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Who Needs Innate Ability to Succeed in Math and Literacy? Academic-Domain-Specific Theories of Intelligence About Peers Versus Adults

Elizabeth A. Gunderson and Noora Hamdan
Temple University

Nicole S. Sorhagen
Millersville University

Alexander P. D'Esterre
University of Maryland, College Park

Individuals' implicit theories of intelligence exist on a spectrum, from believing intelligence is fixed and unchangeable, to believing it is malleable and can be improved with effort. A belief in malleable intelligence leads to adaptive responses to challenge and higher achievement. However, surprisingly little is known about the development of academic-domain-specific theories of intelligence (i.e., math vs. reading and writing). The authors examined this in a cross-section of students from 1st grade to college ($N = 523$). They also examined whether students hold different beliefs about the role of fixed ability in adult jobs versus their own grade. The authors' adult-specific beliefs hypothesis states that when children learn societally held beliefs from adults, they first apply these beliefs specifically to adults and later to students their own age. Consistent with this, even the youngest students (1st and 2nd graders) believed that success in an adult job requires more fixed ability in math than reading and writing. However, when asked about students in their own grade, only high school and college students reported that math involves more fixed ability than reading and writing. High school and college students' math-specific theories of intelligence were related to their motivation and achievement in math, controlling for reading and writing-specific theories. Reading and writing-specific theories did not predict reading and writing-specific motivations or achievement, perhaps because students perceive reading and writing as less challenging than math. In summary, academic-domain-specific theories of intelligence develop early but may not become self-relevant until adolescence, and math-specific beliefs may be especially important targets for intervention.

Keywords: theories of intelligence, motivation, expectancies, math, reading

Is math ability something you are born with, or something you can improve with effort? What about reading and writing ability? In the United States, it is culturally acceptable to say "I'm not a math person," implying that math ability is a fixed trait, whereas it would be unusual to say "I'm not a reading person." Indeed, adults in the United States believe that math requires a relatively high level of fixed ability, compared to other academic domains (Meyer, Cimpian, & Leslie, 2015). An abundance of research has shown that, regardless of the actual nature of intelligence (and regardless of one's own intelligence), the belief that general intelligence is a fixed trait is associated with maladaptive behaviors and lower academic achievement, whereas the belief that intelligence is malleable leads to greater persistence and academic success (e.g., Blackwell, Trzesniewski, & Dweck, 2007; Dweck, 2006; Good, Aronson, & Inzlicht, 2003; Mueller & Dweck, 1998). However, surprisingly little is known about the development and consequences of academic-domain-specific theories of intelligence (TOIs). Given the importance of these belief systems in predicting academic success, and given a growing body of evidence that individual differences in TOI develop in early elementary school (Gunderson et al., 2013; Park, Gunderson, Tsukayama, Levine, & Beilock, 2016), we seek to understand the development of academic-domain-specific TOIs over a broad age range—1st grade through college—and to determine at what age these academic-domain-specific theories begin to relate to academic motivation and achievement. In addition, we propose and test the adult-specific beliefs hypothesis, that children first apply socially learned beliefs to adults, including the belief that math involves more fixed ability than reading and writing. Only at an older age, as they approach adulthood themselves, do they begin to apply these beliefs to students their own age.

General Theories of Intelligence

Individuals' implicit TOIs vary along a continuum (Dweck, 2006). At one extreme, entity theorists believe that intelligence is a fixed trait that cannot change (Dweck, 1986; Dweck & Leggett, 1988). Entity theorists tend to prefer easy tasks that display their high level of ability, avoid challenging tasks, show reduced effort

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Elizabeth A. Gunderson and Noora Hamdan, Department of Psychology, Temple University; Nicole S. Sorhagen, Department of Psychology, Millersville University; Alexander P. D'Esterre, Department of Psychology, University of Maryland, College Park.

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Correspondence concerning this article should be addressed to Elizabeth A. Gunderson, Department of Psychology, Temple University, 1701 North 13th Street, Philadelphia, PA 19122. E-mail: liz.gunderson@temple.edu

in response to setbacks, and, eventually, have lower grades and test scores over time (e.g., Blackwell et al., 2007; Hong, Chiu, Dweck, Lin, & Wan, 1999; Nussbaum & Dweck, 2008; Robins & Pals, 2002). At the other extreme, incremental theorists believe that intelligence can always change and develop through effort. An incremental theory of intelligence leads to a suite of adaptive beliefs and behaviors, including a preference for challenging tasks, increased effort in response to challenges, and ultimately higher grades and test scores (e.g., Blackwell et al., 2007; Good et al., 2003; Park et al., 2016; Robins & Pals, 2002). The positive impact of holding an incremental theory of intelligence has been robustly demonstrated in short-term experimental studies in children as young as pre-K (Cimpian, Arce, Markman, & Dweck, 2007; Mueller & Dweck, 1998), longitudinal studies in elementary school students (Park et al., 2016; Stipek & Gralinski, 1996), and experimental interventions in middle-school and college students (Aronson, Fried, & Good, 2002; Blackwell et al., 2007; Good et al., 2003).

Academic-Domain-Specific Theories of Intelligence

Despite the clear and robust contribution of TOIs to academic achievement, surprisingly little is known about the development of academic-domain-specific TOIs, such as in math versus reading and writing. Individuals can hold different beliefs about the fixedness of human traits like intelligence versus morality (Dweck, Chiu, & Hong, 1995), for example, believing that moral character is relatively unchangeable whereas intelligence can improve with effort. Children as young as 3rd grade hold differentiated beliefs about the malleability of intelligence, personality, and physical skills (Bempechat, London, & Dweck, 1991; Heyman & Dweck, 1998). Similarly, Chinese students in elementary through high school report differentiated implicit theories about intelligence, personality, creativity, and emotional intelligence (Cheng & Hau, 2003). Although these studies show that individuals' beliefs about stability versus malleability of traits are not global, researchers have treated "intelligence" as a single domain and therefore leave open the question of whether individuals hold different beliefs about specific academic domains.

Some researchers have examined TOIs within a single academic domain, such as math. For example, Stipek and Gralinski (1991) asked 3rd graders and junior high school students to report their beliefs about the importance of effort for success in math and found that girls had lower effort beliefs in math than boys. Among 9th graders, incremental theories of math ability predicted learning goals in math as well as positive effort beliefs in math (Jones, Wilkins, Long, & Wang, 2012). Similarly, college women who held an entity theory of math ability reported being less engaged in math and less interested in math than women who held an incremental theory of math ability (Burkley, Parker, Stermer, & Burkley, 2010). However, without measuring TOI in a comparison domain, such as reading and writing, it is impossible to determine whether these findings represent academic-domain-specific beliefs about math, or more general beliefs about academic ability.

Very few studies have examined TOIs in more than one academic domain. One study investigated beliefs in mathematics and social studies among 3rd to 6th graders but failed to find statistically significant differences in TOI in these domains (Stipek & Gralinski, 1996). Another study examined Mexican American high school students' beliefs about math, science, and English abilities (Quihuis, Bempechat, Jimenez, & Boulay, 2002). Students were classified as holding an entity or incremental theory in each domain. Some students (28%) showed mixed views that varied by domain, supporting the idea that these views can be differentiated, but the study lacked sufficient power to compare students' incremental- or entity-oriented beliefs in specific domains. Finally, one study found that parents hold distinct beliefs about the fixedness of their own child's math versus verbal abilities (as shown by separate factor loadings), although these beliefs did not significantly differ between the math and verbal domains (Muenks, Miele, Ramani, Stapleton, & Rowe, 2015).

Recently, researchers have found that adults in the United States believe that adults' success in math requires more innate ability than English, literature, and most other college majors (Leslie, Cimpian, Meyer, & Freeland, 2015; Meyer et al., 2015).[1] In other words, by adulthood, individuals in the United States have a more entity-oriented view of math ability than other academic domains. In the present study, we investigate the developmental origins and consequences of these beliefs. We conceptualize domain-specificity in two ways. First, we examine whether overall levels of incremental versus entity beliefs differ in math versus reading and writing. Second, we examine whether math-specific TOIs predict math motivation and achievement, even after controlling for reading and writing-specific TOIs, and vice versa. To our knowledge, no other study has assessed academic-domain-specific TOIs using these stringent tests.

Theories of Intelligence About Adults Versus Children

In addition to investigating academic-domain-specific TOIs, we also ask whether students hold different views when considering academic success in their own grade versus success in an adult job. Prior work has established that children can hold different gender stereotypes about themselves than about adults. Specifically, children develop academic-gender stereotypes about men and women, but do not apply those stereotypes to children their own age (i.e., boys and girls). Steele (2003) described this phenomenon as an example of stereotype stratification, "the process of cognitively viewing oneself as a member of a subgroup to which the stereotype does not apply" (p. 2590). Stereotype stratification involves aspects of both subgrouping (clustering similar individuals from a larger out-group into subcategories) and subtyping (categorizing individuals as exceptions to a negative stereotype; Richards & Hewstone, 2001). In the context of academic-gender stereotypes, stereotype stratification occurs when young girls create subgroups of females (girls vs. adult women), and view their own subgroup (girls) as an exception to societal academic-gender stereotypes (Steele, 2003).

Prior research about math-gender stereotypes supports the idea that students hold different beliefs about children than adults. In a

[1] We note that recent research with adults has termed these beliefs *field-specific ability beliefs* (Leslie et al., 2015; Meyer et al., 2015). We believe that field-specific ability beliefs are conceptually very similar to (and potentially the same as) theories of intelligence, and therefore prefer to use the term *academic-domain-specific theories of intelligence* for consistency with the majority of research in this area. We further discuss the similarities and possible differences between *field-specific ability beliefs* and *theories of intelligence* in the Discussion.

study of 1st- to 4th-grade girls, children rated men as being better at math than women but did not rate boys as being better at math than girls (Steele, 2003). When asked to draw an adult who is really good at math, the majority of girls (64%) drew a male; in contrast, when asked to draw a child who is really good at math, the majority of girls (69%) drew a female. In a similar study, French 5th graders completed measures of implicit math-gender stereotypes and explicit math-gender stereotype awareness about children versus adults (Martinot, Bagès, & Désert, 2012). On the implicit measure, girls chose a female child as being better at math than a male child, but chose a male adult as being better at math than a female adult. On an explicit stereotype-awareness measure, girls reported that people believe adult men are better at math than adult women, but that people do not believe girls differ from boys at math. In other words, across several studies, girls viewed the societal stereotype that "math is for males" as true for adults, but not true for children their own age.

