Middle School Students' Motivation for Learning Science: Understanding Change across Time and Relationships with Achievement

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Increasing students' motivation in STEM fields is critically important, particularly for students from historically marginalized backgrounds such as women, students of color, and linguistic minorities (NSF, 2010). We define student motivation for learning science to include five dimensions: self-efficacy, intrinsic motivation, career motivation, self-determination, and grade motivation (Bryan, Glynn, & Kittleson, 2011). The goals of this study are to examine: (a) change in students' motivation within the context of a teacher STEM-focused intervention, and (b) the extent to which dimensions of motivation are related to students' science achievement.

This study is situated within an intensive middle school science teacher professional development called the STEM Academy for Science Teachers. The STEM Academy includes 90 hours of summer coursework focused on STEM education including project-based learning, maker-based instruction, socio-emotional competencies including collaboration and communication, the scientific process standards, and science pedagogical content knowledge (Bevan, Gutwill, Petrich, & Wilkinson, 2014; Bybee, 2010; Capraro, Capraro, & Morgan, 2013; NGSS, 2013; NRC, 2000). During each of up to three years of participation, teachers engage in up to seven feedback cycles annually and professional learning communities (PLC) at their school with a university instructional coach, who observes their instruction, provides individual feedback to each teacher, and facilitates a school PLC. At the time of this study, one cohort of teachers had completed their second year of participation and one cohort had completed their first year of participation. The research questions for this study include:

1. Does students' motivation for learning science change in STEM Academy teachers' classrooms?
2. Are there heterogeneous changes in students' motivation based on student, teacher, or school characteristics?
3. What is the relationship between students' motivation and science achievement in STEM Academy teachers' classrooms?

4. Are relationships between motivation and science achievement heterogeneous based on student characteristics?

Given the STEM Academy's strong emphasis on encouraging teachers to engage students in STEM instructional strategies, we hypothesized that we would see increases in students' motivation for learning science across the school year. Based on previous work (Bryan et al., 2011; Glynn, Brickman, Armstrong, & Taasoobshirazi, 2011), we hypothesized that students' motivation would relate positively to their science achievement.

Methods

For research questions one and two, we first test for significant changes in mean scores using a series of paired sample t-tests. Next, we fit a series of hierarchical linear models (HLM) examining change across time including student, teacher, and school-level covariates. We fit a separate model for each of the dimensions of motivation examined in this study. We included the covariates to isolate the influence of each characteristic on students' motivation near the end of the school year after controlling for students' motivation at the beginning of the year and other characteristics. We examined statistically significant covariates to test for heterogeneous change across time.

For research questions three and four, we tested for significant correlations between students' motivation and science achievement. We fit a series of HLMs examining the relationship between students' motivation for learning science and their science achievement including student, teacher, and school-level covariates. In these analyses, we included covariates to remove variance attributable to each characteristic, resulting in a more precise estimate of the relationship between motivation and achievement. We tested statistically significant covariates using interaction terms to examine heterogeneous relationships between motivation and achievement based on student characteristics.

We engaged in both traditional significance testing and HLM for two reasons. First, although significance testing allowed us to understand general trends across time, it did not account for the nesting of students within teachers' classrooms, which contributes to bias in estimates of the observed relationships. Second, significance testing did not account for omitted variable bias, which explains

variation in the relationship between the scores across time such as student, teacher, and school characteristics. As such, we included a rich set of covariates in our models including:

- Students' ethnicity, gender, Limited English Proficiency status, special education status, Free or Reduced Price Lunch (FRL) status, grade, and previous years' tests scores in mathematics, reading, and science;
- Teachers' years of teaching experience, education level, and number of years in the STEM Academy; and
- School-level student enrollment or school size, percent of students identified as Black, percent of students identified as Hispanic, percent of students identified by the district as at risk based on FRL status and previous test scores, percent of teachers retained, percent of students proficient in science, and percent of teachers who agree that the school has a positive climate.

