

Young Children's Motivational Frameworks and Math Achievement: Relation to Teacher-Reported Instructional Practices, but Not Teacher Theory of Intelligence

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Although students' motivational frameworks (entity vs. incremental) have been linked to academic achievement, little is known about how early this link emerges and how motivational frameworks develop in the first place. In a year-long study (student $N = 424$, Teacher $N = 58$), we found that, as early as 1st and 2nd grade, children who endorsed an incremental framework performed better on a nationally normed standardized math test than children who held an entity framework (i.e., believe ability is stable, prefer easy tasks). Furthermore, teachers' self-reported instructional practices (mastery- vs. performance-oriented) played an important role in the development of students' motivational frameworks. The more a teacher reported emphasizing that children demonstrate competence in the classroom (i.e., performance-oriented instructional practices), the more students endorsed an entity framework at the end of the school year, even after controlling for students' beginning-of-year frameworks. These findings have significant implications for theory as well as practice, as they show that even in the early elementary grades, teacher-reported instructional practices are linked to the development of students' motivational frameworks, which in turn, are linked to students' mathematics achievement.

Keywords: math, instructional practice, theory of intelligence, achievement, achievement goal

Individuals can hold different implicit theories about the nature of intelligence (theories of intelligence; Dweck & Leggett, 1988; see Dweck, 2006, for a review). Some believe intelligence is a fixed trait that cannot be changed (entity theorists) whereas others believe intelligence is malleable and performance depends on the amount of effort one puts into a task (incremental theorists). Adopting entity versus incremental theories can lead to different attributions about performance outcomes, as well as different learning strategies for future performance (Hong, Chiu, Dweck, Lin, & Wan, 1999; Kamins & Dweck, 1999; Mueller & Dweck, 1998), which in turn can

shape school achievement (Aronson, Fried, & Good, 2002; Blackwell, Trzesniewski, & Dweck, 2007; Good, Aronson, & Inzlicht, 2003). We will use the term *motivational frameworks* (i.e., entity framework, incremental framework) to refer to children's beliefs about the stability of intelligence and their preferences for easy tasks (vs. challenging tasks; see Gunderson et al., 2013).

Although a number of studies have shown a link between motivational frameworks and achievement among older children and adults, surprisingly little is known about whether this link is present as early as the start of elementary school. Moreover, the link between classroom environments and motivational frameworks among young children remains understudied. Against this backdrop, in the current work, we examined whether young children's motivational frameworks relate to their academic achievement. In addition, we examined whether there is a link between teacher-reported instructional practices and the development of students' motivational frameworks. Given findings that entity frameworks have significant consequences for achievement in older students (Blackwell et al., 2007; Good et al., 2003), it is important to find out whether this link exists during the early school years. This is because early achievement predicts long-term achievement levels (Duncan et al., 2007). Additionally, understanding the relationship between classroom environments and the early development of motivational frameworks is critical for promoting adaptive frameworks and academic achievement beginning early in children's schooling.

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Relation Between Motivational Frameworks and Academic Achievement

A considerable amount of research has shown beneficial effects of holding an incremental theory of intelligence about academic achievement (e.g., see Dweck, 2006, for a review; see Mendoza-Denton, Kahn, & Chan, 2008 for research showing this benefit may depend on whether or not a group is positively stereotyped in a given domain). For instance, seventh graders who held an incremental theory showed improvement in school grades over 2 years of junior high school, whereas those who held an entity theory showed a flat trajectory (Blackwell et al., 2007). Furthermore, encouraging junior high school and college students to adopt an incremental theory enhances their academic performance (Aronson et al., 2002; Blackwell et al., 2007; Good et al., 2003), supporting a causal relation between theories of intelligence and academic achievement.

Several interrelated mechanisms explain the effect of students' theories of intelligence on their academic achievement. First, entity and incremental theorists adopt different achievement goals and coping behaviors, especially when confronted with challenging learning tasks (Dweck, 2012; Dweck & Elliott, 1983; Dweck & Leggett, 1988; Robins & Pals, 2002). Entity theorists tend to adopt a *performance goal* with an aim of demonstrating their ability to other people. Thus, for entity theorists, failure to successfully complete a task represents a lack of ability, which they view as immutable rather than being a result of a lack of effort. This in turn, leads to helpless responses such as loss of task enjoyment, lack of persistence, and high negative affect. Consequently, when given the option of engaging in a hard versus easy task, entity theorists choose the easy task that ensures success rather than the more challenging task that may provide a learning opportunity but presents a higher risk of failure (Dweck & Leggett, 1988; Mueller & Dweck, 1998; Smiley & Dweck, 1994). Further, entity theorists are less likely to take remedial actions (e.g., taking a makeup class) after a setback than incremental theorists (Blackwell et al., 2007; Cury, Da Fonseca, Zahn, & Elliot, 2008; Nussbaum & Dweck, 2008). In contrast, incremental theorists tend to adopt a *mastery goal* with the aim of learning or mastering a task. Thus, for incremental theorists, failure to successfully complete a task is attributed to insufficient effort, which leads to mastery-oriented behaviors, such as exerting more effort and persisting after setbacks (Dweck & Leggett, 1988; Hong et al., 1999; Mangels, Butterfield, Lamb, Good, & Dweck, 2006). When given a choice between a harder and easier task, incremental theorists are more likely to choose the harder task (Dweck & Leggett, 1988; Cimpian, Arce, Markman, & Dweck, 2007; Hong et al., 1999). Further, unlike entity theorists, incremental theorists are likely to take remedial actions after a failure, which enhances their future performance (Hong et al., 1999).

Another mechanism that helps explain why incremental theorists tend to be higher-achieving than entity theorists is that entity theorists and incremental theorists value and interpret effort differently. For incremental theorists, effort is seen as something that is necessary for their skill improvement. In contrast, for entity theorists, effort is a marker of lack of ability (Dweck & Leggett, 1988; Hong et al., 1999; Miele, Finn, & Molden, 2011; Miele & Molden, 2010; Mueller & Dweck, 1998). For instance, when reading a text, entity theorists believed that their comprehension

was lower when they had to exert effort (e.g., reading blurry text) relative to when they did not have to exert much effort (e.g., reading visually clear text), whereas incremental theorists' judgment of comprehension did not differ as a function of the amount of effort they exerted. These findings have been replicated with third- and fifth-grade children, suggesting that entity theorists begin to operate under "the easier, the better" heuristic quite early on in life (Miele, Son, & Metcalfe, 2013). Such differences in beliefs about effort are related to academic achievement over time (Hong et al., 1999). As an example, seventh graders who believed effort leads to success were less likely to attribute failure to fixed ability and were less likely to withdraw from a task. Moreover, their persistence led to improvement in their math grades over 2 years of junior high school (Blackwell et al., 2007).

Relation Between Motivational Frameworks and Academic Achievement in Early Elementary School

Although empirical evidence as well as theoretical grounds support the link between motivational frameworks and academic achievement among adults and older children (Blackwell et al., 2007; Good et al., 2003; Romero, Master, Paunesku, Dweck, & Gross, 2014), little is known about whether this link is present as early as the beginning of elementary school. To the authors' knowledge, there is only one study examining children's achievement as a function of their difference in beliefs about intelligence during elementary school (Stipek & Gralinski, 1996). This study showed that among third to sixth graders, a fixed view of intelligence was negatively related to course grades and achievement test scores. In the present study, we examine whether the link between beliefs about intelligence (together with their preferences for easy tasks) and academic achievement emerges even earlier, in first and second grades, at the beginning of formal schooling.