We propose that students employ age-related stratification—cognitively viewing themselves as belonging to a separate group than adults—not only in the context of academic-gender stereotypes, but also when considering the role of innate ability versus effort in success. According to this theory, which we will refer to as the "adult-specific beliefs hypothesis," children acquire specific socially learned beliefs (such as stereotypes and TOIs) from the proximal adults in their lives such as parents and teachers (e.g., Gunderson, Ramirez, Levine, & Beilock, 2012; Park et al., 2016; Pomerantz & Kempner, 2013). Because these beliefs are learned from adults, children initially believe that they apply primarily to other adults. This process is facilitated by their ability to stratify—to view themselves as part of a social group that is distinct from adults. Children view their own group (students in their grade level) as an exception to their beliefs about adults, instead drawing on their extensive personal experiences to make conclusions about children that may be at odds with their beliefs about adults. Only later, as children approach adulthood themselves, do they come to apply these beliefs to their own age group.

As a first test of our hypothesis, we examine whether children report relatively entity-oriented TOIs about math (compared to reading and writing) at an earlier age when thinking about adults and at a later age when the target is students in their grade. Prior studies that failed to find differences between children's TOIs in different academic domains have specifically focused on children's views about other children, for example, "Some kids can never do well in math, even if they try hard" (Stipek & Gralinski, 1996). However, recent work showing that adults hold academic-domain-specific TOIs has focused on beliefs about the role of fixed ability in success as an adult, for example, "Being a top scholar of [field] requires a special aptitude that just can't be taught" (Leslie et al., 2015; Meyer et al., 2015). We expected that even young children would adopt the societally held view that success in math in an adult job requires more fixed ability than reading and writing. However, it may not be until children are older, approaching adulthood themselves, that they begin to apply those views to students their own age.

Developmental Changes in Theories of Intelligence

In examining children's TOIs across a broad age range, we must also take into account overall age-related changes in TOI. Previous work is mixed, with some research suggesting that children's TOIs become more incremental over the course of elementary school, and others suggesting that they remain constant. A thorough review of this topic indicates that it is important to distinguish between different aspects of children's implicit TOIs (Kinlaw & Kurtz-Costes, 2003). For example, younger children are more likely to believe that intelligence has an innate, biological origin than older children (e.g., Heyman & Gelman, 2000). Older children are also more likely to view intelligence as stable over time and as stable to external forces (e.g., not affected by changes in the school, teacher, etc.) than younger children (Pomerantz & Ruble, 1997; Pomerantz & Saxon, 2001). However, children's belief that ability is stable to internal forces (e.g., cannot be increased through effort) decreases from 4th to 6th grades. Studies that combine these aspects into a single measure of TOI show mixed results, with some finding no change in TOI from 1st to 5th grades (Bempechat et al., 1991; Cain & Dweck, 1995). In contrast, others have found more incremental theories among 2nd graders than 1st graders (Park et al., 2016), an increase in incremental theories increase from 5th to 6th grades (Gonida, Kiosseoglou, & Leondari, 2006), and a decline in entity beliefs decrease from 3rd to 6th grades (Stipek & Gralinski, 1996). Thus, the developmental trajectory of TOI from 1st to 5th grades is complex, and findings suggest that different aspects of a theory of intelligence may develop separately.

However, after elementary school, there appears to be a clearer trajectory, such that junior high and high school students report less incremental-oriented views of intelligence than late elementary school students (Ablard & Mills, 1996; Cheng & Hau, 2003; Leondari & Gialamas, 2002). In general, academic motivation declines during early adolescence, as children transition from elementary school to junior high and high school settings (e.g., Midgley, Feldlaufer, & Eccles, 1989). This decline in academic motivation has been linked to increased academic challenge, lower interpersonal support at school, and a shift from an emphasis on effort to an emphasis on ability (e.g., Eccles & Midgley, 1989; Eccles & Roeser, 2009; Friedel, Cortina, Turner, & Midgley, 2010). This leads young adolescents to begin to attribute their scholastic performance to ability over effort (Harter, 2012). In summary, prior work suggests that incremental theories will either remain stable or increase from 1st grade to late elementary school, then decline in high school and college.

Relation of Theories of Intelligence to Motivation and Achievement

We also examine whether there are domain-specific consequences of holding an incremental or entity-oriented academic-domain-specific theory of intelligence. As a first test of this, we examine the relations of academic-domain-specific TOIs to academic-domain-specific motivation (competence beliefs, task values, and enjoyment) and achievement (self-reported grades). The expectancy-value theory of achievement motivation states that together, student's expectations for academic success and their assessment of the value of the academic task play a critical role in determining students' achievement-related behaviors (Eccles et al., 1983). Expectations for future success and beliefs about one's current competency are positively interrelated and form a construct termed *competence beliefs* (Eccles, Wigfield, Harold, & Blumenfeld, 1993). Beliefs about a task's usefulness (utility value) and importance (attainment value) are also positively interrelated and form a separate construct termed "task values" (Eccles et al., 1993). Although enjoyment of a task is sometimes included as one aspect of task values, we felt it was important to assess enjoyment separately given evidence that intrinsic motivation (i.e., enjoyment) may operate differently than other extrinsic aspects of motivation (Ryan & Deci, 2000). Therefore, in the current study, we examine each of these three noted constructs (competence beliefs, task values, and enjoyment) separately as subscales, in an effort to understand each motivation's unique role in the development of TOI across elementary school, high school, and college. Although it is indeed likely that these subscales are related, examining them separately will allow us to gain a better understanding of the mechanisms through which students' TOI may influence their motivation.

Competence beliefs, task values, and enjoyment are strong predictors of achievement outcomes (Eccles, 1994, 2005; Wigfield & Eccles, 2000). Research on expectancy-value theory and TOI has generally proceeded in parallel, with few studies empirically testing a link between the two constructs. However, competence beliefs, task values, and enjoyment and incremental TOIs are associated with mastery goal orientations, greater persistence, and higher academic achievement (e.g., Blackwell et al., 2007; Chouinard, Karsenti, & Roy, 2007; Eccles et al., 1983; Hong et al., 1999; Robins & Pals, 2002; Wigfield & Eccles, 2000). For example, competence beliefs and utility values separately predict mastery goal orientations in math, supporting the importance of examining these as separate constructs (Chouinard et al., 2007). In addition, direct correlations between incremental theories and expectancies have been demonstrated in nonacademic domains such as beliefs about body weight (Burnette, 2010).

Given these findings, we expected that, to the extent that TOIs differ across academic domains, these theories should have domain-specific relations to competence beliefs, task values, enjoyment, and achievement in each domain. Based on prior intervention work in older students and adults (Aronson et al., 2002; Blackwell et al., 2007; Good et al., 2003), we expected these relations to be strongest among high school and college students. Finally, we expected that TOIs about students' own grade would be more predictive of competence beliefs, task values, enjoyment, and achievement than TOI about adult jobs, because beliefs about their own grade are more personally relevant.

The Present Study

In summary, the present study investigates academic-domain-specific TOIs in a cross-sectional sample of students from 1st grade through college. We focus on the academic domains of math and reading and writing, as these are the core domains of academic standards and instruction in the U.S. from 1st grade onward (e.g., National Governors Association Center for Best Practices Council of Chief State School Officers, 2010). We hypothesized that:

1. Children will hold more entity-oriented views of math than of reading and writing.

2. Distinct beliefs about math and reading and writing will appear at a younger age when considering adult jobs, and at a later age when considering students in their own grade.

3. Theories of intelligence will have domain-specific relations to competence beliefs, task values, enjoyment, and achievement. These relations will be stronger among older students, and for TOI in relation to students in their own grade.

Method

Participants

A total of 523 participants were drawn from four age groups: 1st and 2nd graders ($n = 111$, 57 female), 5th and 6th graders ($n = 82$, 36 female), 10th and 11th graders ($n = 140$, 86 female), and first- and second-year college students ($n = 190$, 124 female). The data were collected as part of a larger study of students' attitudes toward math and reading and writing. An additional four students were excluded because they did not complete the TOI measures. Several of the 523 students in the total sample completed all of the TOI measures but did not complete one or more of the other measures (competence beliefs, task values, enjoyment, grades, or college major); these students (two 1st and 2nd graders, three 5th and 6th graders, two 10th and 11th graders, and four college students) were retained in our analyses when possible.

All participants were recruited from the same large U.S. city. First through 6th-graders were recruited from three Catholic elementary schools, and 10th and 11th graders were recruited from three Catholic high schools. All students in the target grade levels were invited to participate. Those who provided signed consent from their parents and who provided verbal assent were enrolled in the study. For the 1st through 11th graders, demographic information was collected via a parent questionnaire. The 1st through 11th grade sample was socioeconomically diverse: Parents' education ranged from less than high school to a graduate degree, with an average of 14.9 years of education ($SD = 2.42$, where 16 years is a 4-year college degree, $n = 264$). Family income ranged from less than \$15,000 per year to more than \$100,000 per year, with a mean of \$69,550 ($SD = \$31,007$, $n = 239$). As reported by their parents, students were 71.4% White, 16.4% Black or African American, 5.3% Asian or Asian American, 2.6% Hispanic, and 4.2% other or multiple races ($n = 262$).

College students were recruited from a large public university in the same U.S. city as the 1st through 11th graders. College students self-reported their race/ethnicity as 58.2% White, 18.5% Asian or Asian American, 13.6% Black or African American, 3.2% Hispanic, and 6.5% other or multiple races ($n = 184$). Although college students did not self-report their socioeconomic status, the university they attended was socioeconomically diverse. For example, in 2012, 33% of first-year students reported that neither of their parents had graduated from college.

