Motiv Emot
DOI 10.1007/s11031-014-9419-0

ORIGINAL PAPER

What if I can't? Success expectancies moderate the effects of utility value information on situational interest and performance

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Abstract Two studies tested how the effects of a utility value manipulation on interest and performance were moderated by expectations for success. College students learned a new technique for mentally solving multiplication problems with instructions containing task utility information or not. In Study 1 ($N = 62$), the effect of the utility value information was positive for individuals with high success expectancies, but negative for individuals with low success expectancies. Study 2 ($N = 148$) examined the causal role of success expectancies by manipulating whether participants received an expectancy boost before receiving the utility manipulation. The results showed further support for the importance of success expectancies in moderating the effect of directly-communicated utility value. The results are discussed in relation to other research on utility value, interest, and expectancy–value models of achievement behavior.

Keywords Interest · Utility value · Task value · Success expectancies · Perceived competence

Introduction

Achievement activities afford opportunities not only to perform well, but also to experience interest and enjoyment. The experience of interest is especially important if the achievement activity involves a skill that takes time and repetition to develop because the choice to seek out and to practice the skill will be guided at least in part by whether individuals enjoy doing it (Sansone and Thoman 2005). *Situational interest* captures this desire to engage in activities in the moment, and is characterized by heightened attention, intensified emotional experience (often positive), and perceived meaning (Chen et al. 2001; Linnenbrink-Garcia et al. 2010; Mitchell 1993; Schraw and Lehman 2001).

Researchers have made gains in identifying variables that are related to situational interest in achievement situations (see Schraw and Lehman 2001 for a review). Some of this research focuses on task values. Task values define the particular significance that a task holds for an individual, and are correlated with continued engagement in activities and the experience of situational interest (Eccles et al. 1983; Eccles and Wigfield 2002). Although Eccles et al. (1983) identified several task values, the focus of the current research is utility value. A task has utility value if it is perceived as useful for accomplishing personal goals, either in everyday life or in the future.

Utility value

The relationships between self-reported utility value, situational interest, and achievement choices are well established in correlational research. Perceptions of utility value tend to be strongly correlated with reports of task interest and enjoyment (e.g., Eccles and Wigfield 1995; Hulleman et al. 2008; Simpkins et al. 2006) and related to continued engagement in domains. For example, students who reported utility value in their course content took more classes in related areas, thought more broadly about their schoolwork, and were more likely to consider careers in

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Published online: 02 August 2014

related fields (Eccles and Wigfield 1995; Harackiewicz et al. 2012; Husman and Lens 1999; Jacobs and Eccles 2000; Meece et al. 1990; Wigfield 1994).

Self-reported utility value has also been correlated with processes of task engagement that can facilitate learning and task performance (Bong 2001; Hulleman et al. 2008; Simons et al. 2000, 2004). Those who perceived activities as useful or instrumental for future goals used deep-level learning strategies (Lens et al. 2001), wanted to perform well (Lens and Decruyenaere 1991), and evidenced higher effort even when they did not enjoy the work (Sansone et al. 1992, 1999).

Even though utility value is positively correlated with measures of interest and personal choices, utility value has been described as having certain extrinsic qualities because the value emerges from a task's association with other pursuits rather than from direct experience with the task itself (Eccles and Wigfield 2002). That said, the extrinsic aspects of utility value are linked to personally held goals (Eccles and Wigfield 2002). Moreover, individuals with low task interest may be more open to an intervention suggesting that a task could be useful (i.e., has utility value) than that it is fun (i.e., has intrinsic value), because the utility value might match their personal goals without blatantly contradicting their task experience. Interventions directly targeting intrinsic task value may have an ironic effect of undermining a sense of autonomy (Deci and Ryan 1985). On the other hand, individuals might be more receptive to utility value interventions because of the extrinsic nature of utility value, and as they come to appreciate a task's utility value, they may become more engaged and develop more interest in the task.

In this vein, researchers have begun to test the effects of interventions designed to infuse tasks with utility value (Durik and Harackiewicz 2007; Harackiewicz et al. 2012; Hulleman et al. 2010; Hulleman and Harackiewicz 2009; Vansteenkiste et al. 2004). Some of this research has compared different types of utility, testing the content of utility information. For example, utility value in service of communal goals led to better outcomes than utility value in service of material goals, suggesting that the benefits of utility value may vary depending on how individuals internalize the information (Vansteenkiste et al. 2004). However, this research did not compare the effect of the presence versus absence of utility value information. Subsequent research focused on whether the presence of utility value information affected task engagement by comparing task outcomes for participants exposed to utility or not. Two approaches have been used to expose individuals to utility value information. The utility value information is either self-generated by learners or directly communicated to them (see Durik et al. in press). In studies testing self-generated utility, individuals are prompted to generate their own uses for a task. In contrast, in studies testing directly-communicated utility, individuals are explicitly told about plausible uses for a task.

Experimental tests of both self-generated and directly-communicated utility have been shown to increase situational interest and performance for some people but not for others (Durik et al. in press). For example, the self-generated utility intervention was found to promote situational interest and performance more for individuals with lower expectancies for success, compared with those with higher expectancies for success (Hulleman et al. 2010; Hulleman and Harackiewicz 2009). In other words, if individuals who did not expect to perform well were prompted to reflect on the utility of the activity, then they were more likely to enjoy the activity and perform better.

The research examining self-generated utility has revealed effects that are not consistent with traditional expectancy–value models of motivation (e.g., Atkinson 1974; Tolman 1932; Vroom 1964). Expectancy–value models posit stronger motivation when individuals have both high expectations of success and high value (i.e., a positive interaction). In contrast, experimental tests of self-generated utility show interactions with success expectancies in the opposite, negative direction: the presence of utility is more effective for those with low versus high expectancies. One important difference between studies testing self-generated utility and other tests of expectancy–value models, however, is that self-generated utility value relies on beliefs that are derived from the person. In contrast, many of the first experimental studies of the expectancy–value model relied on value that was defined by the task or situation (e.g., Atkinson and Raynor 1974). This difference may be critical in understanding when to expect positive versus negative expectancy $\times$ value interactions. In other words, the predicted interactive expectancy $\times$ utility value effects are less prominent when the values were derived from the self (Nagengast et al. 2011). In studies of self-generated utility, the prompt typically asks individuals to write about how a given achievement activity is useful to them personally. In response, individuals reflect on the task and make personal connections with it. This may be particularly effective for individuals with low expectancies of success because they come to value the activity in their own terms. This might be one effective way that these individuals are able to internalize the utility value, which previous research shows might be critical for producing positive effects on task outcomes (Vansteenkiste et al. 2004).

With this backdrop, consider the effects of directly-communicated utility value information. In this research, individuals are exposed to utility information from an outside source. The effects of such manipulations were also found to depend on an individual difference variable; however, the individual difference that was examined was

not success expectancies. Instead, individual interest was shown to moderate the effect (Durik and Harackiewicz 2007; Shechter et al. 2011). *Individual interest*, in contrast to situational interest, is the level of interest a person starts with. It is an enduring predisposition to attend to and re-engage with particular subject matter, characterized by stored knowledge, value, and affect (Hidi and Renninger 2006; Krapp 1999; Renninger 1990; Renninger et al. 1992; Schiefele 1991). The results showed that, for participants with initially higher individual interest in math, directly-communicated utility value facilitated situational interest, but not for those with lower individual interest in math. These data were interpreted to suggest that when utility value information is encountered in a learning situation, some individuals embraced it. Those with an ongoing individual interest in the domain may not have considered the utility of the math task on their own, but agreed with it once it was pointed out because the information was consistent with their value for the domain overall.

However, there may be another reason why those with higher individual interest benefited from the presence of directly-communicated utility information, and this reason ties directly to traditional expectancy–value models of achievement. Individual interest and expectancies for success often co-occur (Hidi and Renninger 2006; Koller et al. 2001; Krapp 2000; Marsh et al. 2005), but success expectancies have not yet been tested as a moderator of directly-communicated utility value on interest. It is plausible that individuals need to feel somewhat competent at a task in order to be open to information conveyed about its utility. Therefore, expectancies of success, which tend to overlap with individual interest, may be the reason why individuals with higher individual interest benefited from the presence of directly-communicated utility value in the prior research. In other words, the combination of high expectancies for success and utility may have led to the highest task motivation.

Moreover, this explanation is in line with traditional expectancy × value models of achievement motivation. If expectancies for success are tested interactively with the presence or absence of directly-communicated utility information, then the positive interaction between these variables may predict both situational interest and also task performance. Specifically, the combination of entering into the situation with high success expectancies and learning about the utility value of the task may result in higher levels of situational interest and task performance.

Study 1

In Study 1, we examined how directly-communicated utility of a novel math technique (Barron and Harackiewicz 2001) affected situational interest and performance, and tested whether perceived competence in math (PCM) as well as individual interest in math moderated the effect of utility value information on task interest and performance. PCM was measured as an alternative for success expectancies for two, related reasons. First, given that participants would be completing a new math activity, it was unclear whether they would feel able to predict with sufficient certainty their expectancies for success on the activity. Moreover, prior research has shown that expectancies for success and perceived competence are correlated to the point that they are not empirically separable (Eccles and Wigfield 1995). Therefore, we assessed both individual interest and PCM to test whether the effects of the manipulation differed for individuals with low versus high perceived competence as well as for low versus high individual interest in math.

We hypothesized that both individual interest and perceived competence would moderate the effect of utility value information on situational interest, and that perceived competence may also show an effect on task performance. Specifically, participants with high levels of initial perceived competence (or individual interest) should show more situational interest when exposed to utility value information. On the other hand, participants with low levels of initial perceived competence (or individual interest) should not benefit from utility value information. We also tested whether PCM moderated the effects of the utility value manipulation on task performance. Although no effects of directly-communicated utility on performance were found in prior research, it is possible that these effects would emerge if the more specific competence variable were tested.

Method

Participants

Sixty-two students (50 % were women) from a large Midwestern university participated in exchange for course extra credit. The sample was 92 % Caucasian, 2 % African American, 3 % Hispanic, and 3 % Asian.

Design and procedure

Participants were randomly assigned to either the utility or control condition. Initial PCM and individual interest in math were measured at the beginning of the session. The dependent variables were participants' situational interest in the math technique and performance on two problem sets.

Participants completed the session individually. To obtain a baseline measure of math performance to use as a

covariate, participants first used their usual method of multiplication to solve as many problems as they could in 2 min. Then participants reported their initial individual interest and their PCM.

Next, participants learned the new technique with an instructional notebook that was accompanied by an audio recording in order to standardize the time spent with the task materials (Barron and Harackiewicz 2001). The instructional portion of the session lasted approximately 20 min. It focused on a technique for solving 2-digit-by-2-digit multiplication problems (e.g., 32 × 45). The technique outlines a series of calculations whereby each digit in the first number is multiplied by each digit in the second number, while keeping in mind whether each digit is in the "tens place" or "ones place." Individuals are instructed to multiply digits starting with the left and moving to the right of each number, and then summing the products to arrive at the final answer. The technique makes it easier to calculate answers to these types of problems without pencil and paper. After describing the general principles of this technique, the instructional notebook walked participants through two example problems and then invited them to practice several problems on their own.

The utility value information was embedded in the beginning, middle, and end of the instructions. For example, the beginning passage described how the new technique could increase working memory capacity, and therefore improve college performance. In the middle of the instructions, participants were told about how the technique could be used in six different occupations (e.g., "A psychologist may use mental math to evaluate a test report"). Pictures of professionals from these occupations accompanied the manipulation. At the end, a summary paragraph reminded participants of the usefulness of mental math in courses, careers, and graduate school. The control condition did not contain utility information.

After completing the technique instructions, participants solved two 4-min problem sets using the new technique, and were told which problems they solved correctly. Finally, participants reported their situational interest.

Measures

Baseline performance equaled the number of problems, from 0 to 9, participants solved correctly in 2 min, using their usual method of multiplication. Individual interest in math was assessed with four items [e.g., "I find math enjoyable," "Math just doesn't appeal to me" (reversed), "I enjoy working on math problems" and "I like learning new math concepts"]. PCM was assessed with two items [e.g., "I consider math to be one of my best subjects" and "I don't feel comfortable when it comes to doing math problems" (reversed)].