There is reason to believe that motivational frameworks may not be related to achievement in children this young. Researchers have argued that implicit theories have their greatest effect when success is not guaranteed and the task at hand is challenging (Diener & Dweck, 1978; Licht & Dweck, 1984). It has been suggested that the academic work in early elementary school may not be difficult enough to observe the effects of different motivational frameworks, particularly because the early school environment tends to be encouraging and to minimize failure experiences (Blackwell et al., 2007; Dweck, 1999).

However, literature on expectancy-value theory (Wigfield & Eccles, 1992, 2002; Wigfield et al., 1997) suggests that children as young as first grade have different competence beliefs (i.e., how good they are at a given activity) and values (i.e., how important it is to be good at a given task) depending on their previous successes and failures, which indicates that early elementary school is not free of challenge. Furthermore, children as young as 7 years of age report negative affective reactions and difficulties in particular academic subjects (e.g., math anxiety; Ramirez, Gunderson, Levine, & Beilock, 2013), supporting the idea that learning is challenging for many children in early elementary school.

In line with this logic, previous work indicates that children in preschool and early elementary school show individual differences in their motivational frameworks (e.g., Cain & Dweck, 1995; Gunderson et al., 2013; Kinlaw & Kurtz-Costes, 2007; Smiley & Dweck, 1994). Four- and 5-year-old children display different

types of achievement goals (i.e., learning vs. performance), as indicated by their preference in choosing a challenging or non-challenging task. Such individual differences in achievement goals predict children's mastery versus helpless behaviors after failure (Smiley & Dweck, 1994), and helpless first graders were more likely to blame their ability and to display more negative affect than their mastery-oriented peers (Cain & Dweck, 1995). In addition, there are meaningful individual differences in motivational frameworks among children as young as age 7, which are predicted by the kind of praise parents provide their children between 1 and 3 years of age (Gunderson et al., 2013). These findings together indicate that children are already developing different conceptual understandings of intelligence, the value of effort, and learning strategies in early elementary school, which raises the possibility that these motivational frameworks may be associated with their academic achievement in early grades.

Examining the factors related to achievement in early elementary school is especially important because children's acquisition of basic concepts at this age serves as a foundation for later learning (Barnett, 1995). Thus, the first goal of our study was to test whether there is a link between motivational frameworks and math achievement in first and second graders. We focused on math achievement not only because math is one of the core subject areas in elementary school, but also because it is highly predictive of children's later academic achievement—in math as well as other domains (Ball, 1993; Duncan et al., 2007). Moreover, math is a cumulative discipline, where lack of achievement at an early age can make it difficult, if not impossible, to fully understand more advanced topics (Duncan et al., 2007; Morgan, Farkas, & Wu, 2011). Thus, we explored whether first and second graders' motivational frameworks are related to their achievement on a standardized math test.

Adult Influences on Children's Motivational Framework Development

The second goal of our study was to examine how motivational frameworks develop in early elementary school children. For young children, parents and teachers are two likely sources of influence on their motivational framework development. Although there is some support for the role of parents in children's framework development (e.g., Gunderson et al., 2013), less is known about the role of teachers.

Role of Parents in Children's Motivational Framework Development

A growing body of research has shown that parents' own achievement goals and theories of intelligence are related to interactions with their children in ways that may shape the development of their children's motivational frameworks (Dweck, 1999, 2006; Gunderson et al., 2013). For instance, mothers with a performance goal-orientation were more likely to rate "getting good grades" and "doing better compared to others" as more important than did mothers with a mastery goal-orientation who emphasized "working hard" (Ames & Archer, 1987). Further, when mothers' theories of intelligence were experimentally induced, those induced to support an entity theory displayed more unconstructive involvement in children's learning (i.e., higher performance-oriented

teaching, more negative affect, and higher control) compared to those induced to support an incremental theory (Moorman & Pomerantz, 2010).

Relatedly, different types of performance feedback (i.e., praise and criticism) can sway a child's behavior and performance outcomes in the short term as well as the long term. For example, praise that attributes success to fixed ability (e.g., "You must be smart at these problems") leads both younger (5–6 year olds) and older (fifth-grade) children to conceptualize their intelligence as an unchangeable entity, implying that failing at certain tasks reflects a lack of ability. In contrast, praise that attributes success to effort (e.g., "You must have tried really hard") helps children conceptualize their intelligence as malleable and changeable—failure is a product of too little effort rather than a lack of ability (Kamins & Dweck, 1999; Mueller & Dweck, 1998).

Taken together, parental behaviors and beliefs appear to be related to children's motivational framework development. As children grow up, however, they spend an increasing portion of their time in schools; thus, teachers' behaviors and beliefs are also likely to be related to the development of children's attitudes and beliefs about learning (Birch & Ladd, 1997; Cicchetti & Lynch, 1993; Hamre & Pianta, 2001; Pianta, Steinberg, & Rollins, 1995). Regardless, less is known about the role of teachers in the development of young children's motivational frameworks, the focus of the present study.

Role of Teachers in Children's Motivational Framework Development

Past literature on classroom goal structure and teachers' instructional practices provides evidence for a possible link between teachers' instructional practice and students' motivational framework development during middle childhood and early adolescence. The extent to which a teacher emphasizes performance (e.g., displaying the work of high-achieving students as an example) versus mastery (e.g., stressing conceptual understanding over memorization) is related to students' motivation and learning behaviors (Ames & Archer, 1988; Anderman et al., 2001; Anderman & Young, 1994; Kaplan, Gheen, & Midgley, 2002; Kaplan & Maehr, 1999; Midgley et al., 1998; Urdan, Midgley, & Anderman, 1998; Young, 1997). For example, middle- and high-school students who viewed their classroom as mastery-oriented reported greater motivation on challenging tasks and more adaptive learning strategies (Young, 1997). They were also more likely to attribute their success to effort (Ames & Archer, 1988). In line with these findings, students' perception of a mastery-oriented classroom goal structure was related to less disruptive academic behaviors (e.g., getting into trouble in class, disturbing the lesson during class; Kaplan et al., 2002; Murdock, Hale, & Weber, 2001), higher psychological well-being (Kaplan & Maehr, 1999), and higher self-efficacy (Urdan & Midgley, 2003). In contrast, students who perceived their classroom as performance-oriented reported more disruptive academic behaviors (Kaplan et al., 2002), less adaptive coping strategies (e.g., avoiding help-seeking behaviors, more self-handicapping strategies; Ryan, Gheen, & Midgley, 1998; Urdan et al., 1998), lower levels of psychological well-being (Kaplan & Midgley, 1999), and lower self-efficacy (Ames & Archer, 1988; Urdan & Midgley, 2003). Teachers' performance-oriented instructional practices also relate to student behavior. In particular, teachers' reports of performance-oriented instructional practices predicted students' dis-

ruptive behaviors (ninth grade; Kaplan et al., 2002) and maladaptive learning strategies (fifth grade; Urdan et al., 1998), and also were negatively related to students' achievement values in math and reading as early as third grade (e.g., how useful is what you learn in math; Anderman et al., 2001).