Procedure

First and 2nd graders were assessed in a one-on-one session in which the experimenter read all questions out loud to the child in a quiet space at their school. Fifth, 6th, 10th, and 11th graders were assessed in a group setting in which the experimenter read the directions and students read and responded to the paper-and-pencil questionnaire at their own pace. The experimenter was available to answer any clarifying questions. College students completed the questionnaire on a computer either online or in the lab. All students completed all measures in a single session in the following order: (a) TOI; (b) competence beliefs, task values, and enjoyment; (c) self-reported grades; and (d) college major (college students only). The order of the four TOI scales was fully counterbalanced between students. In addition, the order of academic domains (math vs. reading and writing) in the measure of competence beliefs, task values, and enjoyment was counterbalanced between students.

Measures

TOI. We assessed children's TOI in two domains (math vs. reading and writing) and with respect to two age groups (kids in my grade vs. adult jobs). This resulted in four TOI scales: math my-grade TOI, math adult-job TOI, reading-writing my-grade TOI, and reading-writing adult-job TOI. Each scale consisted of four items (adapted from Dweck, 1999; Furnham, Chamorro-Premuzic, & McDougall, 2002; Stipek & Gralinski, 1996). The wording of each item was parallel across math and reading and writing, and across my-grade and adult jobs. For example, one item was: "Only the smartest [people/kids] can do well in [math/reading and writing] [jobs/in my grade]." Students were provided with examples of adult jobs in math (mathematician, engineer, physicist, computer scientist, and math teacher) and in reading and writing (writer, poet, editor, journalist, and English teacher) prior to responding to those items. In some cases, item wording was adjusted to be appropriate to each grade level (for all items, see Appendix).

Fifth graders through college students responded using a 6-point Likert scale ranging from 1 (*strongly disagree*) to 6 (*strongly agree*). We used a different response format for 1st and 2nd graders based on research showing that young children respond more readily to visual scales, such as circles of increasing size, than to Likert scales (e.g., Rebok et al., 2001) and showing that two-part questions are an effective means of reducing social desirability bias in this age range (Harter, 1981, 1982). This type of two-part scale has also been previously used to measure children's TOI, as well as other topics such as self-esteem and moral judgments (e.g., Cain & Dweck, 1995; Costanzo, Coie, Grumet, & Farnill, 1973; Harter, 1981; Harter & Pike, 1984). Specifically, the experimenter first asked the child if she agreed or did not agree. If the child said "agree", then the child responded to the second part of the question by pointing to one of three green circles of increasing size, representing "a little bit agree," "kind of agree," and "really agree." If the child said "not agree," then she responded by pointing to one of three red circles of increasing size, representing "a little bit don't agree," "kind of don't agree," and "really don't agree." Responses were scored on a scale from 1 (*really don't agree*) to 6 (*really agree*). Items were reverse-coded as needed so that higher scores always indicated a more incremental theory. Items were averaged together to form an overall score within each of the four TOI scales.

We used omega-total (ω_T) to estimate reliability. Omega-total estimates the proportion of variance due to all common factors and has been shown to be substantially more robust to common violations of assumptions than Cronbach's alpha (Dunn, Baguley, & Brunsden, 2014; Revelle & Zinbarg, 2009). Preliminary analyses indicated that each TOI scale contained two factors;[2] therefore, ω_T was calculated for each TOI scale assuming two nested factors. Reliabilities for the TOI scales were as follows: math my-grade TOI, $\omega_T = 0.62$; math adult-job TOI, $\omega_T = 0.62$; reading-writing my-grade TOI, $\omega_T = 0.67$; and reading-writing adult-job TOI, $\omega_T = 0.54$. Reliabilities within grade-level group can be found in Table 2. The relatively low reliability of the TOI scales, especially adult-jobs TOIs, appears to be driven primarily by low reliabilities among 1st and 2nd graders (math adult-jobs $\omega_T = 0.33$; reading-writing adult-jobs $\omega_T = 0.38$). We discuss potential reasons for these low reliabilities later in the manuscript. Nevertheless, readers should be cautious when interpreting 1st and 2nd graders' adult-jobs TOIs.

We note that reliabilities below 0.70 are quite common when studying elementary school-age children (e.g., Erdley, Loomis, Cain, & Dumas-Hines, 1997; Ramirez, Gunderson, Levine, & Beilock, 2013). Further, internal consistency is virtually unrelated to validity (McCrae, Kurtz, Yamagata, & Terracciano, 2011). In addition, low reliability generally leads to an underestimate of the true relation between a predictor and outcome (Schmitt, 1996). Therefore, if we find statistically significant results, it is likely that a more reliable measure would lead to even stronger results. Of course, nonsignificant results should be interpreted with caution.

Competence beliefs, task values, and enjoyment. We assessed three key constructs based on expectancy-value theory: competence beliefs, task values, and enjoyment. Each was assessed in two domains (math vs. reading and writing; adapted from Eccles et al., 1993). In each domain, three items assessed competence beliefs (math $\omega_T = 0.87$; reading-writing $\omega_T = 0.82$), 2 items assessed task values (math $\omega_T = 0.68$; reading-writing $\omega_T = 0.65$), and 2 items assessed enjoyment (math $\omega_T = 0.90$; reading-writing $\omega_T = 0.83$; for all items, see Appendix).[3] Reliabilities by grade-level group are shown in Table 2. We note that reliability for the task values scales was particularly low among 1st and 2nd graders (math $\omega_T = 0.05$; reading-writing $\omega_T = 0.19$), and their results relating to this task should be interpreted with caution.

Wording was parallel across the two domains. First and 2nd graders responded by pointing to one of six smiley faces, ranging from sad to happy (see Appendix). Smiley face scales like this one are widely used with 1st and 2nd graders to measure topics including academic attitudes and anxieties (e.g., Davies & Brember, 1994; Ramirez, Gunderson, Levine, & Beilock, 2012). For each item, the experimenter explained the meaning of the endpoints. For example, on the item "How good in math are you?" the experimenter explained that the sad face means "not at all good" and the happy face means "very good." Fifth graders through college students responded using a 6-point Likert scale. In some cases, wording was adjusted for each age group.

Self-reported grades. Students in 5th grade and older self-reported their math and reading and writing class grades by an-

[2] Factor analysis was conducted using Varimax rotation. For each scale, Items 2 and 3 (effort-related items) loaded more strongly on the first factor (rotated factor loadings > 0.78), and Items 1 and 4 (intelligence-related items) loaded more strongly on the second factor (rotated factor loadings $>$ 0.46). Because each TOI scale contained two factors, we asked whether considering item type (effort-related vs. intelligence-related) would change the pattern of results reported below. We reran each ANOVA, adding item type as an additional within-subjects factor. The pattern of results remained the same, and all main effects and interactions reported as significant at $p < .05$ remained significant at $p < .07$.

[3] Preliminary factor analyses indicated that each scale contained one factor. Therefore, omega-total was calculated assuming one factor.

swering one question about each academic domain, "Please put an X inside the box that represents what kind of grades you receive in your [math/reading and writing] related classes." The response "Mostly As" was coded as a 4.0, "Mostly As and Bs" was coded as 3.5, "Mostly Bs" as 3.0, and so forth, until "Mostly Below Ds" was coded as 0.50. Self-reported grades are highly correlated with actual grades among high school and college students (Kuncel, Credé, & Thomas, 2005). Self-reported math grades were not collected for students in 1st and 2nd grades as many students do not receive letter grades in early elementary school.

College major. As a control measure, we asked college students to report their major. Specifically, students were asked "What is/are your majors(s)? If you are undeclared please write 'undecided'." Students were identified as being part of a science, technology, engineering, or math (STEM) major or a non-STEM major based on the categories established by the U.S. Immigration and Customs Enforcement (2012). Although psychology is considered a STEM field according to the U.S. ICE categorization system, in the present study we considered psychology majors to be non-STEM. The reason for this is that psychology is often reported separately from other STEM majors (e.g., Ceci, Ginther, Kahn, & Williams, 2014), and represented a large portion of our college sample (35% of college students).[4] Students that were included in the STEM major group included those with the following majors: biology, kinesiology, neuroscience, exercise science, pre-health, pharmacology, chemistry, management information systems, computer science, and engineering. Students that identified as any other major or undecided were identified as non-STEM majors. In using this college major categorization scheme we observed that 37% of the college students in our sample were STEM majors.

Results

Preliminary Analyses

Means for all measures are presented in Table 1, within grade group. Statistically significant differences between grades are noted in Table 1; however, because we used slightly different survey formats and items across grades (especially 1st and 2nd graders vs. other grade levels), we interpret these overall grade-related differences cautiously. Correlations between all measures, within grade group, are reported in Table 2. We first examined the intercorrelations between the four TOI measures (math my-grade TOI, math adult-job TOI, reading-writing my-grade TOI, and reading-writing adult-job TOI), within grade level (see Table 2). All four TOI measures were statistically significantly positively related in all grade levels. However, these correlations were not high enough to suggest collinearity (1st and 2nd graders: rs = 0.45 to 0.59, ps $<$ .001; 5th and 6th graders: rs = 0.64 to 0.81, ps $<$ .001; 10th and 11th graders: rs = 0.39 to 0.59, ps $<$ .001; college students: rs = 0.46 to 0.69, ps $<$ .001).