Table 1 Zero-order correlations and descriptive statistics for major variables in Study 1

		1	2	3	4	5
1	Baseline performance					
2	Individual interest in math	.29*				
3	PCM	.54*	.64*			
4	Situational interest	−.06	.32*	.24		
5	Task performance	.37*	.34**	.44*	.37*	
	Mean	6.15	4.00	4.52	5.17	34.06
	SD	2.57	1.46	1.53	1.07	11.55
	Cronbach's alpha		.92	.84	.88	

N = 62. Variables ranged from 1 (*low*) to 7 (*high*) except for baseline performance (from 0 to 9 problems) and Task Performance (from 2 to 61 problems)

PCM perceived competence in math

* $p < .05$

After the session, participants responded to three items assessing situational interest in the technique (e.g., "The left-to-right technique is interesting," "Using this multiplication technique is fun" and "The learning program was enjoyable"). Task performance equaled the total number of problems solved correctly on the two problem sets.

All self-report items were rated on a scale from 1 (*Strongly disagree*) to 7 (*Strongly agree*). The Cronbach alphas for multi-item scales were within the acceptable range and are in Table 1.

Results

Overview

Multiple regression was used to test the hypotheses. Contrast codes compared the utility value condition (+1) with the control (−1), and men (+1) with women (−1). The 2-way interactions between initial PCM, initial individual interest, and the utility value manipulation were tested, and significant interactions were examined by testing the effect of the utility manipulation among individuals one standard deviation below and above the mean on the continuous variables. The interactions with gender were not significant and were excluded from the final model. All other terms were tested in the model, but effects that were not statistically significant are not mentioned in the results.

Descriptive statistics and zero-order correlations are presented in Table 1. As expected, the correlation between initial individual interest and PCM was .64, indicating that these variables were highly related.

The PCM model included five predictors: gender, baseline performance, PCM, the utility value contrast, and

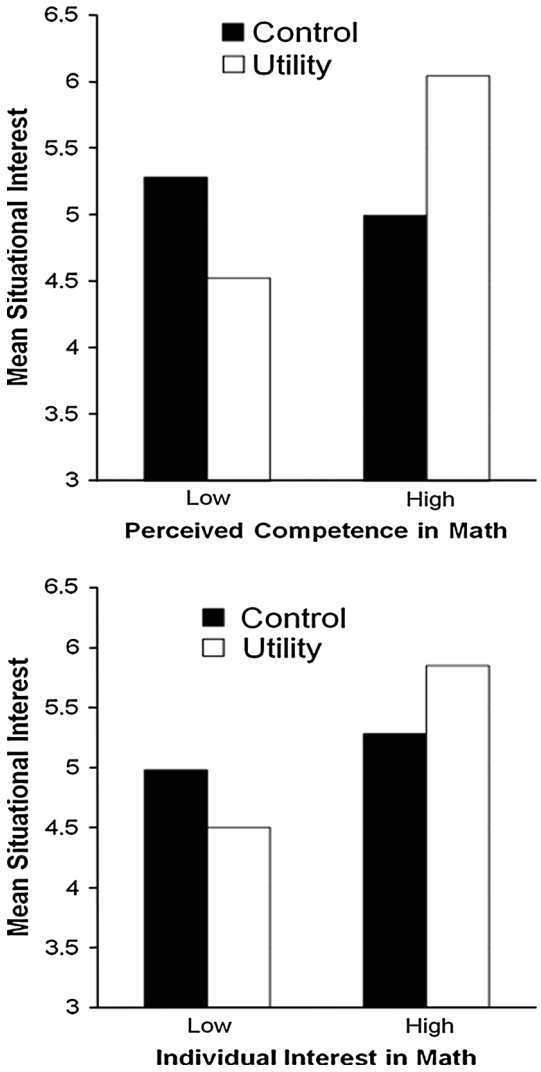

Fig. 1 The effects of utility and perceived competence in math on situational interest (*top panel*) and the effects of utility and individual interest in math on situational interest (*bottom panel*) from Study 1. Situational interest could range from 1 (low) to 7 (high)

the PCM × utility value interaction. The individual interest model also included five predictors, replacing initial PCM with initial individual interest. Finally, due to suppression effects when both PCM and individual interest were in the model, we tested the effects of each proposed moderator using residualized scores as the predictor, having removed variability related to the other moderator.

Perceived competence model

Situational interest A significant effect of PCM, $t(56) = 2.01$, $p < .05$, $\beta = .29$, was qualified by the PCM × utility value interaction, $t(56) = 3.46$, $p < .01$, $\beta = .43$ (see Fig. 1, top panel). Participants with higher PCM found the technique more interesting when they

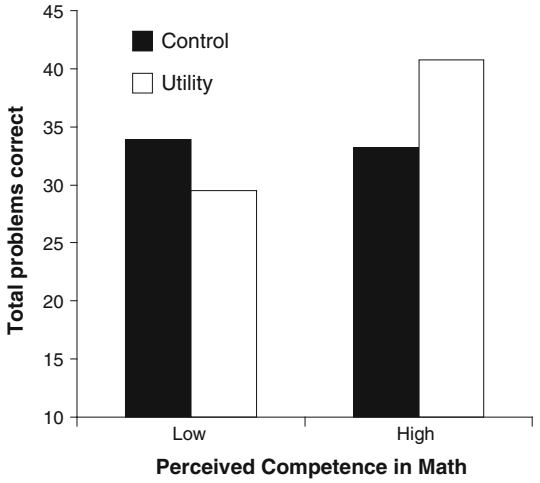

Fig. 2 The effects of utility and perceived competence in math on total problems correct (Study 1)

received the utility value manipulation than when they did not, $t(56) = 2.94$, $p < .01$, $\beta = .50$. The reverse was true for participants with low PCM, $t(56) = -2.10$, $p < .05$, $\beta = -.36$. A significant negative effect of baseline performance also emerged, $t(56) = -2.44$, $p < .05$, $\beta = -.34$, indicating that participants who had lower baseline performance found the technique more interesting. They may have perceived the technique as being an efficient alternative to the typical way of solving these types of problems.

Performance The only effect that emerged when predicting performance was a significant interaction between PCM and the utility value contrast, $t(56) = 2.18$, $p < .05$, $\beta = .26$. Participants with higher PCM solved more problems when assigned to the utility condition, $t(56) = 2.19$, $p < .05$, $\beta = .46$ (see Fig. 2). In contrast, utility information did not affect performance among those with lower PCM, $t(56) = -1.53$, $p = .13$, $\beta = -.33$.

Individual interest model

Situational interest Initial individual interest positively predicted situational interest, $t(56) = 3.04$, $p < .01$, $\beta = .39$, and there was a marginally significant interaction between individual interest and utility value, $t(56) = 1.85$, $p = .07$, $\beta = .25$ (see Fig. 1, bottom panel). Although the simple effects were not significant, the pattern was the same as that found in prior research (Durik and Harackiewicz 2007). The utility value manipulation had opposite effects for those with low compared with high initial individual interest in math, revealing a more positive effect for those with initially higher individual interest.

Performance Individual interest also emerged as a positive predictor of task performance, $t(56) = 2.06$, $p < .05$, $\beta = .25$, and there was a significant main effect of gender, $t(56) = 2.15$, $p < .05$, $\beta = .25$, favoring men. Consistent with prior work (Durik and Harackiewicz 2007), the utility value manipulation did not affect performance when individual interest was tested as the moderator of the utility effect.

Residualized models

Isolating the effect of PCM versus individual interest presents a challenge because the variables are correlated. Therefore, a final set of analyses tested each potential moderator with residualized scores, having statistically removed shared variability with the other potential moderator. Specifically, when PCM (having removed individual interest) was used to predict situational interest, the interaction was robust, $t(56) = 4.06$, $p < .05$, $\beta = .51$, but when individual interest (having removed PCM) was tested, the interaction was not significant, $t(56) = -0.18$, $p = .86$, $\beta = -.03$.

Discussion

Taken together, these results show that PCM moderated the effect of directly-communicated utility value on situational interest, and there is some suggestion that the moderating effect of PCM is stronger than that of individual interest. The utility value manipulation was successful in promoting both interest and performance among participants who had higher expectancies for success in math. These individuals found the new technique more interesting and solved more math problems correctly after learning about the utility value of the task. However, participants with lower expectancies for success in math actually showed less interest in the new technique after being told about its utility value.

These data also replicated the pattern found by Durik and Harackiewicz (2007), showing that initial individual interest moderated to some extent how participants responded to directly-communicated utility value information. However, initial individual interest revealed a weaker moderating effect and did not moderate the effect of the utility value manipulation on performance. Finally, the analyses of residualized variables suggest that the previously observed interaction effect of individual interest and directly-communicated utility value may have emerged because individual interest and perceived competence are related to each other.

The results from the analyses using PCM as the moderator are consistent with traditional expectancy–value models, suggesting that those who received utility information and who reported high success expectancies found the task most interesting. A similar effect emerged on performance, suggesting that the combination of high success expectancies and utility information led participants to work on the task in such a way as to promote performance.

In contrast, the presence of utility value information undermined interest among those with lower success expectancies in math. This suggests that the way individuals respond to direct utility communications may involve a process of internalization (Deci et al. 1994; Ryan and Connell 1989). These data suggest that higher perceptions of competence may facilitate the extent to which individuals internalize suggestions of utility from outside sources. Consistent with this, and with expectancy–value formulations, those with either low expectancies or low value were not as motivated to engage in the activity. However, it is also noteworthy that, not only was the utility value manipulation not helpful for promoting interest for those with low success expectancies, it actually decreased interest. This suggests a separate process, beyond that which would be predicted by expectancy–value models. In other words, the utility information was interpreted by these participants in a way that actually reduced their interest in the activity rather than simply not inspiring it. Drawing from research on intrinsic motivation, we believe that the utility communication may have been perceived as extrinsic and controlling, thereby undermining participants' sense of autonomy in the situation and subsequent interest (Deci and Ryan 1985). Specifically, the statements of utility may have implied a minimal standard of competence that participants were expected to have, and may have been experienced as external pressure to perform well. If so, individuals with lower perceived competence may have been particularly affected by the controlling aspects of the utility value communication. Consistent with this interpretation, the effect was unique to the experience of interest, and did not emerge on task performance.

Study 2

Study 1 showed that initial differences in success expectancies moderated the utility value manipulation, suggesting that expectancy–value models of achievement motivation may be relevant to situations in which utility value is directly-communicated to learners. However, a more definitive test of this idea would be to manipulate not only the presence of utility but also to manipulate expectancies for success. If success expectancies affect reactions to utility information, then an experimental manipulation that promotes feelings of competence should help individuals with low initial PCM find the task interesting and to perform well, when utility is present. We hypothesized that an early manipulation of high expectancy for success would allow individuals with initially low expectancies to

experience motivational gains from directly-communicated utility information.

To test this, half of the participants were given an expectancy boost prior to learning the technique, telling them that they had good potential to learn the technique. The manipulation was designed to provide participants with a sense of confidence as they began the instructional program. The expectancy boost was crafted to strengthen participants' beliefs that they would be able to channel resources and effort in ways that would lead to positive task outcomes (e.g., Bandura 1977, 1982; Dweck 1986; Dweck and Leggett 1988). It was designed to suggest high learning potential so that participants might be willing to put effort into the task and to try hard.

In addition, several process measures were included in Study 2 to help explicate the unfolding processes during task engagement that lead to situational interest (Harackiewicz and Sansone 1991). These variables include competence valuation, task involvement, and task perceived competence. Specifically, competence valuation is the extent to which individuals care about performing well on a task and is measured prior to task performance. Individuals who initiate a task while caring about doing well invest themselves more in the activity. After having experienced the task, participants can report their task involvement and perceived competence. Task involvement is the extent to which individuals become absorbed in the activity. Individuals who get more involved are more likely to find the situation interesting. Finally, we examined whether the expectancy manipulation affected perceived competence for the task after doing it.

Study 2 also tested two separate utility manipulations, focused on either short-term or long-term goals (Eccles 1984; Eccles et al. 1983). Proximal utility focuses individuals on how a task may be useful immediately (e.g., current class performance) whereas distal utility focuses individuals on how a task may be useful in the long term (e.g., career; Simons et al. 2004). The effects of these different types of utility vary depending on cultural differences that may relate to how individuals orient to tasks (Shechter et al. 2011). Whereas the manipulation used in Study 1 combined both types of utility, we separated proximal and distal utility in Study 2. We reasoned that individuals with low success expectancies may feel more discouraged about the possibility of proximal utility because they believe they currently lack the necessary skills.

Method

Participants

Participants were 148 college students (49 % were women) who received extra course credit for introductory psychology in exchange for participation. The sample was 93 % Caucasian, 2 % African American, 4 % Hispanic, and 1 % Asian.

