in these fields may provide a better fit to boys' performance-oriented approach. Future research needs to consider these factors and their influence on girls' and boys' educational and career decisions.

Another important area of exploration for future research will be identifying the factors that influence both children's performance and emotional responses in academic achievement settings. Previous work has shown that girls may receive better grades than boys but at the same time may be more vulnerable to internal distress (e.g., Pomerantz et al., 2002). Notably, the same factors may contribute to both enhanced grades and heightened internal distress for girls. For example, Roberts (1991) has suggested that girls view achievement situations as providing important feedback about their abilities, which may encourage a focus on mastery. However, by interpreting all feedback as informative, girls may also place greater value on messages that highlight their deficits (Roberts, 1991). This acknowledgment of their deficits may leave girls more vulnerable to internal distress. Boys, in contrast, who do not place as much significance on evaluative feedback, are more likely to focus on competition, which may interfere with their grades but buffer them from heightened internal distress.

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