We next examined the correlations between the TOI measures, competence beliefs, task values, and enjoyment, and grades. Among the 1st and 2nd graders and the 5th and 6th graders, the math TOI measures were not statistically significantly correlated with math competence beliefs, task values, and enjoyment or grades. In contrast, there were a number of statistically significant relations among these constructs in older students. Students with more incremental math my-grade TOIs reported more positive attitudes toward math on all three motivation scales (competence beliefs, task values, and enjoyment; 10th and 11th graders: rs = 0.20 to 0.33, ps $<$ .05; college students: rs = 0.19 to 0.29, ps $<$ .05). Similarly, students who held more incremental views of adult jobs in math had higher competence beliefs, task values, and enjoyment in math, although the relations were somewhat weaker than for math my-grade TOIs (10th and 11th graders: rs = 0.15 to 0.31, ps $\leq$ .07; college students: rs = 0.14 to 0.17, ps $\leq$ .06). Students with more incremental beliefs about math in their own grade had higher self-reported math grades (10th and 11th graders: $r(136) = 0.19$, $p < .05$; college students: $r(184) = 0.23$, $p = .001$). In addition, for 10th and 11th graders, more incremental math adult-job TOIs were related to higher math grades, $r(136) = 0.19$, $p < .05$. Reading and writing TOIs were not statistically significantly positive predictors of reading and writing competence beliefs, task values, and enjoyment or reading and writing grades in any age group.[5]

We next examined whether our measures were related to student gender. In the full sample, girls reported statistically significantly higher task values in reading and writing than boys, $t(516) = 2.59$, $p < .01$, $d = 0.23$. Girls also reported higher reading and writing grades than boys, $t(402) = 2.47$, $p < .05$, $d = 0.25$ (note that this excludes 1st and 2nd graders, who did not self-report their grades). No statistically significant gender differences were found on any other measure (ps $>$ .05). In addition, we tested the analyses of variance (ANOVA) and regression models reported below with gender as a factor. We found no statistically significant main effects or interactions involving gender in the ANOVAs reported below. In the regression models, we found unanticipated effects of gender in only two of eight models.[6] Because our study was not designed to test questions involving gender differences and may be

[4] We also reran our regression analyses (Models 5–8) with psychology majors included as part of STEM. The results were consistent with those reported in Table 4: math my-grade TOIs were a statistically significant, positive predictor of math competence beliefs ($\beta = 0.38$, $t = 3.52$, $p <$ .001), math enjoyment ($\beta = 0.24$, $t = 2.13$, $p < .05$), and math grades ($\beta = 0.34$, $t = 3.04$, $p < .01$), but not math task values ($\beta = 0.17$, $t = 1.49$, $p =$ .14). However, STEM major (with psychology majors included) was no longer a statistically significant positive predictor of math competence beliefs, task values, enjoyment, or grades.

[5] There were two statistically significant, though small, negative correlations: a statistically significant negative correlation between reading-writing my-grade TOI and reading-writing enjoyment among 1st and 2nd graders, $r(108) = -0.20$, $p < .05$, and a statistically significant negative correlation between reading-writing adult-job TOI and reading-writing enjoyment in college students, $r(187) = -0.22$, $p < .01$. However, these correlations may be spurious, given their unexpected nature and the large number of correlations reported.

[6] We reran each regression model with main effects and interactions involving gender and math my-grade TOI. For six of the eight models there were no main effects or interactions. The two exceptions were as follows: (a) Among 10th and 11th graders, there was a statistically significant Gender $\times$ Math My-grade TOI interaction predicting math task values (p = .03). When decomposed by gender, math my-grade TOIs were a statistically significant predictor of math task values for males but not females. (b) Among college students, there was a statistically significant main effect of gender when predicting math enjoyment ($p < .01$), where women reported more enjoyment than men. Because both effects were unanticipated and in the opposite direction of previous literature, we do not interpret them further.

Table 1
Means (SDs) for All Measures by Grade Group

Measure	1st and 2nd graders (n = 111)	5th and 6th graders (n = 82)	10th and 11th graders (n = 140)	College students (n = 190)
1. Math my-grade TOI	4.21_a (1.06)	4.87_b (.84)	4.21_a (.90)	4.26_a (.74)
2. Math adult-job TOI	4.00_{ac} (.97)	4.55_b (.92)	4.06_a (.90)	3.82_c (.83)
3. Reading-writing my-grade TOI	4.20_a (1.14)	4.83_b (.86)	4.51_c (.76)	4.51_c (.73)
4. Reading-writing adult-job TOI	4.20_a (.99)	4.67_b (.85)	4.30_a (.80)	4.14_a (.69)
5. Math competence beliefs	5.06_a (.98)	4.99_a (.93)	4.38_b (1.18)	3.73_c (1.25)
6. Math task values	5.19_a (.85)	5.30_a (.87)	4.11_b (1.23)	3.55_c (1.19)
7. Math enjoyment	4.98_a (1.27)	4.54_b (1.34)	3.43_c (1.55)	2.88_d (1.45)
8. Reading-writing competence beliefs	5.19_a (.81)	4.83_b (1.00)	4.61_{bc} (.99)	4.44_c (.99)
9. Reading-writing task values	5.26_a (.88)	4.84_b (1.09)	4.66_b (1.09)	4.58_b (1.22)
10. Reading-writing enjoyment	4.99_a (1.13)	4.32_b (1.28)	3.67_c (1.29)	3.55_c (1.34)
11. Math grades (self-report)	N/A	3.43_a (.69)	3.29_a (.72)	3.10_b (.68)
12. Reading-writing grades (self-report)	N/A	3.53_a (.55)	3.53_a (.59)	3.50_a (.46)

Note. Means with different subscripts are statistically significantly different between grade groups at the $p < .05$ level. TOI = theories of intelligence; N/A = data not collected for this age group.

underpowered to do so, and for the sake of simplicity, gender is excluded from the subsequent analyses.

Confirmatory Factor Analysis on TOI Measures

To examine whether the four TOI constructs (math my-grade TOI, math adult-job TOI, reading-writing my-grade TOI, and reading-writing adult-job TOI) represent separate factors, we conducted a confirmatory factor analysis in Mplus version 7.31. Because we deliberately constructed the scales to contain items with parallel wording, we used a multitrait multimethod framework (Campbell & Fiske, 1959), with item wording as the method effect. In all models, we used the correlated uniqueness approach to account for method variance by correlating the items that share parallel wording (Kenny & Kashy, 1992).

The four-factor model was well-fit (see Table 3 for fit statistics). Each item loaded positively and statistically significantly on its hypothesized factor. Standardized item loadings ranged from 0.17 to 0.77, indicating that some loadings were stronger than others (see Appendix Figure A1 for item loadings). We note that the lowest-loading item on each factor was the single item that was not reverse-coded. We further assessed the relative fit of the four-factor model by comparing it to a one-factor model and a two-factor model with separate factors for my-grade versus adult-job items. Although all models were reasonably well-fit, chi-square difference tests indicated that the four-factor model was a statistically significantly better fit to the data than the other a priori models.[7]

TOIs by Target, Domain, and Grade

Mean responses by target, domain, and grade level are displayed in Figure 1. We first examined all three factors of interest in a 2 (target: my grade vs. adult job) × 2 (domain: math vs. reading and writing) × 4 (child grade group: 1st and 2nd graders, 5th and 6th graders, 10th and 11th graders, college students) mixed-effects ANOVA. Target and domain were within-subjects factors while child grade group was a between-subjects factor. This analysis revealed statistically significant main effects of target, $F(1, 519) = 68.4$, $p < .001$, $\eta_p^2 = 0.116$; domain, $F(1, 519) = 41.7$, $p < .001$, $\eta_p^2 = 0.074$; and grade group, $F(3, 519) = 13.6$, $p < .001$, $\eta_p^2 = 0.073$. Overall, students held more incremental beliefs about their own grade than about adult jobs. Students also held more incremental views of reading and writing than of math. Fifth and 6th graders held more incremental views than the other grade groups (all ps < .001), whereas the other grade groups did not statistically significantly differ from each other (although, as noted previously, we interpret these main effects of grade group cautiously).

In addition, all 2-way interactions were statistically significant: Domain × Target, $F(1, 519) = 4.32$, $p < .05$, $\eta_p^2 = 0.008$; Domain × Grade Group, $F(3, 519) = 5.21$, $p = .001$, $\eta_p^2 = 0.029$, and Target × Grade Group, $F(3, 519) = 6.56$, $p < .001$, $\eta_p^2 = 0.037$. The Target × Grade Group interaction was driven by college students showing a more dramatic difference between adult-job TOIs (less incremental views) versus my-grade TOIs (more incremental views), compared to the other grades. We explain the domain-related interaction terms in detail in our subsequent analyses. The three-way interaction of Domain × Target × Grade Group was not statistically significant, $F(3, 519) = 1.74$, $p = .16$, $\eta_p^2 = 0.010$. However, we did not necessarily expect a three-way interaction given the large number of grade groups and limitations of sample size and power in detecting relatively small effects.

To increase power to detect a potential three-way interaction (Target × Domain × Grade), we created two larger grade groups by combining the two youngest groups (1 and 2nd graders and 5th and 6th graders) and the two oldest age groups (10th and 11th graders and college students). We then ran a 2 (target: my grade vs. adult job) × 2 (domain: math vs. reading and writing) × 2 (child grade group: 1st through 6th graders, high school and college students) mixed-effects ANOVA. All main effects and 2-way interactions were again statis-

[7] Because our preliminary analyses showed that each TOI scale contained two factors, we ran a post hoc CFA with 8 factors, in which each of the four TOI scales was split into an effort-related scale (Items 2 and 3) and an intelligence-related scale (Items 1 and 4). Each pair of factors was nested within one of the four original factors. This CFA was well-fit (CFI = 0.96, AIC = 26,308.82, BIC = 26,675.14, RMSEA = .05) and was significantly better fit than the 4-factor model, $\Delta\chi^2(8) = 44.68$, $p < .001$. However, because this was a post hoc analysis, we retain the four-factor model as the preferred a priori model.