Design and procedure

Participants were randomly assigned to a condition within a 3 (proximal utility, distal utility, versus control) × 2 (no boost versus expectancy boost) between-participants design. Initial PCM and individual interest were again tested as continuous factors. The primary dependent variables were situational interest and task performance. We also assessed competence valuation, task involvement, and perceived competence for the task as process variables in order to evaluate how the manipulation affected participants' experiences throughout the task.

Participants were led to believe that the expectancy boost manipulation in Study 2 was based on self-reported math background and interest. To increase the plausibility of the manipulation, participants first completed a form assessing their background and interest in math. When this form was completed, the experimenter explained that the form needed to be taken to a supervisor for scoring and then left the room. Participants completed the baseline performance measure while the experimenter was absent.

When the experimenter returned, participants received a form that conveyed the expectancy boost manipulation and several filler items (expectancy-boost conditions) or just the filler items (no-boost conditions). The paper had been prepared in advance to prevent the experimenter from knowing the condition. Participants who received the expectancy boost read, "Our research has shown that the ability to learn our mental math technique depends on your interest and previous background in math. Your score on the questionnaire was compared to University of Wisconsin norms for incoming freshmen and second year students, and suggest:" Following this message were three options. The first option was always checked, and read, "You have excellent potential for learning the mental math technique in today's session." The other two statements replaced the word "excellent" with either "good" or "fair."

Depending on the condition, the instructions for the technique contained no utility information, proximal utility information, or distal utility information. Participants in the proximal utility conditions were told about how the technique could be useful in the short term. Examples were provided that highlighted how mental math could be useful in college classes (e.g., calculating scores) and everyday activities (e.g., personal banking). In contrast, participants in the distal utility condition were told about how the technique could be useful in the long term, and examples were provided that highlighted how

mental math could be useful on graduate school admissions tests and in different careers.

The procedure was otherwise similar to Study 1 except that competence valuation was measured before the problem sets and task involvement and perceived competence were assessed after the problem sets.

Measures

Baseline performance and task performance were measured the same as in Study 1. PCM was measured using the same items as in Study 1, but was assessed prior to the session during a mass screening of a collection of self-report measures. Individual interest in math was measured with only two items, "I enjoy working on math problems" and "Math just doesn't appeal to me" (reversed) that were part of the math background questionnaire.

The measure of situational interest used in Study 2 was reformulated to reflect continued interest in the technique rather than their immediate reaction. We intended this measure to reflect a developing interest in the task that may extend beyond the situation so that it might be relevant to those who were exposed to either utility manipulation. Three items were combined that reflected interest beyond the experimental session ("I am interested in using this technique in the future," "I'd like to learn more about this technique," and "I would like to learn more mental math techniques").

Competence valuation was measured with a two-item scale combining items "It is important for me to do well on the upcoming problem sets" and "I don't care how well I do on the upcoming problem sets" (reversed). Participants responded to all items on a scale from 1 (*Strongly disagree*) to 7 (*Strongly agree*) unless otherwise noted.

After the problem sets, task involvement and perceived competence were measured. Beginning with the stem, "During the problem sets, I…" participants responded to four items measuring task involvement ("got really involved in solving the problems," "tried to make sure that I was solving the problems correctly," "got absorbed in solving the problems with the new technique," and "worked really hard on the problems") and three items measuring perceived competence for the task ("felt that I was using the technique correctly," "felt that I was doing poorly on these problems" (reversed, and "felt confident using the technique"). The task perceived competence and task involvement items were rated from 1 (*Not at all*) to 7 (*Very much*). See Table 2 for reliability estimates.

Results

Overview

Multiple regression was used to test the hypotheses. Two contrast codes were constructed to compare participants with either utility manipulation (+1) to those not given utility information (−2), and those exposed to distal utility (+1) versus proximal utility (−1), with the control condition coded as 0. Participants given the expectancy boost (+1) were compared with those given no boost (−1). We then created the 2-way and 3-way interactions between the contrast codes and the standardized measure of initial PCM and individual interest. See Table 2 for descriptive statistics and correlations.

Replication analyses

Before presenting the primary analyses, it is helpful to present briefly analyses comparable to those reported in Study 1 whereby the moderating effects of PCM versus individual interest in math were each tested in separate analyses, only in conditions without the expectancy boost.

Similar to Study 1, when PCM was used as the moderator in the analysis predicting situational interest, the significant effect of PCM, $t(65) = 1.97$, $p = .05$, $\beta = .24$, was qualified by the PCM × utility value interaction, $t(65) = 2.37$, $p < .05$, $\beta = .20$. Similarly, when individual interest in math was used as the moderator to predict situational interest, it too positively predicted situational interest, $t(65) = 2.37$, $p < .05$, $\beta = .28$, and moderated the effect of utility value, $t(65) = 2.55$, $p < .05$, $\beta = .21$.

When predicting task performance, both PCM, $t(65) = 4.98$, $p < .01$, $\beta = .54$, and individual interest, $t(56) = 2.75$, $p < .01$, $\beta = .32$, positively predicted performance, but neither moderated the utility effect on performance. Therefore, consistent with Study 1 and past research, both PCM and individual interest in math moderated the effect of the utility manipulation on situational interest. However, unlike in Study 1, PCM did not moderate the effect of utility value on task performance.

The residualized models were conducted for Study 2 as well, but were not conclusive. The analyses yielded no moderated effects of either variable with utility, when the variance due to the other variable had been removed. It is worth noting that the correlation between initial individual interest and PCM was stronger in Study 2, $r(146) = .77$, $p < .01$, than in Study 1. The greater overlap between the variables in Study 2 may explain why the models that involved both variables were not diagnostic.

Table 2 Zero-order correlations and descriptive statistics for major variables in Study 2

		1	2	3	4	5	6	7
1	Baseline performance							
2	PCM	.16						
3	Competence valuation	.17*	.33*					
4	Perceived competence	.05	.35*	.28*				
5	Task involvement	.13	.19*	.60*	.45*			
6	Situational interest	.09	.39*	.59*	.39*	.49*		
7	Task performance	.24*	.42*	.21*	.44*	23*	.26*	
	Mean	5.39	4.73	5.29	5.62	6.09	5.07	33.50
	SD	2.28	1.69	1.10	0.95	0.84	1.31	11.38
	Cronbach's alpha		.71	.69	.78	.86	.86	

N = 148. Items ranged from 1 (*low*) to 7 (*high*) except for baseline performance (from 0 to 9 problems), and Task Performance (from 1 to 62 problems)

PCM perceived competence in math

* $p < .05$

Primary analyses

The basic regression model consisted of 13 terms: gender, baseline performance, PCM, the expectancy boost contrast, both utility value contrast codes, and the interactions that were parallel to those used in Study 1. The first set of analyses predicted the focal outcomes, situational interest and performance. The second set predicted the process variables. A final set examined whether the process variables mediated the direct effects of the expectancy and utility value manipulations.

Situational interest A significant positive effect of PCM, $t(134) = 4.86$, $p < .01$, $\beta = .38$, was qualified by the predicted 3-way interaction between PCM, the expectancy manipulation, and the presence of utility information, $t(134) = -2.86, p < .01, \beta = -.16$ (see Fig. 3). Although the simple effects of utility when there was no expectancy boost were not significant, the pattern was the same as that in Study 1. Without an expectancy boost, those with low PCM reported somewhat lower situational interest in the utility than in the control conditions, whereas participants with high PCM reported slightly more interest in the utility than in the control conditions. However, when participants received an expectancy boost prior to learning the technique, the presence of utility value increased situational interest among those with low PCM, $t(134) = 3.24$, $p < .01$, $\beta = .33$, but did not affect situational interest among those with high PCM, $t(134) = 0.13$, $p = .90$, $\beta = .01$. The manipulation of proximal versus distal utility had no effect on this or any of the variables, so will not be discussed further. In this context, the mention of utility was the critical element, regardless of whether the utility was described as relevant to short-term or long-term goals.

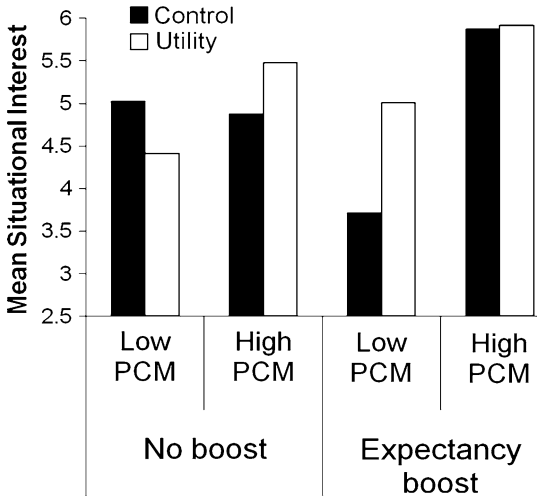

Fig. 3 The effects of utility, perceived competence in math (PCM), and the expectancy manipulation on situational interest (Study 2). Task interest could range from 1 (low) to 7 (high)

Performance Baseline performance positively predicted performance, $t(134) = 2.27$, $p < .05$, $\beta = .17$. PCM also predicted performance, $t(134) = 5.03$, $p < .01$, $\beta = .39$, but this was qualified by a two-way interaction with the expectancy boost manipulation, $t(134) = -1.94$, $p = .05$, $\beta = -.15$ (see Fig. 4). Among participants with low PCM, those who received the expectancy boost performed better than those who did not receive it, $t(134) = 2.67$, $p < .01$, $\beta = .28$, but among those with high PCM, the expectancy boost did not affect performance. This suggests that the feedback suggesting high expectancies for success were more helpful for individuals with initially low perceived competence. The predicted three-way interaction was not significant on task performance.

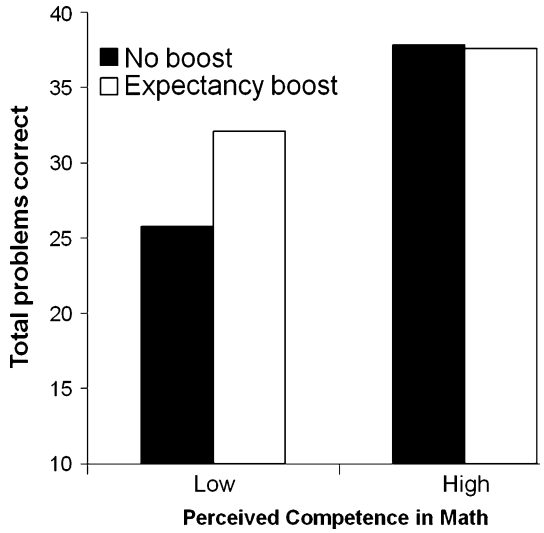

Fig. 4 The effect of perceived competence in math and the expectancy manipulation on task performance (Study 2)

Table 3 Predicted values (standard errors) for process measures showing 3-way interaction (Study 2)

	No expectancy boost		Expectancy boost	
	Control	Utility	Control	Utility
Competence valuation				
Low PCM	4.88 (0.33)	4.62 (0.21)	4.48 (0.28)	5.43 (0.19)
High PCM	5.09 (0.28)	5.76 (0.20)	5.75 (0.29)	5.86 (0.21)
Task involvement				
Low PCM	6.12 (0.27)	5.55 (0.17)	5.72 (0.22)	6.32 (0.16)
High PCM	5.86 (0.22)	6.12 (0.16)	6.32 (0.23)	6.52 (0.17)

Predicted values for low and high perceived competence in math (PCM) were calculated for 1 standard deviation below and above the mean, respectively

Process variables

Competence valuation When the basic model was used to predict competence valuation, there were effects of PCM, $t(134) = 4.46$, $p < .01$, $\beta = .35$, the expectancy manipulation, $t(134) = 2.08$, $p < .05$, $\beta = .16$, the presence of a utility value manipulation, $t(134) = 2.11$, $p < .05$, $\beta = .11$, as well as the three-way interaction, $t(134) = -2.43$, $p < .05$, $\beta = -.13$ (see Table 3 for predicted values). The three-way interaction showed that, among individuals with low PCM who received the expectancy boost, the presence of utility information increased competence valuation, $t(134) = 2.81$, $p < .01$, $\beta = .29$, but not for those who did not receive the expectancy boost. Among participants with high PCM, the utility value manipulation increased competence valuation if they did not receive the expectancy boost, $t(134) = 1.98.$, $p = .05$, $\beta = .20$, but not if they did receive the expectancy boost.