Data Sources

We measured student motivation for learning science using a 25-item survey measure called the Student Motivation Questionnaire II (SMQ-II) (Bryan et al., 2011; Glynn et al., 2011). Scores represented an average on a four-point scale across the items assigned to each dimension (i.e., self-efficacy, intrinsic motivation, career motivation, self-determination, and grade motivation). Based on correlational analyses with our data, this survey was multi-dimensional with correlations between the dimensions ranging from .37 to .67. We measured science achievement using students' scale score on the Grade 8 State of Texas Assessments of Academic Readiness (STAAR) Science Assessment.

Based on data available at this phase of our study, our analyses included two cohorts of students (i.e., first cohort started in 2017-18 and second cohort in 2018-19). During 2017-18, the STEM Academy included 13 teachers. In 2018-19, 23 additional teachers joined the STEM Academy.

Change across time. For research questions one and two, we administered the SMQ-II at two time points (i.e., near the beginning and end of the school year) with the 2018-19 cohort of students. We examined change across time in motivation focusing on the 2018-19 sample of students only because two

time points were not available in 2017-18. These students were situated in 13 middle schools in 36 STEM Academy teachers' classrooms (n=424; μ=12 surveyed students per teacher).

Relationship between motivation and achievement. For research questions three and four, the collaborating school district shared state test scores, which were available for the 2017-18 and 2018-19 students. As such, we examine the relationship between students' motivation for learning science near the end of the school year and science achievement for 2017-18 and 2018-19 students. These students were situated in 12 middle schools in 24 STEM Academy teachers' classrooms (n=425; μ=18 surveyed students per teacher). This analysis only includes students enrolled in Grade 8 science or Grade 7 Pre-AP science, both of which are tested subjects.

Results

Change in science motivation. Overall, we observed small decreases in science motivation for students in STEM Academy teachers' classrooms (Table 1). The decreases were statistically significant for career motivation ($p<.001$), self-determination ($p<.001$), and intrinsic motivation ($p<.01$), but not for students' self-efficacy or grade motivation. Contrary to our hypothesis, we did not see students' motivation for learning science increase during the school year.

Heterogeneous changes in students' motivation. A few student characteristics explained significant variation in the relationship between students' fall and spring motivation (Tables 2 and 3). After controlling for fall motivation and other characteristics, students with higher reading scores in the previous year rated their science grade motivation higher ($p<.05$); this relationship was not observed for students' mathematics test scores.

After controlling for school and other characteristics, the teacher covariates in this study, including number of years in the Academy, did not explain statistically significant variation in the relationship between students' fall and spring motivation scores, but we observed some evidence of heterogeneous changes in students' motivation based on school characteristics. After controlling for fall motivation and other characteristics, students at schools with *more* Black students ($\beta=.01$; $p<.05$) and *less* positive culture ($\beta=-.02$; $p<.01$) rated their grade motivation *higher*. In addition after controlling for

students' fall scores and other characteristics, students at schools with *more* Black students rated their self-efficacy *higher* (β=.01; p<.05).

Motivation and achievement. Of the five dimensions of science motivation, both self-efficacy (r=.14; p<.01) and intrinsic motivation (r=.14; p<.01) were significantly correlated with students' science achievement. After controlling for student, teacher, and school characteristics, the HLM results indicated that *only* self-efficacy (β= 54.84; p<.05) was a statistically significant predictor of students' science achievement (Tables 3 and 4). As described earlier, the HLM results provide a more precise estimate of the relationship between motivation and achievement than correlations. The coefficient for self-efficacy suggests that students who scored one point higher on the self-efficacy scale scored an average of 55 scale score points higher on the science achievement test. The HLM results indicated that intrinsic motivation, grade motivation, career motivation, and self-determination were not significantly related to students' science achievement.

Heterogeneous relationships between motivation and achievement. Across all models, several covariates were significant predictors of science achievement after controlling for students' motivation scores and other characteristics. These significant student covariates indicated that female students scored lower on the science test (p<.01), Grade 8 students scored lower on the science test (p<.001), which makes sense because the Grade 7 students in this study were enrolled in advanced placement courses, and students with higher prior mathematics scores (p<.05) and reading scores (p<.001) scored higher. We tested interaction terms to examine if these variables moderated the relationship between science motivation and achievement. We observed evidence that reading achievement moderated the relationship between one dimension of motivation, grade motivation, and science achievement (Z= 2.72; p<.01).