Table 2
Correlations Among All Measures, by Grade Group

Grade group and measure	1	2	3	4	5	6	7	8	9	10	11
1st and 2nd graders (n = 111)											
1. Math my-grade TOI	*.51*										
2. Math adult-job TOI	**.54**	*.33*									
3. Reading-writing my-grade TOI	**.56**	**.56**	*.60*								
4. Reading-writing adult-job TOI	**.59**	**.56**	**.45**	*.38*							
5. Math competence beliefs	−.05	−.08	.09	.04	*.68*						
6. Math task values	−.08	−.02	.03	.03	**.24**	*.05*					
7. Math enjoyment	.00	−.03	−.06	.10	**.42**	.17	*.71*				
8. Reading-writing competence beliefs	−.09	.03	−.02	−.02	**.38**	**.26**	**.25**	*.59*			
9. Reading-writing task values	.13	−.03	.04	.16	.15	**.48**	.18	.10	*.19*		
10. Reading-writing enjoyment	−.17	−.14	**−.20**	−.10	.17	**.21**	**.46**	**.47**	.17	*.50*	
5th and 6th graders (n = 82)											
1. Math my-grade TOI	*.69*										
2. Math adult-job TOI	**.76**	*.66*									
3. Reading-writing my-grade TOI	**.81**	**.69**	*.76*								
4. Reading-writing adult-job TOI	**.64**	**.72**	**.66**	*.74*							
5. Math competence beliefs	.01	−.01	−.03	.05	*.81*						
6. Math task values	−.07	−.11	−.12	−.07	**.42**	*.51*					
7. Math enjoyment	−.01	−.04	−.07	−.03	**.69**	**.39**	*.87*				
8. Reading-writing competence beliefs	.17	.05	.18	.20	.13	.05	−.01	*.88*			
9. Reading-writing task values	.17	.01	.13	.14	.17	**.26**	.08	**.62**	*.55*		
10. Reading-writing enjoyment	.13	.01	.15	.14	**.24**	.12	**.27**	**.48**	**.67**	*.85*	
11. Math grades (self-report)	−.20	−.18	−.18	−.05	**.42**	.15	**.35**	.10	−.04	−.13	—
12. Reading-writing grades (self-report)	−.16	**−.32**	−.16	−.15	.07	.17	−.04	**.38**	**.28**	.05	**.31**
10th and 11th graders (n = 140)											
1. Math my-grade TOI	*.71*										
2. Math adult-job TOI	**.55**	*.75*									
3. Reading-writing my-grade TOI	**.53**	**.45**	*.70*								
4. Reading-writing adult-job TOI	**.39**	**.59**	**.42**	*.68*							
5. Math competence beliefs	**.33**	**.31**	.01	.14	*.87*						
6. Math task values	**.28**	**.20**	.02	**.19**	**.51**	*.65*					
7. Math enjoyment	**.20**	.15	−.05	.10	**.62**	**.61**	*.87*				
8. Reading-writing competence beliefs	−.02	−.08	.08	.08	.04	**−.17**	−.11	*.87*			
9. Reading-writing task values	.14	.02	.03	.09	.16	**.19**	.05	**.61**	*.68*		
10. Reading-writing enjoyment	.02	−.13	.01	−.00	−.08	−.02	.03	**.56**	**.49**	*.83*	
11. Math grades (self-report)	**.19**	**.19**	−.06	.05	**.72**	**.42**	**.46**	.08	**.23**	−.02	—
12. Reading-writing grades (self-report)	.12	−.08	−.01	−.02	**.23**	.06	−.02	**.56**	**.40**	**.32**	**.44**
College students (n = 190)											
1. Math my-grade TOI	*.67*										
2. Math adult-job TOI	**.69**	*.74*									
3. Reading-writing my-grade TOI	**.60**	**.46**	*.71*								
4. Reading-writing adult-job TOI	**.49**	**.52**	**.61**	*.60*							
5. Math competence beliefs	**.29**	**.17**	.13	.09	*.91*						
6. Math task values	**.19**	.14	.12	.14	**.59**	*.66*					
7. Math enjoyment	**.22**	**.16**	.09	.11	**.65**	**.52**	*.95*				
8. Reading-writing competence beliefs	−.09	−.12	.03	−.09	**−.20**	−.05	**−.31**	*.85*			
9. Reading-writing task values	.02	.07	.01	−.10	**.18**	−.06	−.13	**.63**	*.77*		
10. Reading-writing enjoyment	−.11	−.08	−.14	**−.22**	**−.29**	**−.16**	**−.23**	**.55**	**.58**	*.89*	
11. Math grades (self-report)	**.23**	.10	.12	.10	**.71**	**.40**	**.50**	**−.24**	**−.15**	**−.25**	—
12. Reading-writing grades (self-report)	−.14	−.07	−.03	−.10	−.08	−.04	**−.21**	**.55**	**.34**	**.32**	.05

Note. Bold indicates $p < .05$. Italicized values on the diagonals are reliabilities (omega-totals). Based on preliminary factor analyses, omega-totals for theories of intelligence (TOI) scales assume two factors per scale; omega-totals for competence beliefs, task values, and enjoyment assume one factor per scale.

tically significant (Fs $>$ 5.0, ps $<$ .05). In addition, the 3-way (Target × Domain × Grade Group) interaction approached statistical significance, $F(1, 521) = 3.73$, $p = .054$, $\eta_p^2 = 0.007$.

To further examine the three-way and two-way interactions, we first analyzed domain and grade level differences within each target (my-grade TOIs vs. adult-job TOIs). We then analyzed domain and target differences within each grade group (1st to 6th graders vs. high school and college students). We chose to examine domain and target differences within two larger grade groups, instead of the original four grade levels, to increase power to detect potential 2-way Target × Domain interactions within each grade group.

Domain and Grade-Level Differences Within Target

My-grade TOIs. We first examined the relation of grade level and domain to my-grade TOIs, which ask students whether they believe that math and reading and writing success in their own grade involves more fixed ability or hard work (see Figure 1). Within

Table 3
Results of Confirmatory Factor Analysis on the 16 Theories of Intelligence Items

Model	χ^2	*df*	CFI	AIC	BIC	RMSEA	χ^2 dif[a]
4 factors	212.78	74	.95	26,337.51	26,669.75	.06	—
2 factors (my grade vs. adult job)	291.13	79	.92	26,405.85	26,716.80	.07	78.35***
1 factor	301.30	80	.92	26,414.02	26,720.71	.07	88.52***

Note. CFI = comparative fit index; AIC = Akaike information criterion; BIC = Bayesian information criterion; RMSEA = root mean square error of approximation; dif = difference.
[a] The χ^2 difference tests are calculated by comparison to the 4-factor model.
*** $p < .001$.

my-grade TOIs, a 2 (domain: math vs. reading and writing) × 4 (child grade group: 1st and 2nd grade, 5th and 6th grade, 10th and 11th grade, college) mixed-effects ANOVA revealed a statistically significant main effect of domain, $F(1, 519) = 12.2$, $p < .001$, $\eta_p^2 = 0.023$, a statistically significant main effect of grade group, $F(3, 519) = 11.5$, $p < .001$, $\eta_p^2 = 0.062$, and a statistically significant Domain × Grade Group interaction, $F(3, 519) = 6.09$, $p < .001$, $\eta_p^2 = 0.034$. Based on our hypothesis that distinct beliefs about math and reading and writing would be present only among older students when considering students in their own grade (Hypothesis 2), we conducted planned comparisons within grade level, comparing math my-grade TOIs to reading-writing my-grade TOIs (the statistical significance of these planned comparisons is also noted in Figure 1). The younger children in the sample (1st and 2nd graders and 5th and 6th graders) did not report statistically significantly different beliefs about math versus reading and writing for students in their own grade, *p*s > .40, *d*s < .08. However, students held more incremental views of reading and writing than math for students in their own grade in 10th and 11th grade, $t(139) = 4.41$, $p < .001$, $d = 0.37$, and college, $t(189) = 5.24$, $p < .001$, $d = 0.38$.

Adult-job TOIs. We next examined TOIs about adult jobs, which ask students whether they believe math and reading and writing success in an adult job involves more fixed ability or hard work (see Figure 1). A 2 (domain) × 4 (child grade group) mixed-effects ANOVA revealed a statistically significant main effect of domain, $F(1, 519) = 38.4$, $p < .001$, $\eta_p^2 = 0.069$; a statistically significant main effect of grade group, $F(3, 519) = 13.4$, $p < .001$, $\eta_p^2 = 0.072$; and no statistically significant interaction of domain x grade group, $F(3, 519) = 1.36$, $p = .26$, $\eta_p^2 = 0.008$. Based on our hypothesis that distinct beliefs about math and reading and writing would be present among all age groups when considering adult jobs (Hypothesis 2), we conducted planned comparisons within grade level, comparing math adult-job TOIs to reading-writing adult-job TOIs (the statistical significance of these planned comparisons is also noted in Figure 1). In each grade group, children viewed math jobs as requiring more fixed ability than reading and writing jobs: the difference between math and reading-writing adult-job TOIs was statistically significant for 1st and 2nd graders, $t(110) = 2.36$, $p < .05$, $d = 0.22$, marginally statistically significant for 5th and 6th graders, $t(81) = 1.67$, $p < .10$, $d = 0.18$, statistically significant for 10th and 11th graders, $t(139) = 3.70$, $p < .001$, $d = 0.31$, and statistically significant for college students, $t(189) = 5.87$, $p < .001$, $d = 0.43$.

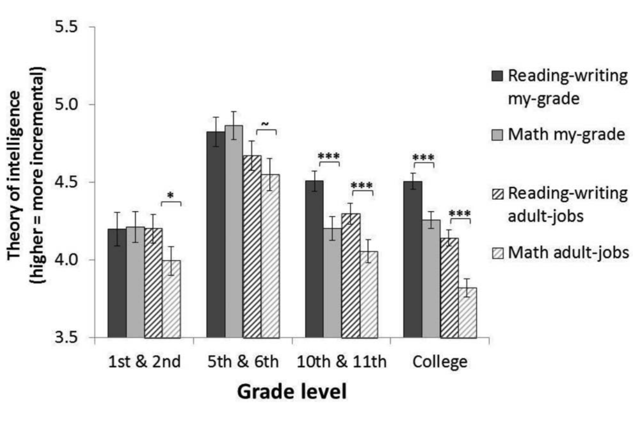

Figure 1. Theories of intelligence by domain, target age, and student grade level. Only statistically significant results of planned comparisons are labeled (comparisons of math to reading-writing within grade level and target). ~ $p < .10$. * $p < .05$. *** $p < .001$.