Task involvement The analysis predicting task involvement revealed a positive effect of the expectancy manipulation, $t(134) = .3{,}03$ $p < .01$, $\beta = .24$, a positive effect of PCM, $t(134) = 2.26$, $p < .05$, $\beta = .19$, and an interaction between the two, $t(134) = 1.97$, $p = .05$, $\beta = .11$. These effects were also qualified by a 3-way interaction with the utility value manipulation, $t(134) = -2.09$, $p < .05$, $\beta = -.12$ (see Table 3). Simple effects revealed that, for individuals with low PCM who received the expectancy boost, the utility value manipulation increased task involvement, $t(134) = 2.20$, $p < .05$, $\beta = .24$, but slightly decreased task involvement for those who did not receive the expectancy boost, $t(134) = -1.80$, $p = .07$, $\beta = -.22$. For individuals with high PCM, the utility value manipulation did not affect task involvement regardless of whether they had received the expectancy boost.

Perceived competence Next, we used the model to predict participants' perceived competence after using the technique. This analysis yielded two significant effects. A positive effect of the expectancy manipulation emerged, $t(134) = 2.70$, $p < .01$, $\beta = .21$, showing that participants who received the expectancy boost ($\hat{Y} = 5.82$) felt more competent using the technique than those who did not receive the boost ($\hat{Y} = 5.42$). The confidence manipulation had a lasting effect, even after participants used the technique on the problem sets. In addition, those who had higher initial PCM felt more competent after using the technique than those who had lower PCM, $t(134) = 4.15$, $p < .01$, $\beta = 33$. The three-way interaction did not emerge when predicting perceived competence.

Mediation analyses

Given the observed 3-way interaction effects on competence valuation and task involvement, we tested whether either or both of these variables mediated the direct effects on situational interest. First we added competence valuation to the model, and then added task involvement. The ordinal sequencing of these potential mediating variables was chosen based on the different times at which these variables were measured. Whereas competence valuation captured the extent to which individuals cared about doing well prior to task engagement, task involvement is a retrospective analysis of participants' experiences while completing the problem sets. For this reason, we tested competence valuation as an initial mediator, followed by task involvement. Although perceived competence could have been a potential mediator, the absence of the 3-way interaction on perceived competence eliminated this possibility.

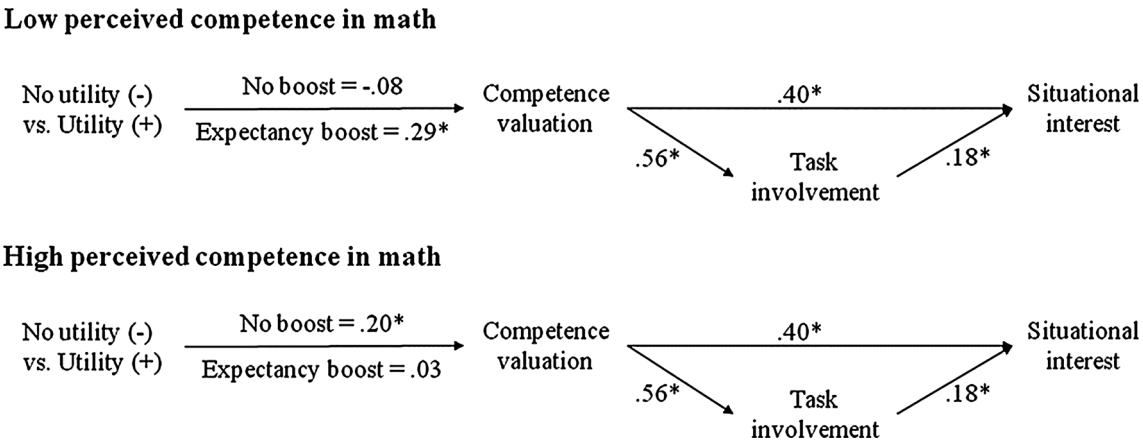

Fig. 5 Path model depicting mediated effects of the utility × PCM × expectancy boost interaction on task interest (Study 2). Values represent standardized regression coefficients. * $p < .05$

When competence valuation was added to the model, it accounted for unique variance in situational interest, $t(133) = 6.79$, $p < .01$, $\beta = .50$, and attenuated the 3-way interaction effect, $t(133) = -1.84$, $p = .07$, $\beta = -.12$. When task involvement was added to the model, it too accounted for unique variability in situational interest, $t(132) = 2.23$, $p < .05$, $\beta = .18$, and slightly reduced the already nonsignificant 3-way interaction effect, $t(132) = -1.69$, $p = .09$, $\beta = -.11$. Sobel tests revealed that competence valuation did account for significant variability in the relationship between the 3-way interaction and situational interest (Sobel = 2.29, $p < .05$), but task involvement did not, above and beyond competence valuation. Figure 5 depicts the mediation model.

An analysis was also performed in which task involvement was tested as the only mediating variable. This analysis revealed a modest mediating effect. When task involvement was added to the initial model, $t(133) = 5.186$, $p < .01$, $\beta = .39$, the 3-way interaction was reduced but still statistically significant, $t(133) = -2.16$, $p = .03$, $\beta = -.15$. A Sobel test revealed that the mediated effect was right at the criterion level of significance, Sobel = 1.94, $p = .05$.

Discussion

The results of Study 2 further support the role of expectancies for success as the critical moderator of directly-communicated utility value. The data provide an experimental test of this idea and show how the effects unfold across the session on processes measured both before and after task engagement.

The mediation model shows that the influence of the utility manipulation depended both on initial PCM and the expectancy boost. If individuals with lower PCM received the expectancy boost, then the presence of utility helped them care about doing well. This effect on competence valuation emerged prior to task performance, but carried through to task involvement and situational interest. What this tells us is that the boost in expectancies allowed individuals with low perceived competence to invest themselves in the activity before performing it. In other words, the process triggered by the expectancy boost and utility was initiated early, and was not contingent on participants' actual experience with the technique. This may suggest that the manipulations initiated a deliberate, top-down process, whereby participants' orientation to the task guided their task engagement. This is in contrast to a process that might materialize in the moment, as individuals work with the activity and corroborate for themselves the utility in the task. That said, the effects were sustained while performing the task, given that the effect also emerged on involvement and task interest.

It is somewhat surprising that perceived competence in the task did not mediate the 3-way interaction effect on situational interest; however, this may relate back to the interactive effects of expectancy and value in predicting motivation. Even though the expectancy boost directly affected perceived competence in the task, the utility manipulation did not. Perceived competence may be a necessary but not sufficient condition for the experience of situational interest. It may be the case that perceived competence needs to reach a threshold for individuals to care about the task and to become involved, but that once met, perceived competence does not add incrementally to situational interest. Additional research can further examine the extent to which perceived competence may help individuals internalize directly-communicated utility value information, so that tasks can become personally meaningful (Deci et al. 1994; Ryan and Connell 1989).

The effects on task performance did not mirror those on task interest, and the performance effect observed in Study

1 was not replicated in Study 2. In other words, although the manipulations affected how much individuals cared about doing well and the extent to which they became involved in the activity, these processes did not translate into performance. These inconsistencies are not easy to explain, but do highlight the difference between wanting to perform well and actually performing well, at least in this short time frame. Although the manipulations did not affect performance in the immediate situation, resultant task interest could produce more noticeable effects on performance if individuals were exposed to subsequent opportunities to engage in the task. If individuals who found the task more interesting were motivated to choose to do the activity over time, then they would likely further develop their skills.

The expectancy boost did increase performance for those with low PCM. This expectancy boost was designed to provide feedback indicating that participants had potential for skill development, consistent with the idea that this skill can grow as a consequence of effort and hard work (Dweck 1986). The rise in performance for participants with low perceived competence in the expectancy boost condition is consistent with prior research suggesting that praise for effort can encourage persistence and facilitate performance (Mueller and Dweck 1998). That said, the expectancy boost was also described as being based on comparisons with other students, which may have invoked social comparisons. Given that the social comparison was subtle, it is somewhat unlikely that the positive effect of the expectancy boost was a result of these individuals' setting normatively referenced goals (Hulleman et al. 2010), but it is worth considering in future research.

General discussion

The results from the present studies suggest that the direct communication of utility value information may be an effective tool to stimulate interest in tasks. However, those who do not have high expectancies for success are reluctant to embrace this information. It may be necessary to bolster expectancies for success before individuals can benefit from the communication of utility value. In Study 1, we found that PCM played a larger role than individual interest in moderating the effect of directly-communicated utility value, and that individuals with only high PCM experienced more interest and attained better performance when given utility value information. Study 2 showed that situational interest among those with lower PCM can be sustained if they are led to have higher expectancies for success for the upcoming task. This research extends what is currently known about directly-communicated utility value, and how individual differences moderate its effects.

The effects of directly-communicated utility value found in this research may seem discrepant from the effects of self-generated utility value found in prior research (Hulleman et al. 2010; Hulleman and Harackiewicz 2009). Specifically, a manipulation to encourage self-generated utility value was found to promote interest and performance for learners with low instead of high expectancies for success. The role of success expectancies in moderating the effects of directly-communicated utility value suggests that the manipulation may have prodded individuals to think beyond their current levels of ability. This may have been exciting for those with high success expectancies but daunting for those with low success expectancies. Those with low success expectancies were less receptive to, if not threatened by, directly-communicated utility value. In contrast, self-generated utility value may have been beneficial for those with low success expectancies for exactly the opposite reason: rather than challenging those with low success expectancies to think about expanding their skills, self-generated utility value may have encouraged them to think about their existing skills and consider how they could be useful. In other words, individuals may not readily generate examples of utility that extend beyond their current perceived expectancies for success, and they may be expert in calibrating examples to current competencies. An interesting prediction for further research follows from this possibility. If the prompts for self-generated utility focused on how future (rather than current) skills could be useful, self-generated utility may show the same effects as that of directly-communicated utility.

Implications for interest and expectancy–value theories

Interest in a subject evolves over time, and each of its developmental phases is characterized by varying amounts of stored knowledge and affective value (Hidi and Renninger 2006). Interest in early phases largely depends on external support in the form of attention-grabbing stimuli, engaging presentation of the subject content, and encouragement. Consistent with this, our findings demonstrate that those with low expectancies for success, who are likely still at early phases of interest development, did not benefit from the presence of utility value information unless it was preceded by an initial boost in success expectancies. These individuals had low expectations for success, so hearing that the new technique was relevant for their everyday life and future career detracted from task engagement and lowered task interest unless their confidence was bolstered by an expectancy boost at the outset of the task. On the other hand, individuals with higher expectancies for success did not require an expectancy boost in order to benefit from learning about the utility value of the new technique. Consistent with interest theory (Hidi and Renninger 2006;

Renninger 2000), individuals with high PCM already possessed a well-developed sense of competence in math, so new utility value information was motivating (Krapp 1999; Renninger and Hidi 2002). These results may suggest that expectancies for success do not directly translate into task value and interest, but may increase the extent to which individuals are open to considering the value of tasks in a way to cultivate interest. As suggested earlier, there may be a threshold for expectancies for success that, once reached, allows for the development of interest.

The present results also extend the expectancy–value model of achievement choices (Eccles 1984; Eccles et al. 1983), which posits that expectancies for success and perceived value of the learning activity are vital determinants of achievement behavior. However, the effects of these variables on achievement behavior were not additive as the revised model would suggest (Eccles and Wigfield 2002). Rather, the effectiveness of directly-communicated utility value information depended on initial expectancies for success, consistent with the original formulation of Eccles and colleagues' expectancy–value model and traditional expectancy–value theories.

Both methodological and theoretical reasons may provide insight into why the results of the current research deviated from the revised model and revealed the positive expectancy × value interaction effect. The reasons are related to the correlational nature of much of the previous research that has been used to test the expectancy–value model of achievement choices (Eccles 1984; Eccles et al. 1983). First, researchers have identified a methodological reason why the expectancy–value interaction effects have not emerged in most correlational studies, and show that alternative statistical techniques do lead to the detection of the interactive effects of expectancies and values that are consistent with initial formulations (Nagengast et al. 2011; Trautwein et al. 2012).

Second, there may be a theoretical reason why the positive interactive effects of expectancies and value are more likely to emerge with experimental than correlational data. This explanation rests on the assumption that intrapersonal processes may lead to the convergence of expectancies and values across time. Specifically, the beliefs that individuals hold about themselves tend toward coherence and consistency in order to make sense of their behaviors and sustain an ongoing sense of who they are (e.g., Aronson 1968; Festinger 1957). It is likely that beliefs related to the self in achievement domains play out in this way, such that internal processes may facilitate consistency between personally held beliefs about expectancies and values, which may bring expectancies and values in line (Marsh et al. 2005). In other words, individuals with high success expectancies in a given domain may also come to perceive the domain as valuable in order to feel good about themselves. For similar reasons, individuals with low success expectancies in a domain may come to devalue the domain. Along these lines, research in which expectancies for success and values are self-reported yield strong positive correlations among these variables (e.g., Eccles and Wigfield 1995). Consequently, processes related to the inner workings of the self-concept may reduce the extent to which individuals hold expectancies and values that are misaligned, making it difficult to observe the interactive effect in self-report data. In contrast, experimental manipulations of expectancies and values yield interactive effects, reaffirming the necessary contributions of each dimension. By doing so, the two predictors (expectancies and values) can be tested as independent contributors to achievement choices.