Despite numerous studies showing a link between classroom goal structures and students' learning behaviors, it is important to note that most studies examined this link in early adolescents at a single time point (Ames & Archer, 1988; Anderman et al., 2001; Anderman & Young, 1994; Kaplan et al., 2002; Kaplan & Maehr, 1999; Ryan et al., 1998; Urdan et al., 1998), rather than longitudinally, with a few exceptions (Anderman et al., 2011; Anderman & Midgley, 2004). For instance, eighth-grade math classroom goal structures were related to students' cheating behaviors at the end of ninth grade (Anderman & Midgley, 2004) and ninth-grade health classroom goal structures were related to students' health outcomes (i.e., efficacy beliefs, knowledge, intentions to have sex, attitudes, and motivation) during the 10th grade (Anderman et al., 2011). Although these studies shed some light on how classroom goal structures are related to students' learning and health outcomes among adolescents, the relation between teachers' instructional practices and students' motivational frameworks across the school year among younger children has not been investigated. Finding out whether elementary school children's motivational frameworks are related to their achievement gains over the course of an academic year is especially important given evidence that early achievement levels are predictive of long term academic outcomes (Duncan et al., 2007).

The Present Study

In the current study, we examined several hypotheses. First, we examined the relationship between first and second graders' motivational frameworks and math achievement both concurrently and longitudinally. Based on studies showing that having an incremental framework is positively related to achievement in older students (Blackwell et al., 2007; Good et al., 2003; Romero et al., 2014), we hypothesized that young children with an incremental framework would perform better than those with an entity framework, and that having an incremental framework at the beginning of the school year would predict increases in math achievement over the course of the year. We also examined the reverse directionality of this relationship—whether having higher math achievement at the beginning of the school year would predict an increase in children's incremental frameworks over the school year. We expected that this might be the case given that success in math might lead children to become more optimistic about the power of effort to improve performance.

Second, we examined whether teachers' instructional practices predict students' motivational framework development in early elementary school. Specifically, we explored whether variation in teachers' self-reported mastery- and performance-oriented instructional practices predicted students' motivational frameworks at the end of the school year. We hypothesized that higher levels of teachers' performance-oriented instructional practices would be related to higher levels of entity framework endorsement among students. In contrast, higher levels of teachers' mastery-oriented instructional practices would be related to higher levels of incremental framework endorsement among students. Critically, we controlled for students' beginning-of-year motivational frameworks as well as other student (e.g., gender, grade level) and

teacher (e.g., teacher's content knowledge for teaching mathematics) variables.

Third, we examined the relationship between teachers' own theories of intelligence and their instructional practices. Previous research indicates that teachers' theories of intelligence are related to their pedagogical practices when students are confronted with difficulties (Rattan, Good, & Dweck, 2012). Teachers who endorse an entity theory are more likely to adopt problematic pedagogical practices, such as making a hasty judgment that a student has low ability, providing comfort to such a student about his or her low ability. These behaviors can lower students' academic motivation and performance (Rattan et al., 2012). Therefore, we hypothesized that teachers with an entity theory would report higher performance-oriented instructional practices, while teachers with an incremental theory would report higher mastery-oriented instructional practices.

Lastly, we tested whether teachers' own theory of intelligence is directly related to children's motivational framework development. Given that teacher beliefs are relatively distal predictors of student motivation compared to teachers' instructional practices, we did not predict that such beliefs would be related to children's motivational framework development.

Method

We began by testing the relationship between students' motivational frameworks and their math achievement. We then asked whether teacher-reported instructional practices predict the development of students' motivational frameworks across the school year.

Participants

As a part of a larger project investigating students' learning and the teachers' role in shaping this learning, we conducted a 1-year study of first and second-grade students. Data were collected from an ethnically and socioeconomically diverse sample of students attending elementary school in a large urban area. Students were recruited using an opt-in consent form; 35.6% children in participating classrooms had parental consent for the current study. Students in the study all had teachers who taught them math throughout the school year and who completed teacher-related questionnaires relevant to this study. Our final sample included 58 teachers (one male, 57 female) and 424 students (194 boys; 194 first grade).¹ Teachers and students were recruited from 21 ele-

¹ Initially, 589 children had teacher data available. Of these, 81 children did not have achievement or motivational framework data, 66 did not meet the basal and ceiling criteria on the achievement measure due to experimenter error, and 18 were flagged as problematic by the experimenter (e.g., did not understand any of the measures in the session; did not pay attention to any of the tasks). Thus, these children were excluded from the analyses. Of note, the direction and the patterns of significance reported stay the same whether or not we include the available data from these "excluded" children. Data from 59 teachers were initially available but we excluded one teacher because that teacher only had one student, whose data was excluded because an experimenter flagged that student as not paying attention to any of the tasks. Thus, the average number of student participants per classroom in the initial sample was 9.98 (i.e., 589 students/59 teachers). The average number of student participants per classroom in the final sample was 7.30 students per classroom, ranging from two to 17 students.

mentary schools (13 public, five charter, three private schools). There was a large variability in the SES of families served by these schools, as measured by family income and average parental education. The school with the lowest SES reported average family income of \$13,333 ($SD = 10,103$) and average parental education of 12.33 years ($SD = 1.71$). The school with the highest SES had average income of \$94,642 ($SD = 6,681$) and average parental education of 17.56 years ($SD = 0.96$). The school with the median SES had average income of \$30,277 ($SD = 18,568$) and average parental education of 13.65 years ($SD = 1.85$). Years of teaching experience for the teachers in the study ranged from 3 to 32 years ($M = 13.06$, $SD = 8.37$). Of the teachers, 12.1% were African American, 48.3% White, 17.2% Hispanic or Latino, 1.7% other/mixed, and 20.7% were not reported. Of the students, 30.9% were African American, 21.5% White, 30.7% Hispanic or Latino, 7.3% Asian, 5.6% other/mixed, and 4.0% were not reported. Years of education for children's primary caregivers varied widely, ranging from 10 to 18 years ($M = 14.56$ years, $SD = 2.42$; where 10 represents "less than high school" and 18 represents "graduate degree"), and family income ranged from less than \$15,000 to more than \$100,000 ($M = \$49,138$, $SD = 34,890$).

Measures

Student variables. Trained research assistants assessed students in four one-on-one sessions, two within the first 3 months of the school year (fall) and two within the last 2 months of the school year (spring). Each session took about 30 minutes. In both the fall and spring, students' math achievement was assessed during the first session and their motivational frameworks were assessed during the second session. Math achievement was assessed first in order to have uncontaminated performance outcome data, which we considered to be the most important outcome variable. The two fall sessions and the two spring sessions generally occurred no more than a week apart ($M = 4.57$ days).

Students' math achievement was measured using the Woodcock-Johnson III Applied Problems (Woodcock, McGrew, & Mather, 2001), a nationally normed standardized test of math skills for individuals aged 2 to 90. We chose the Applied Problems subtest because it examines children's broader math knowledge and reasoning rather than examining simple computational skills and automaticity with basic math facts. Students were given math-related word problems that increased in difficulty. In order to solve the problems, students needed to comprehend the problem, identify relevant information, and calculate the answer. Testing continued until basal (six items in a row correct) and ceiling (six items in a row incorrect) criteria were established. Two parallel forms containing different problems were used in the fall (Form A) and the spring (Form B). In our analyses, we used the W score, which is a transformation of the raw score into a Rasch-scaled score with equal intervals; the W score is recommended for use especially when analyses involve change over time (Woodcock, 1999). Published internal-consistency reliability for the Applied Problems subtest is above .80 between first and third grades (Jordan, Glutting, & Ramineni, 2010).