Domain and Target Differences Within Grade-Level Groups

First to 6th graders. The planned comparisons reported previously indicate that for 1st through 6th graders, TOIs differed in math versus reading and writing only when the target was adult jobs, and not when the target was students in their own grade. If this is the case, we would expect to find a Target × Domain interaction among students in this age range. To test this, we restricted the sample to 1st to 6th graders[8] and conducted a 2

[8] We chose to combine the two youngest age groups (1st to 6th graders) and the two oldest age groups (10th graders to college students) to increase the sample size and thus increase power needed to detect relatively small three-way interaction effects. For completeness, we report the results of separate 2 (target) × 2 (domain) ANOVAs within each of the four original grade groups here. For 1st and 2nd graders, there was no statistically significant main effect of domain, $F(1, 110) = 2.61$, $p = .11$, $\eta_p^2 = 0.023$, nor a main effect of target, $F(1, 110) = 2.44$, $p = .12$, $\eta_p^2 = 0.022$, nor a Target × Domain interaction, $F(1, 110) = 2.37$, $p = .13$, $\eta_p^2 = 0.021$. For 5th and 6th graders, there was no statistically significant main effect of domain, $F(1, 81) = 0.64$, $p = .43$, $\eta_p^2 = 0.008$. There was a statistically significant main effect of target, $F(1, 81) = 15.30$, $p < .001$, $\eta_p^2 = 0.159$, and a Domain × Target interaction that was trending toward statistical significance, $F(1, 81) = 3.76$, $p = .056$, $\eta_p^2 = 0.044$. For 10th and 11th graders, there was a statistically significant main effect of domain, $F(1, 139) = 27.91$, $p < .001$, $\eta_p^2 = 0.167$, a statistically significant main effect of target, $F(1, 139) = 9.81$, $p = .002$, $\eta_p^2 = 0.066$, and no statistically significant Domain × Target interaction, $F(1, 139) = 0.51$, $p = .48$, $\eta_p^2 = 0.004$. College students showed the same pattern as high school students: a statistically significant main effect of domain, $F(1, 189) = 44.13$, $p < .001$, $\eta_p^2 = 0.189$, a statistically significant main effect of target, $F(1, 189) = 125.1$, $p < .001$, $\eta_p^2 = 0.398$, and no statistically significant domain x target interaction, $F(1, 189) = 1.65$, $p = .20$, $\eta_p^2 = 0.009$.

(target) × 2 (domain) × 2 (grade group) ANOVA. As expected, the Target × Domain interaction was statistically significant, $F(1, 191) = 4.46$, $p = .036$, $\eta_p^2 = .023$. There were also statistically significant main effects of target, $F(1, 191) = 12.79$, $p < .001$, $\eta_p^2 = .063$, and grade group, $F(1, 191) = 23.74$, $p < .001$, $\eta_p^2 = .111$. No other main effects or interactions were statistically significant (*p*s > .05).

High school and college students. The planned comparisons reported previously also suggest that for high school and college students, there should be no interaction of Target × Domain, because students view math as involving more fixed ability than reading and writing, regardless of the target. To test this, we restricted the sample to 10th and 11th graders and college students and conducted a 2 (target) × 2 (domain) × 2 (grade group) ANOVA. As expected, the Target × Domain interaction was not statistically significant, $F(1, 328) = 0.01$, $p = .92$, $\eta_p^2 = .00$. There were statistically significant main effects of target, $F(1, 328) = 81.22$, $p < .001$, $\eta_p^2 = .198$; domain, $F(1, 328) = 69.71$, $p < .001$, $\eta_p^2 = .175$; and the Target × Grade Group interaction, $F(1, 328) = 11.99$, $p < .001$, $\eta_p^2 = .035$. No other main effects or interactions reached statistical significance (*p*s > 0.15).

Relations of domain- and target-specific TOIs to competence beliefs, task values, enjoyment, and grades. Having identified differences in children's TOI by domain (math vs. reading and writing) and target (my grade vs. adult job), we next asked whether these specific TOIs were uniquely related to important factors that predict academic success: competence beliefs, task values, enjoyment, and self-reported grades. We focused our analyses on older students (10th and 11th graders and college students), for whom math my-grade TOIs and math adult-job TOIs were correlated with these outcomes (see Table 2). We conducted separate models for each outcome (math competence beliefs, task values, enjoyment, and self-reported grades) and each grade level (10th and 11th graders, college students). We conducted separate models for each grade level because we considered college students' involvement in a STEM major (or not) to be an important covariate, whereas STEM major was not relevant for 10th and 11th graders.

We examined whether math my-grade TOIs or math adult-job TOIs were more strongly related to each outcome by including both variables in a simultaneous regression (see Table 4). To further establish the domain-specificity of these relations, we also controlled for reading-writing my-grade TOIs and reading-writing adult-job TOIs, as well as college STEM major (for college students only). Because these target- and domain-specific TOIs were intercorrelated, we checked all regression models for multicollinearity. All variance inflation factors were less than 2.50, well below the highest acceptable value of 10 (Cohen, Cohen, West, & Aiken, 2003).

For 10th and 11th graders (Models 1–4), math my-grade TOIs were statistically significantly positively related to math competence beliefs ($\beta = 0.35$, $t = 3.47$, $p < .001$), math task values ($\beta = 0.31$, $t = 3.00$, $p < .01$), math enjoyment ($\beta = 0.26$, $t = 2.39$, $p < .05$), and self-reported math grades ($\beta = 0.23$, $t = 2.12$, $p < .05$). In other words, students with more incremental beliefs about math ability in their own grade had higher motivation (competence beliefs, task values, enjoyment) and grades in math than those with more entity beliefs. Math adult-job TOIs were also a statistically significant positive predictor of math competence beliefs ($\beta = 0.26$, $t = 2.44$, $p < .05$), suggesting that math my-grade TOIs and

Table 4
Regressions Predicting Math Competence Beliefs, Task Values, Enjoyment, and Grades

	10th and 11th graders				College students			
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Measure	Math competence beliefs	Math task values	Math enjoyment	Math grades (self-report)	Math competence beliefs	Math task values	Math enjoyment	Math grades (self-report)
Math my-grade TOI	$.35^{***}$	$.31^{**}$	$.26^{*}$	$.23^{*}$	$.43^{***}$	$.21^{\dagger}$	$.28^{*}$	$.37^{***}$
Math adult-job TOI	$.26^{*}$	.05	.09	$.21^{\dagger}$	−.09	−.04	−.01	−.17
Reading-writing my-grade TOI	$-.28^{**}$	$-.22^{*}$	$-.25^{*}$	$-.25^{*}$	−.07	−.04	−.08	−.05
Reading-writing adult-job TOI	−.04	.13	.05	−.05	−.05	.07	.02	.03
STEM major (no = 0, yes = 1)	—	—	—	—	$.26^{***}$	$.19^{*}$	$.19^{**}$	$.21^{**}$
R-squared	18.9	11.5	8.1	9.5	15.9	7.3	8.6	10.6
F-stat (*df*)	7.85^{***} (4, 135)	4.39^{**} (4, 135)	2.97^{*} (4, 135)	3.49^{**} (4, 133)	6.86^{***} (5, 181)	2.84^{*} (5, 181)	3.40^{**} (5, 181)	4.26^{**} (5, 180)

Note. Standardized parameter estimates are shown. TOI = theories of intelligence; STEM = science, technology, engineering, or math.
$^{\dagger} p < .10$. $^{*} p < .05$. $^{**} p < .01$. $^{***} p < .001$.

math adult-job TOIs are independently related to math competence beliefs. However, math adult-job TOIs were not statistically significantly related to any other outcomes. In addition, reading-writing my-grade TOIs were a statistically significant negative predictor of each outcome. In other words, students who had more entity beliefs about reading and writing ability in their own grade had higher math motivation (competence beliefs, task values, enjoyment) and grades than those with more incremental reading and writing beliefs. This finding was unexpected, and replication and investigation may be warranted in future research.

For college students (Models 5–8), math my-grade TOIs were a statistically significant (or marginally significant) positive predictor of math competence beliefs ($\beta = 0.43$, $t = 4.05$, $p < .001$), math task values ($\beta = 0.21$, $t = 1.86$, $p = .065$), math enjoyment ($\beta = 0.28$, $t = 2.50$, $p < .05$), and self-reported math grades ($\beta = 0.37$, $t = 3.38$, $p < .001$). Similar to the high schoolers, college students with more incremental beliefs about math ability in their own grade had higher motivation (competence beliefs, task values, enjoyment) and grades in math. Being in a STEM major was also a statistically significant positive predictor of each math outcome. No other predictors were statistically significant in these models.

Finally, we considered the relation of reading and writing TOIs to reading and writing competence beliefs, task values, and enjoyment and reading and writing grades. However, zero-order correlations (see Table 2) indicated that reading and writing TOIs were not positively related to reading and writing competence beliefs, task values, enjoyment, or self-reported grades for any grade group. Therefore, we did not conduct further tests of these relations.

Discussion

The belief that intelligence is fixed versus malleable has critical implications for later academic success (e.g., Dweck, 2006). The present study is the first to show that children's TOIs vary systematically as a function of academic domain and targeted group (adults vs. students their own age). Consistent with our hypotheses, students believed that math involves more fixed ability than reading and writing. Importantly, this belief emerged at a young age when children considered adult jobs. In other words, even 1st and 2nd graders believed that adults' success in math-related jobs requires a high level of fixed, inborn abilities, more so than success in reading and writing-related jobs. Students in 5th and 6th grades, 10th and 11th grades, and college also endorsed this distinction about adult jobs in math versus adult jobs in reading and writing.

When children considered success in their own grade level, 10th and 11th graders and college students reported that math success involves more fixed ability than reading and writing success. However, younger students (1st and 2nd and 5th and 6th graders) did not differ in their beliefs about math versus reading and writing when considering their own grade level. This pattern is consistent with our adult-specific beliefs hypothesis, which states that children first apply socially learned beliefs to the group that they have learned them from—in this case, adults. As children approach adulthood themselves and become part of the "adult" group, they begin to apply these beliefs to students their own age.