Implications

Although this research is limited in the sense that it tested these effects only among college students and within a single domain, they contribute to knowledge on utility value, and how it can be introduced into learning situations to reap the most benefits. As with other interventions designed to affect interest, the story is not simple, and this intervention tends to be effective only for some people or with the appropriate supports. Increasingly, research is uncovering a handful of tools that educators can use to promote student motivation (see review by Yeager and Walton 2011). Some of these interventions do show continuing effects across time, largely attributed to affecting processes that cyclically foster achievement and motivation. Moreover, several of these interventions involve personal values, similar to directly-communicated utility value. However, a notable feature of the interventions shown to have sustained effects is that they require individuals to actively consider academic domains in relation to themselves, their values, or their developing sense of self. Given that directly-communicated utility value information is provided from an outside source, some of these more personalized processes may not be at play, which may limit the effectiveness of this type of intervention and its longevity. This is an area for future research.

Educators, coaches, and employers are in a perfect position to provide information about how tasks are useful for achieving all kinds of goals. However, an important message from these studies is that it is not enough to emphasize the utility of tasks. According to our results, someone with high success expectancies will benefit from hearing utility value information, whereas someone with low expectancies may not readily benefit from this information. Solid expectancies for success may be necessary before individuals can appreciate utility value that is presented to them.

Acknowledgments The research reported here was supported by the Institute of Education Sciences, U.S. Department of Education, through Award # R305B090009. The opinions expressed are those of the authors and do not represent views of the U.S. Department of Education.

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Research Article

aps ASSOCIATION FOR PSYCHOLOGICAL SCIENCE

Psychological Science
23(8) 899–906

DOI: 10.1177/0956797611435530
http://pss.sagepub.com
SAGE

Helping Parents to Motivate Adolescents in Mathematics and Science: An Experimental Test of a Utility-Value Intervention

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Abstract

The pipeline toward careers in science, technology, engineering, and mathematics (STEM) begins to leak in high school, when some students choose not to take advanced mathematics and science courses. We conducted a field experiment testing whether a theory-based intervention that was designed to help parents convey the importance of mathematics and science courses to their high school–aged children would lead them to take more mathematics and science courses in high school. The three-part intervention consisted of two brochures mailed to parents and a Web site, all highlighting the usefulness of STEM courses. This relatively simple intervention led students whose parents were in the experimental group to take, on average, nearly one semester more of science and mathematics in the last 2 years of high school, compared with the control group. Parents are an untapped resource for increasing STEM motivation in adolescents, and the results demonstrate that motivational theory can be applied to this important pipeline problem.

Keywords

academic motivation, educational intervention, STEM motivation

Received 8/30/11; Revision accepted 12/15/11

The pipeline leading students toward careers in science, technology, engineering, and mathematics (STEM) begins leaking in high school, when some students choose not to take advanced mathematics and science courses. Only 12% of U.S. students take calculus, 56% take chemistry, and 29% take physics (National Science Board, 2004). High school course choices have significant implications for academic and career trajectories (Simpkins, Davis-Kean, & Eccles, 2006), and it is essential to mobilize all potential resources for motivating adolescents to take courses that will best prepare them for their future. Parents can play a critical role in promoting students' motivation to prepare for and aspire to STEM careers (STEM motivation), but they may lack the knowledge and support to do so (Hill & Tyson, 2009; Hyde, Else-Quest, Alibali, Knuth, & Romberg, 2006). The research presented here tested a theory-based, experimental intervention intended to influence parents' values and interactions with their adolescents and ultimately influence the adolescents' course choices.

One way that parents might motivate their children to pursue advanced STEM courses is to help them perceive value in those courses (Eccles-Parsons et al., 1983; Husman & Lens, 1999). According to Eccles's *expectancy-value theory* (Eccles, 2009), a person chooses to take on a challenging task—such as taking a physics course in high school or becoming an engineering major in college—if the person both (a) expects that he or she can succeed at the task (on the basis of self-beliefs) and (b) values the task. Both expectancy and task value are important in predicting course choice. In Eccles's model (Eccles, 2009), task value includes intrinsic value (the enjoyment experienced from a task) and utility value (how useful the task is). A person finds utility value in a task if he or she believes it is useful and relevant for other aspects of his or her life (e.g., "I will really need this for medical school," or "This material will be important when I take over the family farm"). Correlational research shows that when students perceive utility value in course topics, they develop interest and take more advanced courses in those academic disciplines (Durik, Vida, & Eccles, 2006; Harackiewicz, Barron, Tauer, & Elliot, 2002; Harackiewicz, Durik, Barron, Linnenbrink-Garcia, & Tauer, 2008; Hulleman, Durik, Schweigert, & Harackiewicz, 2008; Nagy, Trautwein, Baumert, Koller, & Garrett, 2006).

According to the expectancy-value model, parents hold beliefs and engage in behaviors that can shape their children's

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values and academic motivation. For example, if parents believe that mathematics and science are relevant to their child's future, they might encourage him or her to take more STEM courses during high school, and their conversations about STEM courses might also influence their child's perceptions of the utility value of those courses. Because utility value focuses on how an activity is useful for something else (Wigfield, 1994), it may be particularly amenable to external interventions. Indeed, recent experimental research indicates that it is possible to promote perceived utility value and interest with simple interventions that provide students with information about the utility value of a topic (Durik & Harackiewicz, 2007; Shechter, Durik, Miyamoto, & Harackiewicz, 2011) or that ask students to write about the relevance of course topics to their own life (Hulleman, Godes, Hendricks, & Harackiewicz, 2010; Hulleman & Harackiewicz, 2009). In essence, it may be easier for parents to demonstrate the utility value of academic pursuits than to help their children find these pursuits interesting. For example, even if parents cannot convince their child that mathematics is enjoyable (intrinsic value) or that he or she is good at mathematics (expectancy), they can discuss how useful mathematics is for careers in engineering or computer science and for gaining college admission.

Research comparing the multiple influences on children's mathematics achievement indicates that the predictor with the largest effect is mother's education, followed by home learning environment, quality of primary school, and family's socioeconomic status (Melhuish et al., 2008; Sirin, 2005). These findings emphasize the importance of parents in their children's mathematics performance, and other research has demonstrated the importance of parental involvement in predicting students' outcomes (Epstein, 1990; Grolnick & Slowiaczek, 1994; Jodl, Michael, Malanchuk, Eccles, & Sameroff, 2001).

To test whether we could influence adolescents' motivation to take science and math courses by providing information about utility value to parents, we developed an experimental intervention intended to influence parents' values and interactions with their children and ultimately to influence their children's course choices. We hypothesized that this intervention would persuade parents of the utility value of mathematics and science and help them to convey that value to their children in conversations, with the end result being that their children would take more mathematics and science courses in high school, compared with the children of parents who did not receive the intervention.

Method

Participants

The sample consisted of U.S. high school students and their parents from the longitudinal Wisconsin Study of Families and Work (WSFW; for details of recruitment, see Hyde, Klein, Essex, & Clark, 1995). In 1990 and 1991, women in the 5th month of pregnancy were recruited through physicians' offices and clinics in the Milwaukee (80% of sample) and Dane County (20%) areas of Wisconsin, and families were followed longitudinally through the adolescents' final year in high school. The average age of mothers at recruitment was 29 years (range = 20–43); 95% of the mothers were married to their child's father. On average, mothers had 15.42 years of education ($SD = 2.10$), and fathers also averaged 15.42 years of education ($SD = 2.41$). For the primary analyses reported here, we averaged these two variables ($r = .44$) to create a single measure, parents' education ($M = 15.42$ years, $SD = 1.92$). Household income averaged $51,066 per year (median = $50,000/year) at the beginning of the study (1990–1991). In 1991, $48,169 was the median income of two-income married couples in the United States (U.S. Department of Labor, 1993).

Participants in our randomized experiment were 188 adolescents (88 girls, 100 boys) and their parents. These students attended 108 different high schools. The majority (98%) graduated in 2010, and 94% planned to attend college or a technical school. At the first wave of data collection for the current study, adolescents had just finished ninth grade, and their average age was 15.5 years ($SD = 0.19$). Ninety percent of the adolescents were European American, 2% were African American, 1% were Native American, and 7% were biracial or multiracial. This distribution is representative of the Wisconsin population, which is 10% non-White (U.S. Census Bureau, 2006).

The intervention

We administered the intervention over a 15-month period when the students were in the 10th and 11th grades. First, in October of 10th grade, we mailed a glossy brochure titled "Making Connections: Helping Your Teen Find Value in School" to each household. The package, which was addressed to both parents, included a letter from the WSFW research project thanking them for their participation in the longitudinal study. Second, in January of 11th grade, we mailed a brochure titled "Making Connections: Helping Your Teen With the Choices Ahead" to each parent separately, along with a letter giving access to a dedicated password-protected Web site called "Choices Ahead." Third, in the spring of 11th grade, we asked parents in this group to complete an online questionnaire to evaluate the Choices Ahead Web site; this questionnaire helped bring many parents to the site. Parents in the control group did not receive any of these materials. During the summer following 12th grade, all families—including both adolescents and parents—completed questionnaires.

The first brochure provided information about the importance of mathematics and science in daily life and for various careers, as well as guidance for parents about how to talk to adolescents about potential connections between mathematics and science and the adolescents' lives. The second brochure emphasized the same themes with different examples, with a greater focus on the relevance of mathematics and science to

everyday activities (e.g., video games, driving, and cell-phone use), and preparation for college and careers. The second brochure also included additional guidance for how parents could communicate with their children and personalize the relevance of mathematics and science for them. The Web site included clickable links to extensive resources about STEM fields and careers, as well as to interesting science sites that illustrated the relevance of STEM topics to everyday life. The Web site also presented interviews with current college students who discussed the importance of the mathematics and science courses that they had taken in high school. Parents visiting the site were given the option of e-mailing specific links to their teens.

Measures

Transcripts. We obtained high school transcripts for 181 of the 188 students in our sample. We were unable to obtain transcripts for the other 7 students because the students refused consent (1 student), did not graduate on time and were still in high school (3 students), or were home schooled (3 students). The availability of transcript data did not vary as a function of experimental condition or gender. The 7 students with missing transcript data were not included in any analyses. Thus, the analyses reported here were conducted on a sample of 181 families (47 girls and 53 boys in the control group; 39 girls and 42 boys in the experimental group). Transcripts were coded by counting the number of semesters of mathematics and science taken during the last 2 years of high school.

Self-report measures from the 12th-grade survey. As part of the longitudinal project, students and parents completed surveys during the summer following 12th grade. Unless a participant requested paper copies, these surveys were completed online. We obtained surveys from 171 students (94%), 169 mothers (93%), and 126 fathers (70%) in our final sample. We used questions in the parent surveys to evaluate the extent to which parents had used the brochures and our Web site in interactions with their child. In the student survey, we asked how much respondents agreed with three items: "I have talked to my parents about the importance of mathematics and science more in 12th grade than in previous years" (scale from 1, *strongly disagree*, to 7, *strongly agree*), "I have had more conversations with my parents about course choices and educational plans in 12th grade than in previous years" (scale from 1, *strongly disagree*, to 7, *strongly agree*), and "During my senior year, I talked with my parents about my course choices" (scale from 1, *not at all*, to 7, *a lot*). We averaged responses to these three items into a Conversations With Parents scale (α = .71). To measure students' perceptions of the utility value of mathematics and science courses, we averaged responses to six items (e.g., "In general, how useful is what you learned in math classes?") to create a 12th-grade Students' Perceived Utility Value scale ranging from 1 (*not at all useful*) to 7 (*very useful*; α = .86).

Self-reports of specific classes taken. In order to measure the specific courses that students took, we listed mathematics and science courses that students might take in high school, and asked students to indicate which ones they had taken.[1] We created a measure of early, foundational courses (typically taken early in the high school years) by tallying the number of self-reported biology, earth science, algebra, and geometry courses taken. We created a measure of advanced courses that are more likely to be optional by tallying the number of self-reported intermediate courses from among the following: algebra II or advanced algebra, trigonometry, precalculus, calculus, statistics, chemistry, and physics. This measure provided information about the content of courses taken by students, in addition to the number of semesters of mathematics and science counted from the transcripts.