Students' motivational frameworks were measured using a six-item questionnaire adapted from a previously published study (Gunderson et al., 2013).² The questionnaire measures children's beliefs about the stability of intelligence, as well as academic

abilities and preference for easy tasks (see Appendix). Three items assessed children's views about whether intelligence and academic abilities are fixed (e.g., "Imagine a kid who thinks that a person is a certain amount smart, and stays pretty much the same. How much do you agree with this kid?"). Another three items assessed children's preference for easy tasks (e.g., "How much would you like to do mazes that are very easy so you can get a lot right?"). Among the six items, two items were about math, two items were about reading or spelling, one was about spatial tasks (i.e., mazes), and one was about general intelligence. Children were asked to indicate how much they agreed with each sentence by pointing to one of five circles that varied in size ranging from *not at all* to *really a lot*, which map to a 5-point Likert scale. We reverse coded all items so that a lower score on the scale represents a stronger entity framework and a higher score represents a stronger incremental framework.

We used coefficient Omega to estimate the reliability of the scale. Omega provides a better estimate with more appropriate assumptions compared to the commonly used Cronbach's alpha (see Dunn, Baguley, & Brunsden, 2014 for a detailed technical explanation). In addition, because factor analyses suggested two factors for the two subscales (i.e., views about stability of intelligence/abilities, preference for easy tasks), we followed recommendations of Nunnally (1978; i.e., using a formula for linear composites comprised of items from different subscales) to estimate the reliability of the motivational framework scale composite from the two subscales. These internal reliability estimates were .70 in fall and .82 in spring. We averaged scores across different domains (math, reading and spelling, spatial tasks, and general intelligence) since an exploratory factor analysis did not reveal different factors for different academic domains, in line with past research showing no subject-specific beliefs about ability and effort in math and social studies among elementary schoolchildren (Stipek & Gralinski, 1996).

Teacher variables. Drawing upon past research suggesting stability of teachers' instructional practice (Anderman, Patrick, Hruza, & Linnenbrink, 2002), theory of intelligence (Pomerantz & Saxon, 2001; Robins & Pals, 2002), and teachers' content knowledge for teaching math (Hill & Ball, 2004), teacher data were collected at a single time point, after school hours in the middle of the school year (between fall and spring student testing).

Teacher-reported instructional practices were measured using an 18-item questionnaire modified from the Patterns of Adaptive Learning Scales (PALS; Midgley et al., 2000). Nine items asked about instructional practices in math, and nine asked about reading. Within each domain (math and reading), four items described *mastery-oriented instructional practices*, which emphasize learning and effort (e.g., "I [teacher] give a wide range of math/reading assignments, matched to students' needs and skill level"), and five items described *performance-oriented instructional practices*, which emphasize getting good grades and displaying competence (e.g., "I [teacher] give special privileges to students who do the

² The original scale used in the current study had 12 items with relatively low internal reliability (i.e., $\omega = .66$ for fall motivational frameworks). Based on confirmatory and exploratory factor analyses, we chose six items that demonstrated acceptable reliability. Importantly, the correlation between the six-item scale and 12-item full scale was about $r = .80$ and our findings remain the same as with the 12-item scale. Results are available upon request.

best work in math/reading”). All items were rated on a 5-point Likert scale ranging from *strongly disagree* to *strongly agree*. Given that our main outcome variable was students’ general motivational frameworks rather than domain-specific ones, we averaged teacher-reported instructional practices across the math and reading domains. The correlation between math and reading was $r(56) = .90, p < .001$, for performance-oriented instructional practice and $r(56) = .50, p < .001$, for mastery-oriented instructional practice. Omega was .91 for performance-oriented items (10 items) and .70 for mastery-oriented items (eight items).

Teachers’ theories of intelligence were measured using an eight-item questionnaire (Gunderson et al., 2013, adapted from Hong et al., 1999). Similar to the student motivational framework measure, the teacher questionnaire asked about general intellectual ability (four items; e.g., “People have a certain amount of intelligence, and they can’t really do much to change it”) and domain-specific abilities (one item each for math, reading, writing, and spatial ability; i.e., “Someone’s math/reading/writing/spatial ability is something about them that they can’t change very much”). All items were rated on a 6-point Likert scale ranging from *strongly disagree* to *strongly agree*. Scores were reverse-coded so that higher scores represented higher incremental theory endorsement. As with the student motivational framework measure and the teacher instructional practice measures, items were averaged across domains. Omega (eight items) was .88.

Teacher’s Content Knowledge for Teaching Math (CKT-M; Hill, Schilling, & Ball, 2004) was assessed using the Elementary Number Concepts and Operations subtest of CKT-M (Hill & Ball, 2004). Drawing on prior work showing that teachers’ knowledge plays an important role in the quality of their teaching (Ball, Thames, & Phelps, 2008), we controlled for its effect on student motivational frameworks. CKT-M consists of 26 multiple-choice questions, and measures not only teachers’ knowledge about math content but also teachers’ knowledge about students’ math knowledge, such as common misconceptions and mistakes that students make in mathematics. Published interreliability of the CKT-M is from .84 to .89 (Hill & Ball, 2004). Content validity for the CKT-M has been established via cognitive tracing interviews where teachers explained their rationale behind their answer (Hill & Ball, 2004).

Results

Table 1 shows descriptive statistics and zero-order correlations between all variables at the student- and teacher-levels that are included in the analyses below. Prior to any analyses, we examined residual plots and histograms to assess linearity, normality, homoscedasticity, and outliers. These inspections indicated that the statistical assumptions underlying our models were reasonable.

Children’s Motivational Framework as a Predictor of Achievement

We first tested whether individual differences in motivational frameworks are related to math achievement in children as young as first and second grades. The between-classroom variance estimate for fall achievement was 158.61, $\chi^2(57) = 330.045, p < .001$ (Table 2, Model 1), and for spring achievement was 188.56, $\chi^2(57) = 312.38, p < .001$ (Table 2, Model 3), respectively; thus, we used hierarchical linear models (HLMs)

to take into account the correlated scores of students in the same classroom (Bryk & Raudenbush, 1992). In the current analyses, the HLM had two levels: the student level (i.e., students’ fall and spring motivational framework, students’ fall and spring math achievement, grade,³ gender) and the classroom level with no predictors. All predictors were grand-mean centered. Students’ math achievement was regressed on their motivational framework. Additionally, we controlled for gender because some studies have reported gender differences on math tasks at this age, in favor of girls (Hyde, Fennema, & Lamon, 1990). We also controlled for grade level to account for differences in achievement levels between first and second grades. We let the slopes vary if random effects were significant.

Fall motivational framework as a predictor of fall achievement. Students’ fall motivational framework, grade, and gender were included as predictors of fall math achievement (Table 2, Model 2). As expected, students’ fall motivational framework was positively related to their fall math achievement, $\gamma_{30} = 2.96, t = 3.61, p < .001$. That is, at the beginning of the school year, students with a stronger incremental framework had higher math achievement than those with a stronger entity framework, even after controlling for their grade and gender (Figure 1, left). Not surprisingly, grade was a positive predictor of math achievement, $\gamma_{10} = 15.15, t = 5.58, p < .001$, indicating that second graders performed better than first graders. Gender was also a significant predictor of math achievement in fall, $\gamma_{20} = 3.14, t = 1.98, p = .05$, indicating that boys performed slightly better than girls in fall.