Finally, we asked whether domain- and target-specific TOIs are linked to academic-domain-specific motivation (competence beliefs, task values, and enjoyment) and achievement, an important test of their divergent validity. As expected, we found these relations to be present only for the older students (10th and 11th graders and college students). Specifically, incremental math my-grade TOIs were a statistically significant positive predictor of math competence beliefs, task values, and enjoyment and self-reported math grades among both 10th and 11th graders and college students. This relation held even after accounting for math adult-job TOIs, reading-writing my-grade TOIs, reading-writing adult-job TOIs, and for college students, whether the student was a STEM major (a statistically significant positive predictor of math motivation and grades).

Although these results strongly suggest that math TOIs are distinct from reading and writing TOIs for each target, it would be informative for future work to examine the relation of the more-typically studied, general TOIs to these domain-and target-specific TOIs across development. One study found that college students' general TOIs were more incremental than their math-specific TOIs (Shively & Ryan, 2013). In addition, college students' math-specific TOIs became less incremental after completing a college algebra course (their general TOIs also declined, but less severely). An important question is to what extent general versus domain-specific TOIs predict students' behaviors and achievement. In this prior study of college students, the results were mixed: Only general TOIs predicted help-seeking behaviors, whereas only math-specific TOIs predicted course grades (Shively & Ryan, 2013). Future research should examine these questions among younger students, examine TOIs in both math and reading and writing, and incorporate target-specific TOIs (my-grade vs. adult-jobs). If domain- and target-specific TOIs remain predictive of math motivation and achievement, even after accounting for general TOIs, this would provide additional evidence that domain and target specificity are crucial aspects of students' TOIs that should be considered in future research and interventions.

Interestingly, although math-specific TOIs were positively correlated with math competence beliefs, task values, and enjoyment and math grades, reading and writing-specific TOIs were not significantly positively related to reading and writing motivation or reading and writing grades. It is possible that TOIs are actually more important in math because math is perceived as being more challenging than reading and writing (e.g., Anderman & Midgley, 1997; Stodolsky, Salk, & Glaessner, 1991). An incremental TOI is especially important for persisting in the face of challenging new material (Licht & Dweck, 1984), and math coursework frequently presents challenging new concepts. In addition, interventions encouraging an incremental TOI are especially effective at improving performance in domains where students face negative, anxiety-inducing stereotypes, such as those regarding women in math (Aronson et al., 2002; Good et al., 2003). Therefore, an incremental TOI might be more important for math than reading and writing if students are more likely to be the target of negative stereotypes in math, and to have high levels of math anxiety, than in reading and writing (e.g., Hembree, 1990; Maloney, Schaeffer, & Beilock, 2013; Schmader, Johns, & Forbes, 2008). However, it is also possible that our choice to combine reading and writing may have obscured separate beliefs about reading ability and writing ability; the relatively low reliability of the reading-writing adult-job TOI measure suggests that this may be the case. It would be informative for future work to examine reading TOIs and writing TOIs separately to determine whether they are, in fact, distinct.

Interestingly, we found no gender differences in students' TOIs, unlike two recent studies of children in early elementary school that found that boys held slightly stronger incremental theories than girls (Gunderson et al., 2013; Park et al., 2016). Given these mixed results, it will be important for future work to continue to examine whether and under what circumstances boys and girls develop different TOIs.

Although the results of our study are consistent with our adult-specific beliefs hypothesis, several alternative theoretical explanations are possible. The present study sets the stage for distinguishing between these alternatives in future work. One possibility is that students may believe that doing well in an adult job involves top-level success, whereas doing well in their own grade involves a lower standard of success, such as being above average. If so, then differences between adult-job versus my-grade TOIs may be due to different beliefs about the importance of innate ability for top-level success, versus simply being above average. A study that varies both the target age (adult jobs and my grade) and level of success (above average vs. top-level success) would help to distinguish between these possibilities.

A second possibility is that the way that younger students are socialized by adults to think about math and reading and writing differs from how high school and college students are socialized. It is possible that when adults talk to younger students (compared to older students), they may be less likely to discriminate between math and reading and writing or less likely to speak specifically about students' success in each area and whether that entails more or less fixed ability. Relatedly, adults may talk about the abilities of older students and adults differently than those of younger students. These potential differences might be rooted in the differing goals of these conversations held by adults. For example, adults might be more interested in providing guidance to older versus younger students in terms of figuring out where their strengths lie, what career path to pursue, and so forth (e.g., Hill & Tyson, 2009). Thus, they might make more explicit distinctions between math versus reading and writing in their discourse, as they might view this as helpful. Future work examining how parents and teachers talk with students about math versus reading and writing, and how this relates to students' domain- and target-specific TOIs, may prove fruitful.

A third possibility is that all students—regardless of their age—believe that in elementary school, math and reading and writing require equal amounts of fixed ability. Initial support for this theory comes from a study showing that parents believe that their children's math and verbal abilities are equally malleable (Muenks et al., 2015). Alternately, it is possible that older students—but not younger students—believe that math requires more fixed ability than reading and writing, for all target ages. Because we asked students to report their TOIs for adult jobs and for students in their own grade, but not for students in other grades, both possibilities are consistent with the present results. Future research could distinguish between these possibilities by asking students at each grade level to report their TOIs about students in elementary school, middle school, high school, and college. Results of such a study would help to refine our adult-specific beliefs hypothesis.

We note several limitations of the present study. One is that our data are cross-sectional, and so it is possible that age-related differences could be due to cohort effects. Nevertheless, we attempted to minimize these effects by recruiting students from the same city and, where possible, the same school and district. The cross-sectional nature of the data also limits our ability to interpret the direction of the relations between math TOIs, competence beliefs, task values, and enjoyment, and grades. This opens the door for future longitudinal or experimental studies, a point we discuss further below.

In addition, although it was necessary to use different formats of our survey so that it could be understood across students of different ages, it is possible that the overall levels of incremental TOIs of 1st and 2nd graders (who used a two-part response format for TOIs, while the rest of the participants used a Likert scale), may have been impacted by the response format relative to other groups. For this reason, we are cautious in interpreting the result that 1st and 2nd graders had lower incremental TOIs than 5th and 6th graders. Although this finding is consistent with some developmental research on TOIs (Leondari & Gialamas, 2002; Stipek & Gralinski, 1996), it is inconsistent with others (Bempechat et al., 1991; Cain & Dweck, 1995). Therefore, a study using a consistent survey format across a wide age range is important for definitively showing the developmental trajectory of TOIs, especially given conflicting results in prior work. Importantly, however, we believe this change in study format between grades is unlikely to explain our main findings regarding differences between domain- and target-specific TOIs, given that the questions themselves were well-matched across grade levels, domains, and targets.

Another limitation is the relatively low reliability of some measures, especially among the youngest age group (1st and 2nd graders). There are several possible reasons for this. One is that each measure included a small number of items (2 to 4) due to time constraints. Because internal reliability is directly related to the number of items on a scale (Carmines & Zeller, 1979; Ercan, Yazici, Sigirli, Ediz, & Kan, 2007), developing scales with additional items may increase reliability. In addition, young children may have difficulty understanding and reasoning about adult jobs, although we gave examples of math and reading and writing jobs to mitigate this possibility. Developing more reliable measures of domain- and target-specific TOIs, especially for young children, remains a challenge for future work. Nevertheless, because low reliability generally leads to an underestimate of the true relation between variables (Schmitt, 1996), we expect that use of more reliable measures would lead to even stronger results in support of our hypotheses.

We also note that we measured domain- and target-specific TOIs by asking questions about the extent to which success involves innate ability versus hard work. These questions were adapted from items previously used to measure incremental and entity TOIs (Furnham & Chamorro-Premuzic, 2005; Furnham et al., 2002) but are also similar to the more recently defined "field-specific ability beliefs" (Leslie et al., 2015; Meyer et al., 2015). We believe that TOIs and field-specific ability beliefs are conceptually very similar, and in the present study chose to use the term *theories of intelligence* for consistency with the majority of research. Nevertheless, it is theoretically possible that the belief that intelligence is fixed or malleable (a theory of intelligence, strictly defined) may be subtly different from the belief that fixed intelligence is necessary for success in a specific area (a field-specific ability belief, strictly defined). It will be informative for future work to examine whether these beliefs are, in fact, distinguishable, and at what point in development.

One unexpected post hoc result was that each of our TOI measures contained two factors, suggesting a distinction between items assessing the role of intelligence in success versus the role of effort in success. Although we conceptualized these TOI measures as a single scale, following prior work (e.g., Furnham et al., 2002; Leslie et al., 2015), the presence of these two nested factors is consistent with prior research that has considered effort-related beliefs and ability-related beliefs as distinct constructs (e.g., Stipek & Gralinski, 1996). Further work is needed to determine whether these beliefs are indeed meaningfully distinct in the context of domain- and target-specific TOIs.

Conclusion

The present study represents a crucial first step in understanding the development of academic-domain- and target-specific TOIs. We show that even young students believe that math requires more innate ability than reading and writing for adult jobs, and that older students also believe that math involves more fixed ability than reading and writing in their own grade. These findings provide initial support for our adult-specific beliefs hypothesis, and an important next step will be to further test this hypothesis. One way to do so involves examining the relations between adult-job TOIs and my-grade TOIs across time. Specifically, the adult-specific beliefs hypothesis suggests that children who adopt an entity view of adults' math success should be more likely to later adopt an entity view of math in their own grade, a hypothesis that can be empirically tested.

Another test of the adult-specific beliefs hypothesis involves directly measuring the role of parents and teachers in fostering academic-domain-specific TOIs. Prior work with young children has shown that parents' use of process praise (e.g., "good effort") predicts children's incremental TOIs, while use of person praise (e.g., "you're smart") predicts entity TOIs (Gunderson et al., 2013; Pomerantz & Kempner, 2013). In addition, teachers' use of performance-oriented teaching practices, such as displaying high-achieving students' work on the wall, predicts increases in entity TOIs (Park et al., 2016). However, these studies have examined adults' influences on general TOIs, rather than examining influences on academic-domain-specific TOIs. This leaves open crucial research questions: What adult behaviors lead children to believe that math involves more fixed ability than reading and writing? Can these behaviors be changed to foster more adaptive, incremental beliefs about math among students of all ages? Future research can examine these relations, and help us to understand how to reduce the prevalence of maladaptive, entity-oriented views of math ability.