Self-report measures from earlier waves of the longitudinal study. We were able to use data from earlier waves of the longitudinal study (9th grade and 11th grade) to assess mothers' perceptions of the utility of mathematics and science for their child at two earlier time points. In 9th grade, prior to the intervention, we obtained surveys from 142 mothers (78% of the 181 families in the current sample). In 11th grade, after the intervention was implemented, we obtained surveys from 148 mothers (82%). When the students were in 9th grade, mothers were asked three questions (e.g., "In general, how useful will _____ be for your child?") for each of five subjects (algebra, geometry, biology, chemistry, and physics). They responded on scales ranging from 1 (*not at all useful*) to 7 (*very useful*). Responses to these items were used to create the 9th-grade Mothers' Perceived Utility Value scale (α = .96). When the students were in 11th grade, we asked mothers three different questions about the utility value of mathematics and science for their child (e.g., "Math and science are important for my teen's life") to create the 11th-grade Mothers' Perceived Utility Value scale (α = .84).

Results

Randomization check

To determine whether the experimental group and the control group differed prior to the experimental intervention, we examined three variables: mother's perceptions of utility at ninth grade, parents' education, and student's gender. We found no differences on any of the variables (all *p*s > .75), which suggests that the randomization was successful.

Manipulation check

To evaluate the extent to which parents used the brochures and Web site in interactions with their child, we coded parents' responses to open-ended questions in the 12th-grade survey. In addition, the Web site program tracked user log-ins and link sending. In 86% of the families, at least 1 parent reported

using the brochures or Web site in communications with his or her child. Also, in 82% of the families, at least 1 parent logged into the Web site at least once. To evaluate whether students were exposed to any of these resources (the only way this could happen is if parents shared them with their child), we asked the students if they had seen either brochure or the Web site. Seventy-five percent of students reported that they had been exposed to at least one of these resources. This finding indicates that the intervention was quite effective in influencing parental behavior.

Number of STEM courses taken

We used multiple regression analyses to test the effect of our intervention on the number of STEM courses taken, as reported on the students' transcripts. Predictors in this model were experimental condition, parents' education level (mother's and father's levels combined), student's gender, and all interactions among these variables. Our analysis revealed a significant effect of the intervention, $F(1, 180) = 4.70$, $p = .03$, $\beta = 0.16$; students in the experimental group took significantly more mathematics and science classes during their last 2 years of high school ($\hat{Y} = 8.31$ semesters) than did students in the control group ($\hat{Y} = 7.50$ semesters). This difference was equivalent to nearly an extra semester of mathematics or science. In addition, there was a significant effect of parents' education, $F(1, 180) = 9.35$, $p < .01$, $\beta = 0.23$; the children of more highly educated parents took more mathematics and science courses in high school.[2] Figure 1 shows the effect of parents' education and of condition (intervention, no intervention) on students' number of mathematics and science courses. No other effects were significant. So that our study could be compared with previous research that focused on mother's education as a predictor of academic motivation and achievement (Melhuish et al., 2008), we replaced parents' education with mother's education and found that the effect of mother's education was significant, $F(1, 180) = 4.77$, $p = .03$, $\beta = 0.17$, and comparable to the magnitude of the intervention effect, $F(1, 180) = 4.93$, $p = .03$, $\beta = 0.16$.

We also examined students' self-reports about the specific mathematics and science courses they took in high school, which allowed us to examine the intervention effect in more detail. For this and all subsequent analyses, we tested the same model that we had used for transcript-measured course taking, but used full-information maximum likelihood estimation methods (Arbuckle, 1996) because of missing data on questionnaire measures. Figure 2 shows the number of self-reported mathematics and science courses (early, foundational and elective, advanced) in the intervention and control conditions. The intervention and control groups did not differ in the number of early, foundational mathematics and science courses (algebra, geometry, biology, and earth science) that they had taken, $z = 1.10$, $p = .28$, $\beta = 0.08$. For most students, these classes would have been taken before the intervention was implemented with their parents. However, as predicted (see Fig. 2), there was a significant difference between the

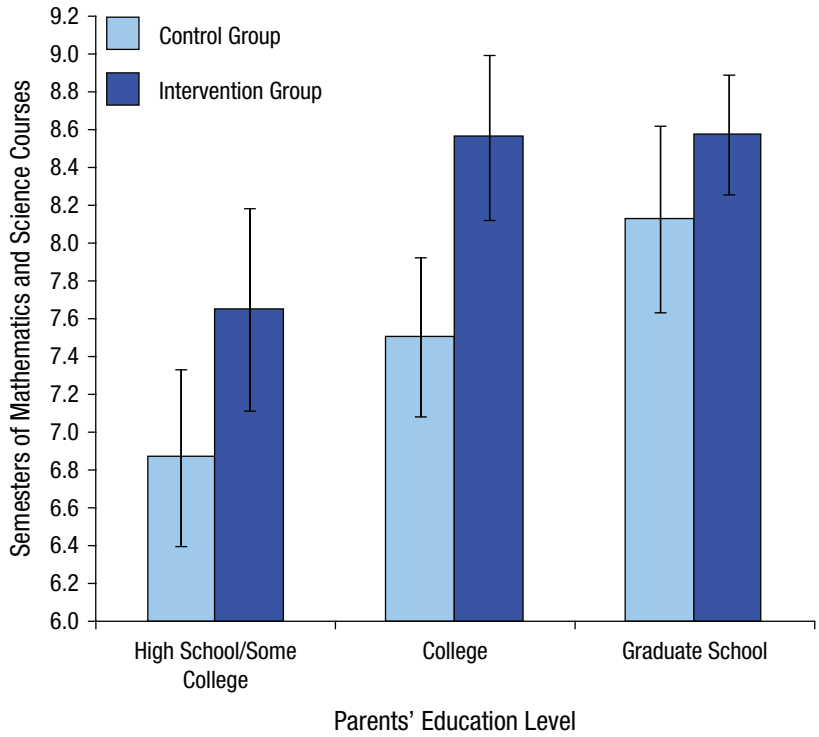

Fig. 1. Number of semesters of mathematics and science courses that students took in the last 2 years of high school (as reported on their transcripts) as a function of parents' education level and experimental condition. Error bars represent ±1 *SEM*.

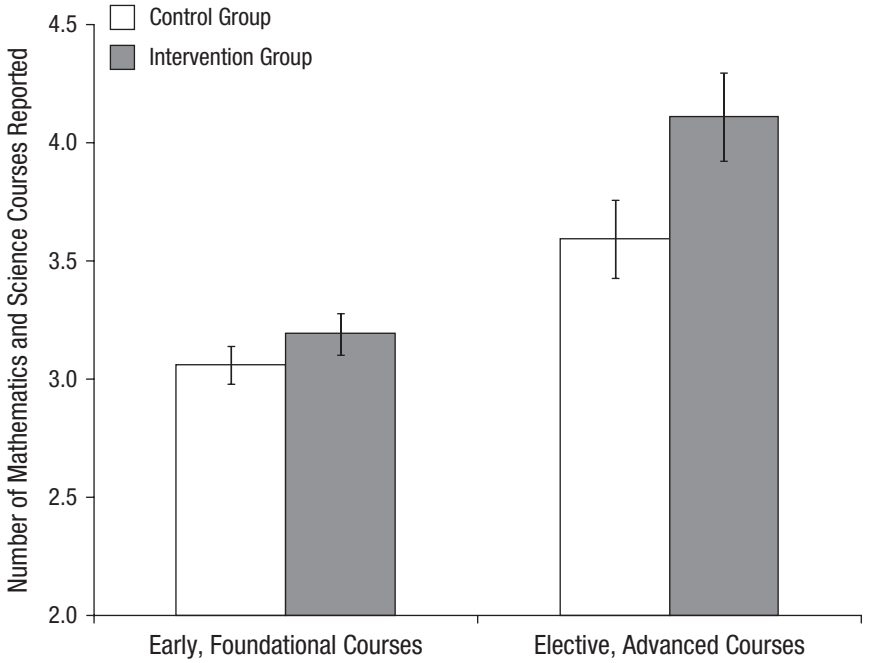

Fig. 2. Number of self-reported mathematics and science courses taken during high school as a function of type of course (early, foundational vs. elective, advanced) and experimental condition. Error bars represent ±1 *SEM*.

intervention and control groups in the number of more elective, advanced mathematics and science courses taken (algebra II or advanced algebra, trigonometry, precalculus, calculus, statistics, chemistry, and physics), $z = 2.12$, $p = .03$, $\beta = 0.15$.

Process analyses

We had hypothesized that the intervention would influence not only students' course taking but also parents' values at the end of 11th grade, and that it would lead to more conversations between parents and adolescents about the importance of mathematics and science courses. We were able to test this hypothesis only for mothers, because of an insufficient response rate from fathers. We found that the intervention had a significant effect on mother's perceived utility value, $z = 2.09$, $p = .04$, $\beta = 0.17$; mothers in the experimental group reported higher perceived utility value of mathematics and science for their child than did mothers in the control group. In addition, mother's education level had a significant effect on perceived utility value; more highly educated mothers perceived more utility value of STEM courses for their child, $z = 3.10$, $p < .01$, $\beta = 0.25$. Students' retrospective reports of conversations with their parents over the previous year, measured at the end of 12th grade, revealed a significant effect of the intervention, $z = 2.30$, $p = .02$, $\beta = 0.17$. Specifically, compared with students in the control group, students in the experimental group reported having had more conversations with their parents about course choices, educational plans, and the importance of mathematics and science.

Given that these processes occurred during the same time period as course taking, mediation analyses were inappropriate. Mothers' values were assessed halfway through the student's course taking, which extended over a 2-year period, and conversations were assessed in retrospect at the end of 12th grade, after all course taking was completed. Thus, the process variables were not measured in the optimal sequence for testing mediation of the intervention effect on course taking. Rather, mothers' values and conversations are most appropriately conceptualized as process measures that can help show the many ways in which the intervention influenced the parents' beliefs and behaviors and how these beliefs and behaviors in turn influenced the students' beliefs and course taking.

However, we could test mother's perceived utility value, measured after 11th grade, and student's reports of conversations as predictors of student's perceived utility value, which we measured after graduation. Therefore, we added these two predictors to the basic regression model tested earlier[3] and examined student's perceived utility value as the outcome variable. We found that the intervention had an indirect effect on student's perceived utility value through both mother's perceived utility value and conversations (Fig. 3). As reported earlier, the intervention promoted both mother's perceived utility value and student's reported number of conversations. In turn, these process variables were significant predictors of

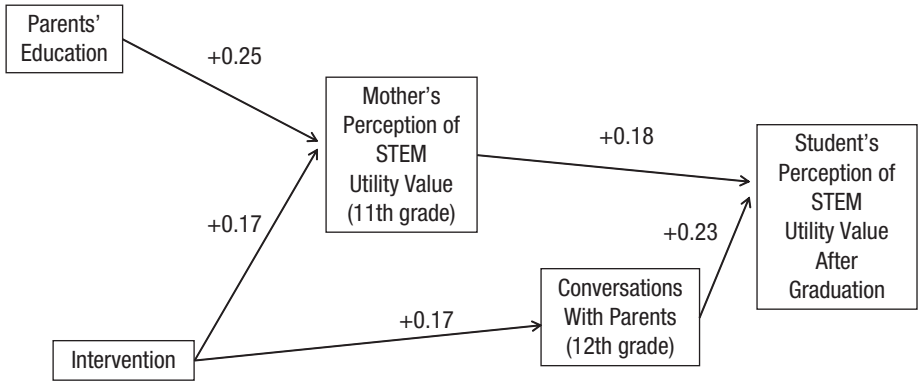

Fig. 3. Path model of the direct effects of the intervention on mother's perceived utility value of science, technology, engineering, and mathematics (STEM) topics (11th grade) and student's report of conversations with parents (12th grade), and the indirect effects of the intervention on student's perceived utility value of STEM topics after graduation from high school. These paths were generated from regression analyses in which all prior variables were controlled. In regression on mother's perceived utility value, we used mother's education instead of parents' education.

students' perceptions of the utility value of mathematics and science for their future. Students perceived more STEM utility if their mothers had higher levels of perceived utility, $z = 2.13$, $p = .03$, $\beta = 0.18$, and if they had more conversations with their parents, $z = 3.11$, $p < .01$, $\beta = 0.23$.

Discussion

The results of this study demonstrate that a simple, theory-based intervention designed to increase communication between parents and their adolescents about the utility value of mathematics and science courses promoted mothers' perception of the value of STEM courses, promoted parent-child conversations about the value of STEM courses, and increased the number of STEM courses adolescents took during the last 2 years of high school. These are the critical years in which mathematics and science courses are elective, and our results indicate that parents can become more influential in their children's academic choices if given the proper support. Moreover, these courses serve as gateways to college majors in STEM disciplines by preparing students in mathematics and science (Riegle-Crumb & King, 2010). Increasing the number of STEM courses that students take in high school is therefore critical for increasing the pool of college students who are eligible for and interested in STEM majors.