Scholarly Significance

We find that middle school students start the school year more motivated than they are near the end. In general, previous work has shown students' motivation decreases in middle school (Wigfield & Eccles, 1994). Skinner and Belmont (1993) documented the reciprocal relationship between student motivation and teacher behavior; as student motivation decreased, teachers encouraged motivation less

often and in some cases, undermined students' motivation. In future analyses, we will examine the relationship between change in student motivation and teachers' implementation of STEM to understand if teachers who were higher implementers experienced differential change in students' motivation across the year. The results will support identifying instructional strategies that encourage students' motivation in ways that leverage middle school students' unique affordances developmentally and contextually (Turner & Patrick, 2008).

We observed interesting heterogeneous changes in motivation specific to grade motivation. Students with higher prior reading scores, but not mathematics scores, reported more grade motivation in science. We also observed a statistically significant interaction between grade motivation in science and reading achievement in predicting science achievement, which we did not observe for mathematics achievement. Students may recognize the disadvantage presented by lower reading ability for achieving proficiency in science (Israel, Wang, & Marino, 2015). In addition, our findings support previous studies that show school characteristics contribute to explaining change in students' motivation (e.g., Shumow, Lyutykh, & Schmidt, 2011). In our study, the observed significant covariates likely relate to unobserved school factors such as parental involvement, expectations for staff and students, and school leadership. Furthermore, these covariates may capture variance attributable to reference bias, where students' perceptions of their motivation are influenced by their perceptions of their peers' motivation (Egalite, Mills, & Greene, 2015). We are in the process of unpacking the influence of contextual factors on students' motivation through in-depth teacher interviews.

Science achievement was predicted by one dimension of motivation, self-efficacy, but not by grade determination, self-determination, career motivation, or intrinsic motivation. The finding that achievement and motivation are not related across all dimensions does not mean that motivation is not important for students' futures. Compared to student achievement in science, exposure to and interest in STEM education are stronger predictors of students' pursuit of a science career later in life (Wang, 2013). Researchers often use science achievement as the primary outcome of interest (e.g., Navruz et al., 2014). This singular focus on achievement excludes important information about students' motivation, which is

predictive of future outcomes. Our findings support that if researchers focus only on science achievement, we preclude important information related to future outcomes. Our findings highlight the need to address unexpected decreases in middle school students' motivation through supporting teachers in implementing effective instructional and socio-emotional strategies, which we will identify in the next phase of this work.

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Table 1. Change in Students' Mean Motivation for Learning Science

Dimension	Fall	Spring	*t*-statistic
Grade motivation	3.5	3.4	-1.52
Intrinsic motivation	3.0	2.9	-3.09**
Self-efficacy	3.3	3.3	-1.99
Career motivation	2.9	2.7	-6.40***
Self-determination	2.9	2.8	-4.10***

N=424 middle grades students in 2018-19

Table 2. Change in Motivation for Learning Science during the School Year (2018-19) (continued in Table 3)