Spring motivational framework as a predictor of spring achievement. To replicate the findings from the fall data, we ran the same analysis using the spring data. That is, students’ spring motivational framework, grade, and gender were included as predictors of spring math achievement (Table 2, Model 4). As was the case for the fall data, students’ spring motivational framework was positively related to their spring math achievement, $\gamma_{40} = 6.01, t = 7.33, p < .001$ even after controlling for their grade and gender (Figure 2, right). Grade was a positive predictor of math achievement, $\gamma_{10} = 15.33, t = 5.34, p < .001$, whereas gender was not, $\gamma_{20} = 2.06, t = 1.15, p > .20$.

Fall motivational framework as a predictor of spring math achievement. To examine whether students’ motivational frameworks at the beginning of the school year predicted their math achievement at the end of school year, students’ fall motivational framework, grade, and gender were included as predictors of their spring math achievement (Table 2, Model 5). Students’ fall motivational framework was a positive predictor of their spring achievement, $\gamma_{30} = 3.97, t = 1.05, p < .001$, indicating that the stronger endorsement of an incremental framework at the beginning of the school year was associated with higher math achievement at the end of the school year. When students’ fall math achievement was added to the model, the effect of fall motivational framework on spring math achievement was reduced, but was still statistically significant, $\gamma_{30} = 1.67, t = 2.30, p < .05$, indicating that among students with the same math achievement score in the fall, those with a stronger incremental framework had higher

³ Grade was entered as the student level since some classes had mixed grades.

Table 1
Descriptive Statistics and Zero-Order Correlations Between All Variables at the Student and Teacher Levels

	Student measures (N = 424)							
	M	SD	1	2	3	4	5	6
1. Grade (first grade = 1, second grade = 2)	1.54	0.50	—	—	—	—	—	—
2. Gender (female = 0, male = 1)	0.46	0.50	.01	—	—	—	—	—
3. Fall motivational frameworks	2.24	0.85	.09 [~]	.09 [~]	—	—	—	—
4. Fall math achievement	463.48	20.16	.44 ^{***}	.07	.25 ^{***}	—	—	—
5. Spring motivational frameworks	2.53	1.00	.10 [*]	.01	.47 ^{***}	.36 ^{***}	—	—
6. Spring math achievement	474.75	22.81	.40 ^{***}	.03	.27 ^{***}	.82 ^{***}	.37 ^{***}	—

	Teacher measures (N = 58)					
	M	SD	1	2	3	4
1. Performance-oriented instructional practices	2.30	0.79	—	—	—	—
2. Mastery-oriented instructional practices	3.88	0.55	-.11	—	—	—
3. Theory of intelligence	4.98	0.70	-.30 [*]	.23 [~]	—	—
4. CKT-M	11.45	5.30	.08	-.04	-.15	—

Note. CKT-M = Content Knowledge for Teaching Math.
[~] $p < .10$. * $p < .05$. ** $p < .01$. *** $p < .001$.

scores than those with a stronger entity framework on a math achievement test at the end of the school year (Table 2, Model 6).

Fall math achievement as a predictor of spring motivational framework. Findings from past intervention studies (Aronson et al., 2002; Blackwell et al., 2007; Good et al., 2003) have shown that motivational frameworks influence students' achievement; however, it is possible that there exists a bidirectional relationship. That is, students who perform well may be more likely to adopt an incremental framework. In the current work, a reversed model (i.e., math achievement at the beginning of the school year predicting motivational framework development across the school year) indicated that students' fall math achievement was a significant predictor of their spring motivational framework, even after controlling for their motivational frameworks in the fall, as well as their grade and gender $\gamma_{40} = 0.01, t = 7.15, p < .001$, providing

evidence for the bidirectional relationship between students' motivational frameworks and math achievement.

Teachers' Instructional Practices as Predictors of Students' Motivational Framework Development

We have demonstrated that children's motivational frameworks are related to their math achievement in early elementary school. Next we asked how children's motivational frameworks develop. Here, we specifically looked at the relation of teacher-reported instructional practices to the development of children's motivational frameworks across the first- and second-grade school years.

Descriptive statistics and zero-order correlations. Teachers tended to adapt higher levels of mastery-oriented instructional practices ($M = 3.88, SD = 0.55$) than performance-oriented instruc-

Table 2
Two-Level HLMs Predicting Students' Fall and Spring Math Achievement

	Fall math achievement		Spring math achievement			
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Fixed effect						
Intercept, γ_{00}	462.21 (1.84) ^{***}	462.56 (1.43) ^{***}	473.61 (2.03) ^{***}	474.12 (1.51) ^{***}	473.89 (1.62) ^{***}	474.74 (0.81) ^{***}
Student grade (first grade = 1, second grade = 2), γ_{10}		15.15 (2.71) ^{***}		15.33 (2.87) ^{***}	15.48 (3.07) ^{***}	2.48 (1.82)
Student gender (female = 0, male = 1), γ_{20}		3.14 (1.59) [*]		2.06 (1.79)	1.80 (1.85)	-1.06 (1.29)
Student fall motivational framework, γ_{30}		2.96 (0.82) ^{***}			3.97 (1.05) ^{***}	1.67 (0.73) [*]
Student spring motivational framework, γ_{40}				6.01 (0.82) ^{***}		
Student fall math achievement, γ_{50}						0.86 (0.03) ^{***}
Random effect						
Between-classroom variance						
Intercept, u_0	158.61 ^{***}	66.56 ^{***}	188.56 ^{***}	73.07 ^{***}	84.93 ^{***}	16.90 ^{***}
Grade slope, u_2		58.62 ^{**}		55.49 [*]	74.82 [*]	
Within-classroom variance	247.98	244.99	324.85	302.56	320.48	152.45

Note. HLMs = hierarchical linear models. Numbers in parentheses are standard errors.
^{*} $p < .05$. ^{**} $p < .01$. ^{***} $p < .001$.

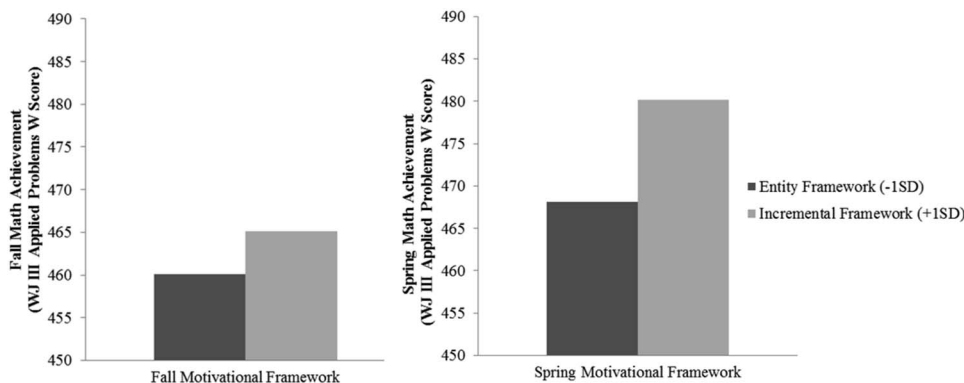


Figure 1. Students' achievement on Woodcock-Johnson III Applied Math problems as a function of their motivational frameworks. The entity framework represents 1 *SD* below the grand mean of the student motivational framework scale whereas the incremental framework represents 1 *SD* above the mean.