We found that parents' education was a strong predictor of their children's course taking, as have previous researchers (Jodl et al., 2001; Simpkins et al., 2006): The children of more highly educated parents took more mathematics and science courses in high school. However, the effect of our randomized intervention was almost as strong as the effect of parents' education, and this finding suggests that theoretically based motivational interventions can be powerful in promoting important academic choices. Our brochures and Web site provided parents with information about the utility of mathematics and science courses for their children's futures and emphasized the importance of helping adolescents make connections between mathematics and science and their lives. Compared with their counterparts in the control group, mothers in the experimental group perceived more utility value in STEM courses for their children, and parents seemed inspired to discuss the intervention materials with their children. The 12th-grade surveys suggest that parents found the materials useful for starting conversations (e.g., "Presenting the resources was a good way to open a discussion about the importance of school subjects and college"; "We spoke about the usefulness of the website in career choice, classes needed, and ability to find employment"). Also, students whose parents had received the intervention reported having more conversations with their parents about course choices and the importance of mathematics and science.

These findings suggest that our intervention worked to promote parents' involvement in their children's educational choices (Grolnick, Benjet, Kurowski, & Apostoleris, 1997). In turn, these conversations were related to higher levels of perceived STEM utility value among students at the end of high school. With such resources and some encouragement to share them with their children, parents may be able to foster their children's motivation to take mathematics and science classes or pursue STEM careers. In fact, having intimate knowledge of their children's specific interests and history, parents may be uniquely qualified to help them appreciate the relevance of mathematics and science to their lives.

Educational research has focused on what teachers can do to promote students' learning and motivation (Harackiewicz & Hulleman, 2010; Hidi & Harackiewicz, 2000; Pintrich, 2003; Yeager & Walton, 2011), and researchers have recently identified some effective interventions to promote students' motivation and performance in STEM classes (Blackwell, Trzesniewski, & Dweck, 2007; Cohen, Garcia, Apfel, & Master,

2006; Hulleman et al., 2010; Hulleman & Harackiewicz, 2009; Miyake et al., 2010; Walton & Cohen, 2011). However, a critical motivational problem occurs outside of class: convincing students to enroll in STEM courses in the first place. Many important educational decisions are made outside of school, and given that education occurs in a broader social context, it is important to consider the role that parents can play in their children's education (Epstein, 1990). The social-psychological intervention tested here was based on motivational principles that could be implemented with respect to academic choices and could prove to be a cost-effective method for enhancing parents' involvement, perceived utility value, and communication.

Unlike previous social-psychological interventions that have been delivered directly to their intended beneficiaries (students), our intervention is novel in that it adopts a family-level analysis and an indirect approach. We delivered our intervention to parents, hoping to inspire them to discuss the value of science and mathematics with their children and to become more involved in their children's education. Parents are an untapped resource for promoting STEM motivation, and the results of our study demonstrate that a modest intervention aimed at parents can produce significant changes in their children's academic choices.

Acknowledgments

We thank Carlie Allison, Corinne Boldt, Andrew Carpenter, Amanda Durik, Claire Johnson, Kerstin Krautbauer, Dan Lamanna, Maria Mens, Michael Noh, and Jenni Petersen for their help in conducting this research. We also thank the members of our advisory board—Jacque Eccles, Adam Gamoran, Jo Handelsman, Jenefer Husman, Dominic Johann-Berkel, Ann Renninger, and Judith Smetana—for their guidance. We are most grateful to the families of the Wisconsin Study of Families and Work project for their participation over the years.

Declaration of Conflicting Interests

The authors declared that they had no conflicts of interest with respect to their authorship or the publication of this article.

Funding

This research was supported by the National Science Foundation (Grant DRL 0814750) and by the Institute for Education Sciences, U.S. Department of Education (Grants R305C050055 and R305B090009).

Notes

1. We used self-reports to assess specific course taking because of the great variability in transcript reporting of courses (in terms of detail and course labels) across the 108 different high schools attended by students in this sample. Our self-report measure allowed us to assess specific course taking with a common metric across students.

2. Although the first part of the intervention was implemented prior to 11th grade, the second and third components were implemented midway through 11th grade. Therefore, we also analyzed the number of mathematics and science courses taken in the last three semesters of high school, and we found the same results for both parents' education and experimental condition.

3. The only exception was that when testing the regression model on mother's perceived utility value, we used mother's education level instead of the combined parents' measure, because this dependent measure was mother-specific.

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Urban Education
Volume 42 Number 1
January 2007 82-110

10.1177/0042085906293818
http://ue.sagepub.com
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The Relationship Between Parental Involvement and Urban Secondary School Student Academic Achievement

A Meta-Analysis

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A meta-analysis is undertaken, including 52 studies, to determine the influence of parental involvement on the educational outcomes of urban secondary school children. Statistical analyses are done to determine the overall impact of parental involvement as well as specific components of parental involvement. Four different measures of educational outcomes are used. These measures include an overall measure of all components of academic achievement combined, grades, standardized tests, and other measures that generally included teacher rating scales and indices of academic attitudes and behaviors. The possible differing effects of parental involvement by race and socioeconomic status are also examined. The results indicate that the influence of parental involvement overall is significant for secondary school children. Parental involvement as a whole affects all the academic variables under study by about .5 to .55 of a standard deviation unit. The positive effects of parental involvement hold for both White and minority children.

Keywords: *achievement; meta-analysis; education; parental involvement; family; urban*

For the past two decades, social scientists have sought to quantify the influence of parental involvement on the educational outcomes of secondary school children (Mau, 1997; Shanham & Walberg, 1985). Moreover, some educators have increasingly identified parental involvement as the primary vehicle by which to raise academic achievement from current levels (e.g., Hara, 1998). Many researchers have argued that in urban areas, in particular, parental involvement may be especially salient because of high family dissolution rates, numerous two-parent working families, and unique

sociological pressures on children (Bauch & Goldring, 1995; Hampton, Mumford, & Bond, 1998).

The question, therefore, emerges: Can parental involvement really improve the educational outcomes of urban children? More specifically, four issues are especially pertinent to parents and educators. First, to what degree is parental involvement associated with higher levels of school achievement among urban students? Second, do school programs of parental involvement positively influence urban students? Third, what aspects of parental involvement help those students the most? Fourth, does the relationship between parental involvement and academic achievement hold across racial groups? To answer these four key questions, it is important to know what the overall body of research indicates. A meta-analysis statistically combines all the relevant existing studies on a given subject to determine the aggregated results of said research. This study uses meta-analysis to examine the effects of parental involvement on urban secondary school children, addressing each of the four research questions listed.

The Importance of Parental Involvement and These Four Research Questions

Research indicates that American teachers and educational psychologists place great importance on parental involvement to elevate educational outcomes, particularly among students who face other disadvantages (Eccles & Harold, 1993; Jeynes, 2005a; McBride & Lin, 1996). However, no meta-analysis specifically examining the effects of parental involvement on the educational outcomes of urban secondary student populations has ever been published in an academic journal. This fact largely contributes to a dearth of knowledge about which aspects of parental involvement help urban student achievement and just what kind of parental involvement is most important (Christian, Morrison, & Bryant, 1998; Epstein, 2001; Henderson & Mapp, 2002). Both urban parents and teachers need specific guidance and information to maximize the efficacy of parental involvement.

For the purposes of this study, parental involvement was defined as parental participation in the educational processes and experiences of their children. This definition is based on the most prominent research and theorizing in this discipline, which is important when conducting a meta-analysis (Epstein, 2001; Henderson & Mapp, 2002). With these facts in mind, the first research question focuses on the degree of association between parental involvement and achievement outcomes among urban students.

Some researchers have noted little is known about the effects of parental involvement on the educational attainment of urban students specifically (Jeynes, 2005a; Shaver & Walls, 1998). Instead, most research tends to focus on the influence of involvement on the general population rather than on urban students. Further complicating the matter is the divergent results of two of the most comprehensive studies on the influence of parental involvement.

Mattingly, Prislin, McKenzie, Rodriguez, and Kayzar (2002) published a research overview or synthesis focusing only on parental involvement programs. The Mattingly study makes no statistical or meta-analytical attempt to combine the results of the individual studies. Nonetheless, Mattingly et al. concluded that parental involvement programs demonstrated virtually no influence on student educational outcomes. In contrast, Fan and Chen (2001) performed a meta-analysis examining the effects of parental involvement on the general student population and concluded that parental involvement positively influenced educational outcomes. Adding to the debate is the fact that neither study included calculations for urban students or identified and tested components of parental involvement.

This study's second research question addresses whether programs of parental involvement affect urban student achievement. Parental involvement programs are school-sponsored initiatives that are designed to require or encourage parental participation in their children's education. It is important to determine if these programs have an impact, because even though voluntary acts of parental involvement may positively affect educational outcomes, the same may or may not be true of programs, in which schools require or encourage involvement. Fan and Chen (2001) did not distinguish those studies examining parental involvement programs from other studies that examined parental involvement without the use of programs. This proves problematic in that even if parental involvement effectively raises achievement, this does not necessarily mean parental involvement programs work as well. They are, in essence, two distinct research questions.

For their part, Mattingly et al. (2002) focused only on parental involvement programs. In addition, they did not include a number of prominent studies in the research synthesis (e.g., Koskinen, Blum, Bisson, Phillips, & Creamer, 2000; Miedel & Reynolds, 1999; Shaver & Walls, 1998). Instead, about one half of the studies were unpublished. Given that unpublished research more likely suffers from statistically insignificant results, their omission of published studies could bias the results in favor of the authors' conclusion; namely, parental involvement programs may have no impact. Furthermore, Mattingly concludes that some of the studies indicating a statistically significant effect for parental involvement programs actually show no impact.

The third research question addresses specific aspects of parental involvement that help urban students the most. Ballantine (1999) identifies many components of parental involvement and asserts that it would be helpful if researchers identified the aspects most beneficial to children. Grolnick, Benjet, Kurowski, and Apostoleris (1997) further contend that once the academic community knows the constructs inherent in parental involvement, it can better predict the family and social attributes most ameliorative to producing parents who participate in the educational experience of their children. To fulfill this assertion, a meta-analysis needs to specify what aspects help the most (Hoover-Dempsey & Sandler, 1997).

The fourth research question addresses whether the relationship between parental involvement and educational outcomes holds across racial and gender groups. Certainly, if educators are to be able to espouse the practice parental educational support, it would be imperative for parental involvement to have an influence that holds for virtually all groups (Jeynes, 2005a; Muller, 1998).

The Need for a Meta-Analysis for Urban Students

Both the Mattingly and Fan and Chen studies contribute to initiating a broader debate about the influence of parental involvement. However, for the aforementioned reasons, a meta-analysis is needed to assess the effects of parental involvement on urban secondary school achievement, specific manifestations of parental involvement, and parental support programs specifically designed to help urban students. In addition to the four goals listed, this meta-analysis examines what are the effects of parental involvement across different kinds of academic measures, especially standardized versus nonstandardized measures.

Method

Analytical Approach

This meta-analysis examined the relationship between parental involvement and urban secondary student achievement. The first analysis consisted of computing effect sizes for the overall parental involvement variable and for programs of parental involvement (Research Questions 1 and 2). The second analysis assessed the association between specific types of parental involvement (e.g., checking homework and parental expectations) with student achievement (Research Question 3). The third analysis examined the relationship between parental involvement and student achievement by

race (Research Question 4). The procedures used to conduct the meta-analysis are outlined under this heading (Analytical Approach) and the following headings below: Data Collection Method, Study Quality Rating, Statistical Methods and Effect Size Statistics, and Defining of Variables.

Each study incorporated in this meta-analysis met the following criteria:

1. It needed to examine parental involvement in a way that could be conceptually and statistically distinguished from other primary variables under consideration. For example, if a school implemented a program that involved nine key variables, including parental involvement, and the impact of parental involvement could not be statistically isolated from the other features, the study was not included in the analysis.
2. It must include a sufficient amount of statistical information to ascertain effect sizes. That is, a study needed to possess enough information so that test statistics, such as those resulting from a *t* test, analysis of variance, and so forth, were either provided in the study or could be determined from the means and measures of variance provided in the study.
3. If the study included a control group, it had to qualify as a true control group and therefore be a fair and accurate means of comparison. Furthermore, if the research used a control group at some times but not others, only the former comparisons were included in the meta-analysis.
4. The study needed to be set in an urban environment and could be a published or unpublished study.