Variable	Intrinsic Motivation					Career Motivation					Self-Efficacy				
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 1	Model 2	Model 3	Model 4	Model 5	Model 1	Model 2	Model 3	Model 4	Model 5
Outcome		0.72***	0.70***	0.68***	0.69***		0.76***	0.78***	0.78***	0.78***		0.65***	0.62***	0.62***	0.61***
		(0.04)	(0.04)	(0.04)	(0.04)		(0.04)	(0.05)	(0.05)	(0.05)		(0.04)	(0.04)	(0.04)	(0.04)
Black			-0.01	0.00	-0.03			0.00	0.00	0.03			0.20	0.21	0.15
			(0.32)	(0.32)	(0.32)			(0.42)	(0.42)	(0.42)			(0.29)	(0.29)	(0.29)
Hispanic			-0.05	-0.04	0.01			0.07	0.08	0.16			0.10	0.12	0.14
			(0.31)	(0.31)	(0.31)			(0.40)	(0.40)	(0.40)			(0.28)	(0.28)	(0.28)
Other Race			0.07	0.06	0.06			0.04	0.03	0.04			0.10	0.11	0.09
			(0.33)	(0.33)	(0.33)			(0.43)	(0.43)	(0.43)			(0.30)	(0.30)	(0.30)
Female			0.02	0.03	0.05			0.03	0.03	0.04			-0.07	-0.07	-0.05
			(0.06)	(0.06)	(0.06)			(0.08)	(0.08)	(0.08)			(0.05)	(0.05)	(0.05)
LEP			0.05	0.04	0.05			0.04	0.04	0.05			-0.02	-0.02	-0.02
			(0.06)	(0.06)	(0.06)			(0.08)	(0.08)	(0.08)			(0.05)	(0.05)	(0.05)
SWD			-0.17	-0.21	-0.23			-0.03	-0.03	-0.05			-0.11	-0.11	-0.13
			(0.13)	(0.13)	(0.13)			(0.17)	(0.17)	(0.17)			(0.12)	(0.12)	(0.12)
FRL			0.00	0.00	0.00			0.00	0.00	0.00			0.00	0.00	0.00
			(.00)	(.00)	(.00)			(.00)	(.00)	(.00)			(.00)	(.00)	(.00)
Grade 8			-0.06	-0.09	-0.10			0.02	-0.01	-0.04			-0.02	-0.02	-0.04
			(0.06)	(0.07)	(0.07)			(0.09)	(0.09)	(0.09)			(0.06)	(0.06)	(0.06)
Reading test score			0.00	0.00	0.00			0.00	0.00	0.00			0.00	0.00	0.00
			(0.00)	(0.00)	(0.00)			(0.00)	(0.00)	(0.00)			(0.00)	(0.00)	(0.00)
Mathematics test score			0.00	0.00	0.00			0.00	0.00	0.00			0.00	0.00	0.00
			(0.00)	(0.00)	(0.00)			(0.00)	(0.00)	(0.00)			(0.00)	(0.00)	(0.00)
Teacher CYS				0.01*	0.01				0.01	0.01				0.00	0.00
				(0.01)	(0.01)				(0.01)	(0.01)				(0.01)	(0.01)
Teacher master's degree or higher				-0.14	-0.14				0.08	0.13				0.06	0.05
				(0.09)	(0.11)				(0.13)	(0.15)				(0.09)	(0.10)
Teacher cohort				0.00	-0.03				-0.08	-0.14				-0.01	0.05
				(0.07)	(0.10)				(0.10)	(0.13)				(0.06)	(0.09)
School enrollment					0.00					0.00					0.00
					(0.00)					(0.00)					(0.00)
School percent Black					0.01					0.00					0.01*
					(0.00)					(0.00)					(0.00)
School percent at risk					0.00					-0.01					0.00
					(0.01)					(0.01)					(0.01)
School percent teachers retained					0.01					0.01					0.00
					(0.01)					(0.01)					(0.00)
School percent proficient science					0.00					-0.01					0.00

					(0.01)					(0.01)					(0.01)
School percent teachers agree positive climate					0.00					0.01					-0.01
					(0.01)					(0.01)					(0.01)
Constant	2.89***	0.74***	0.33	0.40	0.25	2.69***	0.45***	-0.54	-0.61	-0.74	3.26***	1.11***	0.91*	0.83	0.85
	(0.06)	(0.11)	(0.50)	(0.51)	(1.02)	(0.06)	(0.13)	(0.67)	(0.68)	(1.35)	(0.05)	(0.12)	(0.45)	(0.46)	(0.92)
AIC	924.26	668.21	579.69	579.90	582.95	1146.83	892.59	763.24	766.84	773.16	800.30	574.81	510.18	514.65	518.99
BIC	936.41	684.41	629.91	641.72	667.95	1158.98	908.79	813.46	828.66	858.16	812.45	591.00	560.41	576.47	603.99
N	402	402	398	398	398	402	402	398	398	398	402	402	398	398	398

* p<0.05, ** p<0.01, *** p<0.001

Note: This table does not include prior science test scores results because those scores were only available for a subset of students.