tional practices ($M = 2.30$, $SD = 0.79$), $t(57) = -11.95$, $p < .001$. As expected, teachers' theories of intelligence were negatively related to their performance-oriented instructional practices, $r(56) = -.30$, $p < .05$, indicating that teachers with higher entity theories reported higher performance-oriented instructional practices, such as emphasizing getting high grades, compared to teachers with higher incremental theories. Conversely, teachers' theories of intelligence were positively related to their mastery-oriented instructional practices at a marginally significant level, $r(56) = .23$, $p < .10$, indicating that teachers with higher incremental theories were more likely to adopt mastery-oriented instructional practices, such as focusing on students' learning and improvement. Replicating previous results (Midgley, Anderman, & Hicks, 1995), teachers' performance- and mastery-oriented instructional practices were not significantly related to each other, $r(56) = -.11$, $p > .30$. We also found that teachers' content knowledge for teaching math was not correlated with their performance-oriented instructional practices, $r(56) = .08$, $p > .50$, their mastery-oriented instructional practices,

$r(56) = -.04$, $p > .70$, or their theories of intelligence, $r(56) = -.15$, $p > .20$.

To examine the relationship between teacher-reported instructional practices and students' motivational framework development, we again used HLM analyses with two levels: the student level (i.e., students' fall and spring motivational framework, grade, gender) and the classroom level (i.e., teacher-reported instructional practices, CKT-M, teacher's theory of intelligence).

Between-classroom variability in students' fall and spring motivational frameworks. We first ran two fully unconditional HLM models to examine whether students' motivational frameworks varied significantly between classrooms in the fall or in the spring. If teacher-reported instructional practices are related to students' motivational frameworks over the course of the school year, then students' frameworks should vary between classrooms to a greater degree in spring than in fall. Between-classroom variance estimate for students' spring frameworks was 0.12, $\chi^2(57) = 116.10$, $p < .001$ (Table 3, Model 1). We also found

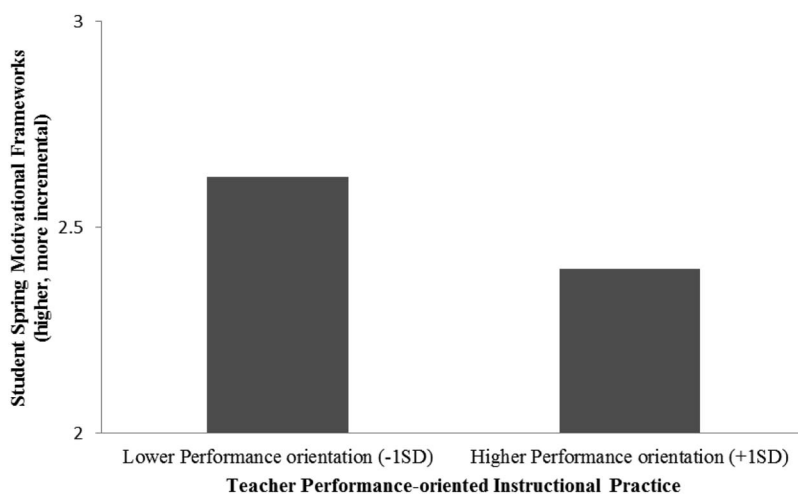


Figure 2. Students' spring motivational frameworks as a function of teachers' performance-oriented instructional practice (Table 2, Model 3). The lower performance orientation represents 1 *SD* below the grand mean of the performance-oriented instructional practice scale whereas the higher performance orientation represents 1 *SD* above the mean.

Table 3
Two-Level HLMs Predicting Students' Spring Motivational Frameworks

	Model 1	Model 2	Model 3	Model 4	Model 5
			Fixed effect		
Intercept, γ_{00}	2.50 (0.07)***	2.51 (0.06)***	2.51 (0.05)***	2.51 (0.05)***	2.51 (0.05)***
Teacher performance-oriented instructional practices, γ_{01}			-0.14 (0.05)**		-0.14 (0.05)**
Teacher mastery-oriented instructional practices, γ_{02}			0.10 (0.09)		0.08 (0.09)
Teacher content knowledge for teaching mathematics, γ_{03}			0.00 (0.01)	0.00 (0.01)	0.00 (0.01)
Teacher theory of intelligence, γ_{04}				0.10 (0.09)	0.05 (0.08)
Student grade (first grade = 1, second grade = 2), γ_{10}		0.08 (0.11)	0.11 (0.10)	0.11 (0.10)	0.12 (0.10)
Student gender (female = 0, male = 1), γ_{20}		-0.04 (0.10)	-0.06 (0.10)	-0.05 (0.10)	-0.06 (0.10)
Student fall motivational framework, γ_{30}		0.53 (0.05)***	0.52 (0.05)***	0.53 (0.05)***	0.52 (0.05)***
			Random effect		
Between-classroom variance					
Intercept, u_0	0.12***	0.07***	0.06**	0.07**	0.06**
Within-classroom variance	0.88	0.71	0.71	0.71	0.71

Note. HLMs = hierarchical linear models. Numbers in parentheses are standard errors.

* $p < .05$. ** $p < .01$. *** $p < .001$.

significant between-classroom variance for students' fall frameworks, $u_0 = 0.05$, $\chi^2(57) = 85.12$, $p < .01$, which was marginally less than the variance in the spring, $\chi^2(1) = 3.41$, $p = .065$. Thus, we controlled for students' preexisting motivational frameworks in fall to examine the relationship between teacher-reported instructional practice and students' motivational frameworks at the end of school year. The intraclass correlation coefficient (ICC) for fall was 0.068, which was almost doubled in spring, to an ICC = 0.120, indicating that 12.0% of the variance in students' spring motivational frameworks was between classrooms.

Between-classroom variability in students' spring motivational frameworks with student-level covariates. Next, we examined the relation between students' spring motivational frameworks and other student-level predictors. Students' fall motivational framework, grade, and gender were included as predictors of spring motivational framework. The slopes of the predictors were fixed because preliminary analyses showed that none of the random effects of slopes were significant. All predictors were grand-mean centered. The results are reported in Table 3 (Model 2). Neither grade, $\gamma_{10} = 0.08$, $t = 0.72$, $p > .40$, nor gender, $\gamma_{20} = -0.04$, $t = -0.46$, $p > .60$, was a significant predictor of spring framework, whereas fall framework was a significant positive predictor of spring framework, $\gamma_{30} = 0.53$, $t = 9.94$, $p < .001$. Importantly, even after accounting for these student-level variables, there was significant unexplained variance between classrooms in students' spring motivational frameworks, $u_0 = 0.07$, $\chi^2(57) = 97.15$, $p < .001$.

Teacher-reported instructional practices as predictors of students' spring motivational frameworks. We then entered our measures of teacher's mastery- and performance-oriented instructional practices as classroom-level predictors of students' motivational framework at the end of school year. CKT-M was entered to control for any possible effect of teachers' knowledge on students' spring frameworks. As with the student-level variables, the classroom-level variables were

grand-mean centered. The results are reported in Model 3 (see Table 3) and in Figure 2.