Importantly, we show that math-specific TOIs are related to math motivation and math achievement among high school and college students, whereas reading and writing-specific TOIs are not robust predictors of motivation or grades. Interventions that increase incremental TOIs have succeeded in increasing academic achievement (e.g., Blackwell et al., 2007), and our findings suggest that targeting incremental versus entity views specific to math ability may be even more impactful. In summary, the present study offers a crucial new perspective on the early emerging roots of the belief that some people are "just not math people," laying the groundwork for future work to understand and, ultimately, improve students' motivation and achievement in math.

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Appendix

Confirmatory Factor Analysis on Theories of Intelligence Items

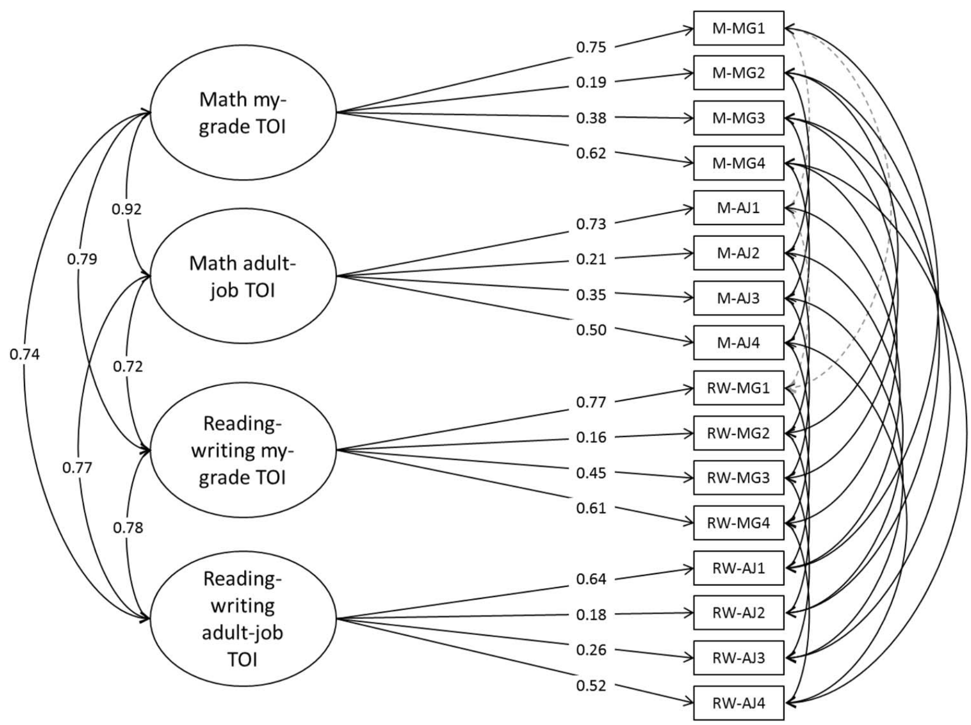


Figure A1. A summary of the four-factor confirmatory factor analysis on the 16 theories of intelligence (TOI) items. Statistically significant factor loadings are labeled with standardized coefficients. Solid black lines indicate statistically significant loadings or associations. Gray dashed lines indicate nonsignificant associations. M-MG = math my-grade; M-AJ = math adult-job; RW-MG = reading-writing my-grade; RW-AJ = reading-writing adult-job.

(*Appendix continues*)

Items Used in Each Theory of Intelligence (TOI) Measure by Grade Level

Item 1st and 2nd graders	5th and 6th graders	10th and 11th graders	College students
Math adult-job TOI			
1. (reversed) Only the smartest people can do well in math jobs.	Same as 1st and 2nd graders	Same as 1st and 2nd graders	Same as 1st and 2nd graders
2. Everyone can do well in a math job if they work hard enough.	Same as 1st and 2nd graders	Same as 1st and 2nd graders	Same as 1st and 2nd graders
3. (reversed) Some people can never do well in a math job even if they try hard.	Same as 1st and 2nd graders	Same as 1st and 2nd graders	Same as 1st and 2nd graders
4. (reversed) People who do well in math jobs were born with a lot of smarts.	People who do well in math jobs were born with a lot of intelligence.	Same as 5th and 6th graders	Same as 5th and 6th graders
Reading and writing adult-job TOI			
1. (reversed) Only the smartest people can do well in reading and writing jobs.	Same as 1st and 2nd graders	Same as 1st and 2nd graders	Same as 1st and 2nd graders
2. Everyone can do well in a reading and writing job if they work hard enough.	Same as 1st and 2nd graders	Same as 1st and 2nd graders	Same as 1st and 2nd graders
3. (reversed) Some people can never do well in a reading and writing job even if they try hard.	Same as 1st and 2nd graders	Same as 1st and 2nd graders	Same as 1st and 2nd graders
4. (reversed) People who do well in reading and writing jobs were born with a lot of smarts.	People who do well in reading and writing jobs were born with a lot of intelligence.	Same as 5th and 6th graders	Same as 5th and 6th graders
Math my-grade TOI			
1. (reversed) Only the smartest kids can do well in math in my grade.	Same as 1st and 2nd graders	Only the smartest students can do well in math in my grade.	Only the smartest students can do well in math in college.
2. Kids in my grade can do well in math if they work hard enough.	Same as 1st and 2nd graders	Students in my grade can do well in math if they work hard enough.	College students can do well in math if they work hard enough.
3. (reversed) Some kids in my grade can never do well in math even if they try hard.	Same as 1st and 2nd graders	Some students in my grade can never do well in math even if they try hard.	Some college students can never do well in math even if they try hard.
4. (reversed) You have to be really smart to do well in math in my grade.	Kids in my grade who do well in math were born with a lot of intelligence	Students in my grade who do well in math were born with a lot of intelligence.	College students who do well in math were born with a lot of intelligence.
Reading and writing my-grade TOI			
1. (reversed) Only the smartest kids can do well in reading and writing in my grade.	Same as 1st and 2nd graders	Only the smartest students can do well in reading and writing in my grade	Only the smartest students can do well in reading and writing in college.
2. Kids in my grade can do well in reading and writing if they work hard enough.	Same as 1st and 2nd graders	Students in my grade can do well in reading and writing if they work hard enough.	College students can do well in reading and writing if they work hard enough.
3. (reversed) Some kids in my grade can never do well in reading and writing even if they try hard.	Same as 1st and 2nd graders	Some students in my grade can never do well in reading and writing even if they try hard.	Some college students can never do well in reading and writing even if they try hard.

(*Appendix continues*)

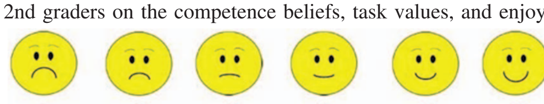
Appendix (*continued*)

Item	1st and 2nd graders	5th and 6th graders	10th and 11th graders	College students
4.	(reversed) You have to be really smart to do well in reading and writing in my grade.	Kids in my grade who do well in reading and writing were born with a lot of intelligence.	Students in my grade who do well in reading and writing were born with a lot of intelligence.	College students who do well in reading and writing were born with a lot of intelligence.

Items Used in Measures of Competence Beliefs, Task Values, and Enjoyment, by Domain and Grade Level

Measure	1st and 2nd graders	5th and 6th graders, 10th and 11th graders, and college students
Math competence beliefs		
	1. How good in math are you? [1: not good at all, 6: very good]	Same as 1st and 2nd graders
	2. How well do you think you will do in math this year? [1: not at all well, 6: very well]	How well do you expect to do in math this year? [1: not at all well, 6: very well]
	3. How good would you be at learning something new in math? [1: not at all good, 6: very good]	Same as 1st and 2nd graders
Math task values		
	4. Some things that you learn in school help you do things better outside of class, that is, they are useful. For example, learning about plants might help you grow a garden. In general, how useful is what you learn in math? [1: not at all useful, 6: very useful]	Same as 1st and 2nd graders
	5. How important is it for you to be good at math? [1: not at all important, 6: very important]	For me, being good in math is [1: not at all important, 6: very important]
Math enjoyment		
	6. Do you find your math schoolwork to be [1: not fun at all, 6: very fun]	In general, I find working on math assignments [1: very boring, 6: very interesting]
	7. How much do you like doing math? [1: not at all, 6: very much]	Same as 1st and 2nd graders
Reading and writing competence beliefs		
	1. How good in reading and writing are you? [1: not good at all, 6: very good]	Same as 1st and 2nd graders
	2. How well do you think you will do in reading and writing this year? [1: not at all well, 6: very well]	How well do you expect to do in reading and writing this year? [1: not at all well, 6: very well]
	3. How good would you be at learning something new in reading and writing? [1: not at all good, 6: very good]	Same as 1st and 2nd graders
Reading and writing task values		
	4. Some things that you learn in school help you do things better outside of class, that is, they are useful. For example, learning about plants might help you grow a garden. In general, how useful is what you learn in reading and writing? [1: not at all useful, 6: very useful]	Same as 1st and 2nd graders
	5. How important is it for you to be good at reading and writing? [1: not at all important, 6: very important]	For me, being good in reading and writing is [1: not at all important, 6: very important]
Reading and writing enjoyment		
	6. Do you find your reading and writing schoolwork to be [1: not fun at all, 6: very fun]	In general, I find working on reading and writing assignments [1: very boring, 6: very interesting]
	7. How much do you like reading and writing? [1: not at all, 6: very much]	Same as 1st and 2nd graders

Note. Smiley-face scale used with 1st and 2nd graders on the competence beliefs, task values, and enjoyment items.



See the online article for the color version of this table.

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