Table 3. Change in Motivation for Learning Science during the School Year (2018-19) (cont.)

Variable	Self-Determination					Grade Motivation				
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 1	Model 2	Model 3	Model 4	Model 5
Outcome		0.69***	0.69***	0.69***	0.70***		0.61***	0.56***	0.56***	0.56***
		(0.03)	(0.04)	(0.04)	(0.04)		(0.04)	(0.05)	(0.05)	(0.05)
Black			-0.01	-0.02	-0.02			0.54	0.55	0.45
			(0.30)	(0.30)	(0.30)			(0.29)	(0.29)	(0.29)
Hispanic			0.04	0.04	0.11			0.45	0.47	0.43
			(0.29)	(0.29)	(0.29)			(0.28)	(0.28)	(0.28)
Other Race			0.01	0.01	0.02			0.52	0.53	0.48
			(0.32)	(0.32)	(0.31)			(0.30)	(0.30)	(0.29)
Female			-0.07	-0.07	-0.05			0.03	0.03	0.05
			(0.05)	(0.06)	(0.06)			(0.05)	(0.05)	(0.05)
LEP			-0.02	-0.02	-0.03			0.03	0.04	0.04
			(0.06)	(0.06)	(0.06)			(0.05)	(0.05)	(0.05)
SWD			-0.13	-0.15	-0.17			-0.04	-0.05	-0.06
			(0.13)	(0.13)	(0.13)			(0.12)	(0.12)	(0.12)
FRL			0.00	0.00	0.00			0.00	0.00	0.00
			(.)	(.)	(.)			(.00)	(.00)	(.00)
Grade 8			0.02	0.01	-0.01			-0.05	-0.04	-0.02
			(0.06)	(0.06)	(0.06)			(0.05)	(0.06)	(0.06)
Reading test score			0.00	0.00	0.00			0.00**	0.00**	0.00*
			(0.00)	(0.00)	(0.00)			(0.00)	(0.00)	(0.00)
Mathematics test score			0.00	0.00	0.00			0.00	0.00	0.00
			(0.00)	(0.00)	(0.00)			(0.00)	(0.00)	(0.00)
Teacher CYS				0.00	0.00				0.00	-0.01
				(0.01)	(0.01)				(0.01)	(0.01)
Teacher master's degree or higher				-0.09	-0.01				0.01	0.05
				(0.09)	(0.10)				(0.08)	(0.10)
Teacher cohort				0.08	0.02				0.04	0.06
				(0.07)	(0.09)				(0.06)	(0.09)
School enrollment					0.00					0.00
					(0.00)					(0.00)
School percent Black					0.00					0.01*
					(0.00)					(0.00)

School percent at risk					0.00					0.01
					(0.01)					(0.01)
School percent teachers retained					0.01					0.00
					(0.00)					(0.00)
School percent proficient science					-0.01					0.01
					(0.01)					(0.01)
School percent teachers agree positive climate					0.00					-0.02**
					(0.01)					(0.01)
Constant	2.83***	0.80***	0.69	0.68	1.21	3.43***	1.31***	0.54	0.48	1.24
	(0.05)	(0.11)	(0.49)	(0.49)	(0.95)	(0.03)	(0.16)	(0.45)	(0.46)	(0.90)
AIC	883.84	614.58	542.49	546.08	546.78	737.71	590.46	498.32	503.06	503.72
BIC	895.98	630.78	592.71	607.90	631.78	749.86	606.66	548.54	564.88	588.72
N	402	402	398	398	398	402	402	398	398	398

* p<0.05, ** p<0.01, *** p<0.001

Note: This table does not include prior science test scores results because those scores were only available for a subset of students.