As expected, teachers' performance-oriented instructional practice was significantly and negatively related to students' spring framework scores, $\gamma_{01} = -0.14$, $t = -3.13$, $p < .01$. That is, the more a teacher reported that she emphasized performance outcomes and demonstrating competence, the more students endorsed an entity framework at the end of the school year, even after accounting for students' beginning-of-year framework. However, teachers' mastery-oriented instructional practices did not predict student frameworks at the end of school year, $\gamma_{02} = 0.10$, $t = 1.10$, $p > .20$. In our study, performance-oriented instructional practices explained 13.9% of between-classroom variance in students' spring motivational frameworks (10.0% over and above teachers' CKT-M and mastery-oriented instructional practice). After accounting for teacher variables, the between-classroom variation in student spring frameworks was still significant, $u_0 = 0.06$, $\chi^2(54) = 84.27$, $p < .01$, but significantly reduced from the variance from Model 2, $\Delta\chi^2(3) = 12.88$, $p < .01$.

Teachers' theories of intelligence as a predictor of students' spring motivational frameworks. In addition, we examined the relation between teachers' theories of intelligence and students' motivational framework development. The model was the same as in the previous analysis, except that the instructional practice variables were replaced by our measure of teachers' theories of intelligence (Table 3, Model 4). Teachers' theories of intelligence did not predict students' motivational frameworks in spring, $\gamma_{04} = 0.10$, $t = 1.12$, $p > .20$. When teachers' theories of intelligence were entered together with teacher-reported instructional practices (Table 3, Model 5), the performance-oriented instructional practices still remained a significant predictor of students' spring motivational framework, $\gamma_{01} = -0.14$, $t = -2.75$, $p < .01$, whereas teachers' theory of intelligence was not a significant predictor, $\gamma_{04} = 0.05$, $t = 0.60$, $p > .50$.

In the zero-order correlation, teachers' theories of intelligence were related to their reported instructional practices, $r(56) = -.30$, $p < .05$ for performance-oriented and $r(56) = .23$, $p < .10$ for mastery-oriented respectively, but their theories did not directly predict students' motivational frameworks. This is likely because teachers' behavioral and verbal communications are more proximal to students than teachers' thoughts and beliefs.

Teacher-reported instructional practice as a predictor of students' spring math achievement. Lastly, we explored the direct link between teacher-reported instructional practices and students' spring math achievement after taking into account students' fall math achievement.⁴ Given that teachers' performance-oriented instructional practices predicted the development of students' motivational framework across the school year and students' motivational framework was associated with growth in math achievement across the school year, one might expect that teacher-reported instructional practices would be related to students' spring math achievement, controlling for their fall math achievement. Although the coefficient was in the predicted direction, such that teachers' performance-oriented instructional practice predicted lower spring math achievement, this relation was not statistically significant, $\gamma_{01} = -1.63$, $t = -1.65$, $p = .10$. Teachers' mastery-oriented instructional practice was not a significant predictor of spring math achievement either, $\gamma_{02} = 0.87$, $t = 0.56$, $p > .50$. Thus, we did not find strong evidence supporting a direct link between teacher-reported instructional practices and students' math achievement growth across the school year.

Discussion

Despite abundant support for the beneficial effects of an incremental framework on academic achievement, little is known about whether this link is already present at the beginning of formal schooling and how the classroom environment predicts the development of motivational frameworks. In the current study, we addressed this gap in the literature by investigating the relation between motivational frameworks and math achievement among first and second graders and the relation between teacher-reported instructional practices and children's motivational framework development across the school year.

First, in line with previous research suggesting that individual differences in beliefs about the malleability of human attributes (i.e., intelligence, personality) emerge as early as the preschool years (Giles & Heyman, 2003; Kinlaw & Kurtz-Costes, 2007; Smiley & Dweck, 1994), we found that children in first and second grades already exhibit individual differences in their motivational frameworks, but not in a domain-specific manner. This result indicates that although children tend to develop domain specificity in their self-perception about their own ability (i.e., whether a child is good at a given activity and how much the child values said activity; Eccles, Wigfield, Harold, & Blumenfeld, 1993; Wigfield et al., 1997; Wigfield & Eccles, 2000, 2002) during early elementary school, domain specificity of their motivational frameworks (i.e., the relationship among effort, intellectual ability, and performance) might emerge later.

We show that differences in motivational frameworks are related to children's achievement on a standardized math test, even after controlling for their grade level and gender. More specifically, higher entity framework endorsement is associated with lower achievement, whereas higher incremental framework en-

dorsement is related to higher achievement. These findings align well with findings on the relationship between motivational frameworks and achievement in adults (Aronson et al., 2002) and older children (Blackwell et al., 2007; Good et al., 2003; Romero et al., 2014; Stipek & Gralinski, 1996). Because we focused on math achievement, it remains an open question whether children's motivational frameworks are particularly important for this academic domain, or whether a similar relation would be found for other academic domains; for example, reading.

Second, we found that teacher-reported instructional practices predict children's motivational frameworks across the school year. As hypothesized, teachers' performance-oriented instructional practices significantly predicted children's motivational frameworks at the end of the school year, even after controlling for children's frameworks at the beginning of the school year. That is, the more teachers reported having emphasized performance outcomes and pointing out the best-performing students, the more students endorsed an entity framework by the end of school year. We note that the unstandardized coefficient of performance-oriented instructional practice was small ($\gamma_{01} = -0.14$; Table 3, Model 3), indicating that every 1-point change in teachers' performance-oriented instructional practices is related to a decrement of 0.14 points in students' spring motivational framework (i.e., more likely to adopt an entity framework). Although this value may seem trivial, it is important to note that students' motivational frameworks are quite stable across the school year (Dweck, 2006; the mean change in students' motivational framework from fall to spring in our data was 0.29 points) and that we obtained our effects even after accounting for a strict set of control variables (i.e., age, gender, fall motivational framework) over the course of only 6 months. Though small, the relation between teacher-reported instructional practices and students' motivational frameworks is significant and could likely intensify over the course of several years with repeated teachers who focus on performance-oriented instructional practices.

Teachers' mastery-oriented instructional practices were not a significant predictor of children's motivational framework development although the relation was in the predicted direction. This might be because elementary-school teachers tend to report high levels of mastery-oriented instructional practices (Midgley et al., 1995), which in turn leads to a higher mean with a lower variability than performance-oriented instructional practices. This claim is supported by the current data where teachers' mastery-oriented instructional practices had a higher mean and smaller variance than their performance-oriented instructional practices ($M = 3.88$, $SD = 0.55$ vs. $M = 2.30$, $SD = 0.79$, respectively; $t(57) = -11.95$, $p < .001$).⁵

⁴ Student-level model: $\text{Spring Achievement}_{ij} = \beta_{0j} + \beta_{1j}(\text{Grade}_{ij}) + \beta_{2j}(\text{Gender}_{ij}) + \beta_{3j}(\text{Fall Achievement}_{ij}) + r_{ij}$. Classroom-level model: $\beta_{0j} = \gamma_{00} + \gamma_{01}(\text{Performance-oriented instructional practice}) + \gamma_{02}(\text{Mastery-oriented instructional practice}) + \gamma_{03}(\text{Content knowledge for teaching}) + u_{0j}$, $\beta_{1j} = \gamma_{10}$, $\beta_{2j} = \gamma_{20}$, $\beta_{3j} = \gamma_{30}$.