Table 4. Relationship between Motivation for Learning Science and Science Achievement (2017-18 and 2018-19) (continued in Table 5)

Variable	Intrinsic Motivation					Career Motivation					Self-Efficacy				
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 1	Model 2	Model 3	Model 4	Model 5	Model 1	Model 2	Model 3	Model 4	Model 5
Outcome		51.26	19.41	18.22	10.11		-24.65	-49.16	-49.63	-24.97		183.57***	123.03**	119.83**	54.84*
		(39.47)	(37.98)	(37.66)	(24.52)		(30.98)	(29.02)	(28.77)	(18.83)		(43.57)	(41.84)	(41.51)	(27.38)
Black			-353.90*	-362.37*	-106.16			-373.23*	-381.31*	-116.64			-354.84*	-362.74*	-109.36
			(164.49)	(163.16)	(107.12)			(163.67)	(162.31)	(106.85)			(162.17)	(160.87)	(106.40)
Hispanic			-166.34	-166.97	21.71			-176.36	-176.42	16.04			-163.64	-164.39	19.62
			(145.59)	(144.37)	(94.48)			(144.40)	(143.18)	(93.91)			(143.28)	(142.10)	(93.65)
Female			-62.46	-61.07	-108.01**			-55.63	-54.18	-104.28**			-59.22	-57.99	-106.04**
			(54.91)	(54.45)	(35.53)			(54.77)	(54.30)	(35.53)			(54.22)	(53.77)	(35.35)
LEP			-154.76**	-155.21**	-51.70			-159.69**	-160.03**	-54.33			-138.63**	-139.37**	-45.90
			(51.52)	(51.08)	(33.62)			(51.10)	(50.65)	(33.45)			(51.06)	(50.63)	(33.53)
SWD			92.11	81.79	50.99			76.46	66.39	42.80			101.52	91.76	54.79
			(121.50)	(120.56)	(78.35)			(120.33)	(119.37)	(77.75)			(119.37)	(118.47)	(77.56)
FRL			0.00	0.00	0.00			0.00	0.00	0.00			0.00	0.00	0.00
			(.00)	(.00)	(.00)			(.00)	(.00)	(.00)			(.00)	(.00)	(.00)
Grade 8			-280.54**	-313.67**	-262.01***			-310.36**	-344.12**	-277.97***			-265.04*	-297.31**	-258.12***
			(105.79)	(106.30)	(75.82)			(105.96)	(106.43)	(76.11)			(104.32)	(104.89)	(75.30)
Previous year reading test score			1.87***	1.86***	2.47***			1.86***	1.85***	2.47***			1.80***	1.80***	2.43***
			(0.29)	(0.28)	(0.19)			(0.28)	(0.28)	(0.19)			(0.28)	(0.28)	(0.19)
Previous year mathematics test score			0.41*	0.40*	0.27*			0.40*	0.38*	0.26*			0.39*	0.37*	0.26*
			(0.17)	(0.17)	(0.11)			(0.17)	(0.17)	(0.11)			(0.17)	(0.17)	(0.11)
Teacher CYS				58.31*	340.11				59.51*	339.11				56.53*	336.20
				(28.73)	(413.06)				(28.86)	(411.67)				(28.76)	(407.35)
Teacher master's degree or higher				59.57	-12113.75				57.65	-12036.86				61.75	-11955.06
				(596.24)	(7862.33)				(599.68)	(7836.19)				(597.29)	(7754.22)
School enrollment					28.16***					27.99***					27.75***
					(2.21)					(2.21)					(2.20)
School percent Black					-159.42					-158.63					-154.15
					(347.68)					(346.52)					(342.92)
School percent Hispanic					-111.26					-110.91					-105.97
					(330.78)					(329.68)					(326.26)