⁵ We examined skewness and kurtosis of teacher-reported instructional practice measures (i.e., performance-, mastery-oriented instructional practices). Kline (2005) noted that absolute values of the skew index greater than 3.0 are considered extreme and that a kurtosis index greater than 10.0 may suggest a problem. Two teacher measures had skew and kurtosis indices that were equal or less than 1.05, indicating weak evidence for skewness on both measures ($\text{skewness}_{\text{performance}} = 1.05$, $\text{kurtosis}_{\text{performance}} = 1.00$; $\text{skewness}_{\text{mastery}} = 0.06$, $\text{kurtosis}_{\text{mastery}} = -0.23$).

Furthermore, previous research (Anderman et al., 2001; Kaplan et al., 2002; Urdan et al., 1998) has shown similar results such that teachers' performance-oriented but not mastery-oriented instructional practices were related to student outcomes (i.e., math and reading achievement, disruptive behaviors). Our null result mimics previous research, which failed to show the positive effect of mothers' self-reported effort feedback on children's theory of intelligence development (Pomerantz & Kempner, 2013; but see Gunderson et al., 2013, in which directly observed effort praise predicted children's motivational frameworks).

Although higher levels of teacher performance-oriented instructional practice were negatively related to students' achievement growth across the school year, this relation was not statistically significant. This raises the possibility that it takes more than one school year for teacher-reported instructional practices to directly influence children's achievement. This claim is consistent with a previous study demonstrating that teacher-related effects on children's performance are cumulative and additive (Sanders & RIVERS, 1996). That is, having an ineffective teacher for 2 years in a row is related to lower performance more so than the sum of having an ineffective teacher for two separate 1-year periods. Such findings suggest that the direct influence of teachers' performance-oriented instructional practices on children's performance may not be apparent within one school year, but rather, may produce achievement differences if children have performance-oriented teachers for 2 or more consecutive years.

We also explored the relation between teachers' theories of intelligence and their reported instructional practices based on findings suggesting that teachers' own theories of intelligence govern their reactions to students' performance (Dweck, 2006; Rattan et al., 2012). In line with our prediction, teachers who endorsed an entity theory were more likely to adopt performance-oriented instructional practices and less likely to adopt mastery-oriented instructional practices. In other words, if teachers believed that individuals' intellectual abilities were fixed, they were more likely to highlight students' performance outcomes and less likely to focus on students' learning. Although teachers' own beliefs about the malleability of intelligence were related to their-reported instructional practices, their beliefs were not directly related to students' motivational framework development across the school year. This suggests that what matters to children's frameworks is not what teachers believe but rather how teachers embed their beliefs into teaching practices. Indeed, a previous study examining the long-term effect of parental praise on children's motivational framework development supported this pattern of results by showing that parental praise style (i.e., use of process praise) predicted children's motivational framework development, whereas parents' theories of intelligence did not (Gunderson et al., 2013).

A key strength of the current study was that a large diverse sample of children was followed across the school year in real-world classroom settings, which provided an optimal test-bed for developmental models. However, it is important to mention that the correlational nature of the current study limits any strong claims about causality. Future experimental studies that manipulate students' motivational frameworks and test for changes in math achievement over time among young elementary school children will provide important causal evidence.

Another limitation of the current work is that findings relied on children's and teachers' self-reports. Despite the fact that self-reported questionnaire data are relatively easy to obtain, they may elicit response biases (e.g., social desirability bias, reference bias; Heine, Lehman, Peng, & Greenholtz, 2002). This might explain why prior studies have focused primarily on students' perceived classroom goal structure, rather than teacher-reported instructional practices. Although student reports of perceived classroom goal structure might be a better gauge of the classroom environment as students experience it (Meece, Herman, & McCombs, 2003; Murayama & Elliot, 2009), it is also subjective and may conflate the effects of classroom goal structure with other outcomes that students report (e.g., their own motivation and achievement goals). Thus, future studies should examine the role of both students' perceived classroom goal structure and teachers' report of their instructional practices on students' motivational framework development. Further, it would also be important to validate teacher reports with classroom observations of their actual instructional practices.

Although in the current study we showed that teacher-reported instructional practices are related to children's motivational framework development, there is no doubt that the role of parents is crucial as well. Past research has shown that parents' theories of intelligence (Moorman & Pomerantz, 2010), achievement goals (Ames & Archer, 1987), and performance feedback (Gunderson et al., 2013) are related to children's motivational framework. One way in which the current research can be extended is to explore interactive effects of teacher's classroom practices and parent's beliefs and behaviors.

Finally, although the current study includes a diverse sample of children in terms of gender, SES, and race, an opt-in consent procedure was employed to solicit participants which might have led to a biased sample (Kearney, Hopkins, Mauss, & Weisheit, 1983; Severson & Ary, 1983; Smith, Van Gessel, David-Ferdon, & Kistner, 2013). Our results should be viewed with the opt-in consent factor as a potential limitation for generalization.

Taken together, the findings from the present study make several important contributions. First, they add to a growing literature supporting the importance of motivational frameworks by providing evidence that as early as first and second grade, children already differ in their beliefs about the stability of academic ability and the value of effort, and in their preferences for challenging versus easy tasks. Further, these motivational frameworks are associated with their math learning across the school year. Second, we provide evidence that teacher-reported instructional practices predict the development of children's motivational frameworks. We believe that our findings have significant implications for educators by suggesting possible classroom interventions, not only for students but also for teachers. Indeed, there have been many attempts to promote an incremental framework among older students (Aronson et al., 2002; Blackwell et al., 2007; Good et al., 2003), but no published studies have attempted to promote incremental frameworks in younger elementary-school students or in elementary-school teachers. Findings from our study suggest that by avoiding performance-based instructional practices, teachers may help children form adaptive, incremental frame-

works, which in turn may lead to higher levels of math achievement, and perhaps academic achievement more generally.

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Appendix

Motivational Framework Questionnaire

Materials: Circle Scale (as depicted below)



Say, "I'm going to ask you some questions, and you'll use these circles to answer. The smallest circle [point] means *not at all*, this circle [point] means *a little*, this circle [point] means *medium*, this circle [point] means *kind of a lot*, and the biggest circle [point] means *really a lot*. You can point to any one of these circles to answer the questions. Let's try one. Imagine a boy who thinks ice cream is tasty. How much do you agree with this boy? [Give feedback.] Okay, let's try another one. How much do you like playing sports? [Give feedback.] Okay, now let's do some more."

Record yes/no or 1–5 (Smallest circle = 1, Largest circle = 5).

Response	Question
	1. How much would you like to do mazes that are very easy so you can get a lot right? [show child picture of easy maze; show circles]
	2. Imagine a kid who thinks that people have a certain amount of math ability, and stay pretty much the same. How much do you agree with this kid? [show circles]
	3. How much would you like to do math problems that are very easy so you can get a lot right? [show circles]
	4. How much would you like to spell words that are very easy so you can get a lot right? [show circles]
	5. Imagine a kid who thinks that a person is a certain amount smart, and stays pretty much the same. How much do you agree with this kid? [show circles]
	6. Imagine a kid who thinks that people have a certain amount of reading ability, and stay pretty much the same. How much do you agree with this kid? [show circles]

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