School percent at risk					309.01***					309.25***					305.29***
					(20.38)					(20.31)					(20.32)
Constant	3637.31***	3490.91***	390.92	-10.17	-41496.70	3637.31***	3705.62***	660.44	247.51	-41254.94	3637.31***	3052.19***	177.51	-209.57	-41372.90
	(152.76)	(189.06)	(575.33)	(603.12)	(27274.30)	(152.76)	(175.46)	(558.21)	(587.65)	(27183.31)	(152.76)	(205.07)	(552.70)	(581.69)	(26900.62)
AIC	6677.39	6677.71	5412.09	5411.74	5247.37	6677.39	6678.76	5409.50	5409.01	5245.79	6677.39	6662.01	5403.81	5403.74	5243.56
BIC	6689.55	6693.92	5458.39	5465.75	5316.81	6689.55	6694.97	5455.79	5463.02	5315.23	6689.55	6678.22	5450.11	5457.75	5313.00
N	425	425	350	350	350	425	425	350	350	350	425	425	350	350	350

* p<0.05, ** p<0.01, *** p<0.001

Table 5. Relationship between Motivation for Learning Science and Science Achievement (2017-18 and 2018-19) (cont.)

Variable	Self-Determination					Grade Motivation				
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 1	Model 2	Model 3	Model 4	Model 5
Outcome		87.86*	62.71	61.22	7.45		131.46*	61.05	58.78	44.51
		(44.09)	(42.76)	(42.41)	(27.75)		(52.97)	(53.01)	(52.57)	(34.11)
Black			-338.55*	-347.02*	-106.67			-359.91*	-367.84*	-109.26
			(164.33)	(163.02)	(107.25)			(163.88)	(162.55)	(106.68)
Hispanic			-149.59	-150.30	20.79			-162.08	-162.66	26.35
			(145.50)	(144.31)	(94.61)			(145.08)	(143.88)	(94.09)
Female			-67.25	-65.79	-108.27**			-67.70	-66.13	-111.97**
			(54.87)	(54.42)	(35.60)			(55.04)	(54.58)	(35.59)
LEP			-150.68**	-151.12**	-52.21			-155.61**	-155.98**	-51.93
			(51.35)	(50.92)	(33.60)			(51.22)	(50.79)	(33.43)
SWD			98.59	88.38	49.00			89.06	79.12	50.38
			(120.75)	(119.84)	(78.11)			(120.56)	(119.63)	(77.70)
FRL			0.00	0.00	0.00			0.00	0.00	0.00
			(.00)	(.00)	(.00)			(.00)	(.00)	(.00)
Grade 8			-275.30**	-308.00**	-263.12***			-279.36**	-312.34**	-259.19***
			(105.30)	(105.81)	(75.77)			(105.31)	(105.83)	(75.53)
Previous year reading test score			1.84***	1.83***	2.47***			1.82***	1.81***	2.43***
			(0.28)	(0.28)	(0.19)			(0.29)	(0.29)	(0.19)
Previous year mathematics test score			0.42*	0.40*	0.27*			0.40*	0.38*	0.27*
			(0.17)	(0.17)	(0.11)			(0.17)	(0.17)	(0.11)
Teacher CYS				57.63*	340.03				58.23*	339.41
				(28.62)	(412.75)				(28.82)	(412.74)
Teacher master's degree or higher				70.27	-12099.96				56.48	-12105.24
				(593.97)	(7856.70)				(598.41)	(7856.15)
School enrollment					28.12***					28.15***
					(2.21)					(2.21)
School percent Black					-159.97					-160.26
					(347.43)					(347.40)
School percent Hispanic					-111.85					-112.19
					(330.54)					(330.51)
School percent at risk					309.08***					308.74***
					(20.40)					(20.32)

Constant	3637.31***	3391.34***	279.68	-118.23	-41393.55	3637.31***	3188.11***	341.10	-59.50	-41428.06
	(152.76)	(196.21)	(564.47)	(592.61)	(27254.76)	(152.76)	(237.09)	(561.44)	(590.12)	(27252.07)
AIC	6677.39	6675.44	5410.21	5409.89	5247.47	6677.39	6673.28	5411.03	5410.72	5245.84
BIC	6689.55	6691.65	5456.51	5463.90	5316.91	6689.55	6689.49	5457.33	5464.73	5315.29
N	425	425	350	350	350	425	425	350	350	350

* p<0.05, ** p<0.01, *** p<0.001