Given the nature of the criteria listed above, qualitative studies were not included in the study. Qualitative studies are definitely valuable, but they are difficult to code for quantitative purposes, and any attempt to do so might bias the results of the meta-analysis.

Data Collection Method (Coding and Rater Reliability)

To obtain the studies used in the meta-analysis, a search was performed using every major social science research database totaling 25 databases (e.g., Psych Info., ERIC, Dissertation Abstracts International, Wilson Periodicals, Sociological Abstracts, and so forth) to locate studies examining the relationship between parental involvement and the educational outcomes of students from grades 6 through 12. The search terms included parental involvement, parents, schools, family, partnership, education, expectations, parental support, programs, communication, expectations, reading, attendance, homework, household, rules, parental style, and several other terms. Reference sections from journal articles on parental involvement were also examined to

locate additional research articles. Although this search yielded more than 5,000 articles and papers on parental involvement, nearly all of these articles were not quantitative in nature. This process yielded a total of 67 studies that quantitatively assessed the relationship between parental involvement and urban secondary school student achievement. Of these, 52 had a sufficient degree of quantitative data to include in this meta-analysis.

Study Quality Rating

Two researchers coded the studies independently for quality, the presence of randomization, and whether both the definitional criteria for parental involvement and specific aspects of parental involvement were met. Study quality and the use of random samples were graded on a 0 (*lowest*) to 3 (*highest*) scale. Quality was determined using the following:

1. Did it use randomization of assignment?
2. Did it avoid mono-method bias?
3. Did it avoid mono-operation bias?
4. Did it avoid selection bias?
5. Did it use a specific definition of parental involvement?

We computed interrater reliability by calculating the percentage of agreement on the definition of parental involvement, issues of randomization, the specific components examined in each study, and quality of the study. Interrater reliability was 100% on whether a study examined parental involvement, 96% for the specific components of parental involvement examined in a given study, and 92% for the quality of the study. For the specific components of quality, interrater agreement percentages were 98% for randomization, 94% for avoiding mono-method bias, 94% for avoiding mono-operation bias, 92% for avoiding selection bias, and 96% for using a specific definition of parental involvement.

Two supplementary analyses were done to include first, only those studies with quality ratings of 2 and 3, and second, only those studies with quality ratings of 1 to 3.

Statistical Methods and the Effect Size Statistics

Among the 52 studies that had a sufficient degree of quantitative data to include in this meta-analysis, the total number of subjects was well above 300,000. To ensure accurate statistical results, a number of steps were taken to make the meta-analysis more sophisticated. First, the Hedges' *g* measure

of effect size was used (Hedges, 1981). Because it uses the pooled standard deviation in the denominator, it customarily provides a more conservative estimate of effect size. Hedges also provides a correction factor that helps to adjust for the impact of small samples. Effect sizes from data in such forms as *t* tests, *F* tests, *p* levels, frequencies, and *r* values were calculated via conversion formulas provided by Glass, McGaw, and Smith (1981). When results were not statistically significant, studies sometimes reported only a significance level. In the unusual case that the direction of these not significant results was not available, the effect size was calculated to be zero.

The analysis in this study determines the overall relationship between parental involvement and achievement obtained for each study, as well as specific types of parental involvement mentioned earlier in the Method section. Four different measures of academic achievement were used to assess the effects of parental involvement on educational outcomes. First, there was an overall measure of all components of academic achievement combined. The other measures included grades, standardized tests, and other measures that generally included teacher rating scales and indices of academic attitudes and behaviors. The results that emerged in this study reflect the association between parental involvement and achievement found for each component of parental involvement, using each of these educational outcomes.

Two sets of statistical procedures were also used to distinguish between those analyses that included sophisticated controls (socioeconomic status [SES], race, gender, or previous achievement) and those studies that did not. The effect sizes were determined using weights based on the inverse of the variance, to give greater weight to studies with larger sample sizes. The results of these procedures are listed in different columns in the Results section, with the degree of statistical significance and 95% confidence intervals listed for each. An overall effect size was then determined, combining the studies that did and did not use sophisticated controls. No analyses of statistical significance were completed on the combined effect sizes given the different structure of the studies involved.

Supplementary analyses also addressed what effect sizes arose when adjusting for the quality of the study. In one set of analyses, only studies with an average quality rating of 2 or 3 (on a 0 to 3 scale) were included. In the second set of analyses, only studies with an average quality rating of 1 to 3 (on a 0 to 3 scale) were included. Tests of homogeneity were completed on the specific components of parental involvement to gain a sense of the consistency of specific parental involvement measures across studies.

For all the analyses, when only one study was included using a specific academic outcome for a specific parental involvement variable, the regression coefficient for this study is listed with a notation indicating that the table cell only included one study, to serve as a means of comparison with the various other effect sizes.

Defining of Variables

For the purposes of this study, parental involvement was defined as parental participation in the educational processes and experiences of their children. The specific parental involvement variables, defined below, were the types of parental involvement identified by educators as most frequently practiced by parents, examined by researchers, and hypothesized by theorists as the most fundamental aspects of parental involvement (Deslandes, Royer, Turcott, & Bertrand, 1997; Epstein, 2001). The categorization of these specific parental involvement variables was based on the precise terms used in the original studies included in the meta-analysis. Fortunately, these researchers used widely accepted and recognized terms. Therefore, the proper categorization of effect sizes was nearly always self-evident (e.g., those studies included in the meta-analysis for "parental expectations" typically used precisely the same term).

General parental involvement includes the overall measure of parental involvement, as defined by the researchers of a particular study. If a study did not possess an overall measure of parental involvement, the effect size of this variable was determined by combining all its discrete measures.

Specific parental involvement includes a specific measure of parental involvement, as distinguished from other measures of parental involvement used in the study.

Parental expectations is the degree to which a student's parents maintained high expectations of the student's ability to achieve at high levels.

Attendance and participation is whether and how frequently parents attend and participate in school functions and activities.

Communication is the extent to which parents and their children communicated about school activities and reported a high level of communication overall.

Homework is the extent to which parents checked their children's homework before the child handed it in to his or her teacher.

Parental style is the extent to which a parent demonstrated a supportive and helpful parenting approach. In the studies included in the meta-analysis, this most frequently referred to a simultaneous ability to be loving and supportive and yet maintain an adequate level of discipline in the household. It also included styles in which the parent demonstrated such qualities as trust and approachability.

Results

Homogeneity Tests

Homogeneity tests were performed to assess the extent to which the specific aspects of parental involvement across the various studies included were comparable. Generally speaking, for the same educational outcome measure, the results usually indicated that the tests for homogeneity were not statistically significant. These results indicate that within each specific component of parental involvement, the various measures of parental involvement were relatively homogeneous across studies.

Among the specific parental variables that did not test statistically significant for heterogeneity were parental expectations ($X^2 = 4.33$, n.s.), specific parental involvement ($X^2 = 4.44$, n.s.), and parental style ($X^2 = 8.66$, n.s.). In addition, parental programs were also homogeneous as indicated by this test ($X^2 = 1.81$, n.s.). Nevertheless, some of the other specific variables tested as heterogeneous (e.g., parental participation and attendance [$X^2 = 13.80$, $p < .001$] and household rules [$X^2 = 5.59$, $p < .05$]).

The results of the meta-analysis indicate that parental involvement is associated with higher student achievement outcomes. This trend holds not only for parental involvement overall but also for most different components of parental involvement that were examined in the meta-analysis. Moreover, parental involvement is also associated with higher achievement for racial minority students as well.

The results of this study indicate that the general parental involvement variable yielded statistically significant outcomes of .5 to .55 of a standard deviation unit. Table 1 lists the effects that emerged for the individual studies examined in this meta-analysis. The effects varied from .01 to .83. Generally speaking, the effects that were the largest and smallest in size were from studies that had small sample sizes. This fact contributed to a "funnel pattern" in the effects that is desirable when one is doing a meta-analysis.

Effect Sizes for Overall Parental Involvement

In Table 2 are listed the effect sizes for parental involvement in general, using the four academic achievement variables. For all the achievement variables combined, the effect sizes were somewhat higher for studies that did not use sophisticated controls than those that did. For the studies that did not use sophisticated controls, the overall effect size was .53 ($p < .0001$) of a standard deviation versus .38 ($p < .05$) for those studies that did use

Table 1
List of Studies Used in the Meta-Analysis for Parental Involvement, the Year of the Study, and the Effect Sizes for the Various Studies

Study	Year	*N*	Effect Size Without Sophisticated Controls	Effect Size With Sophisticated Controls
Wise	1972	38	+.83	—
Ma	1999	3,116	+.82	—
Singh et al.	1995	27,834	—	+.81
T. Z. Keith, Keith, Quirk, Cohen-Rosenthal, & Franzese	1996	16,378	+.80	—
Simich-Dudgeon	1993	89	+.76	—
Mau	1997	13,837	+.74	—
Unger, McLeod, Brown, & Tressell	2000	115	+.70	+.65
Grolnick & Slowiaczek	1994	301	+.67	—
T. Z. Keith, Keith, Troutman et al.	1993	21,814	+.67	—
Paulson	1994b	247	+.67	—
Zdzinski	1992	113	+.67	—
P. B. Keith & Lichtman	1994	1,714	+.65	—
Steinberg, Elmen, & Mounts	1989	120	+.63	+.41
Russell & Elder	1997	377	—	+.63
T. Z. Keith, Reimers, Fehrmann, Pottebaum, & Aubey	1986	2,051	+.63	—
Eagle	1989	11,227	—	+.62
Paulson	1994a	80	+.62	—
T. Z. Keith, Keith, Bickley, & Singh	1992	21,835	—	+.61
Brown & Madhere	1996	1,394	—	+.60
Jeynes	2000	20,706	+.60	+.27
Shanham & Walberg	1985	26,279	+.56	—
Steinberg, Lamborn, Dornbusch, & Darling	1992	6,400	—	+.56
Melby & Conger	1996	347	+.51	+.35
Jeynes	2002	20,706	+.50	+.29
Yan	1999	6,459	+.49	+.34
R. D. Taylor	1996	135	—	+.49
Hoge, Smit, & Crist	1997	300	+.47	—
O'Reilly	1992	131	+.45	—
Deslandes, Royer, & Turcotte	1997	525	—	+.43
Aeby, Thyer, & Carpenter-Aeby	1999	215	+.42	—
Fehrmann, Keith, & Reimers	1987	28,051	+.42	+.33
Stevenson & Baker	1987	179	+.38	—
L. C. Taylor, Hinton, & Wilson	1995	566	+.37	—

(continued)

Table 1 (continued)

Study	Year	*N*	Effect Size Without Sophisticated Controls	Effect Size With Sophisticated Controls
Bermudez & Padron	1990	162	+.37	—
Uguroglu & Walberg	1986	970	+.37	+.17
Sui-Chu & Willms	1996	24,599	—	+.35
Williams	1999	467	+.30	—
Hampton, Mumford, & Bond	1998	676	+.29	—
Yap & Enoki	1995	328	+.28	—
Peng & Wright	1994	25,000	—	+.27
Heiss	1996	2,296	—	+.26
Desimone	1996	20,000	+.28	+.04
Sanders	1996	826	+.26	—
P. B. Keith & Lichtman	1992	1,714	+.25	—
Epstein, Herick, & Coates	1996	244	+.25	—
T. Z. Keith, Keith, Sperduto, Santillo, & Killings	1998	15,703	—	+.23
Cardenas-Rivera	1994	217	+.22	—
Fletcher	1994	216	+.22	—
Brownell	1995	996	+.20	—
McNeal	1999	14,103	+.18	
Cooper, Lindsay, & Nye	2000	709	+.04	—
Veneziano	1996	281	+.01	—

sophisticated controls. For those studies that did not use sophisticated controls, the regression coefficients were quite consistent across the academic measures, varying from .55 ($p < .0001$) for standardized test scores to .34 ($p < .001$) for other measures. For those studies with sophisticated controls, the regression coefficients ranged from .53 ($p < .0001$) for other measures to .27 ($p < .05$) for grades. Further analysis, not listed here, indicated that there were no differences in the influence of parental involvement among the different participants included in the standardized tests.

Study Quality

In the secondary set of analyses that adjusted for the average quality rating of the study, the effect sizes were about the same as when no quality adjustments were made. When only those studies rated 2 and 3 (on a 0 to 3 scale)

Table 2
Effect Sizes for General Parental Involvement and Programs of Parental Involvement

Parental Involvement and Academic Variables	Effect Size Without Sophisticated Controls	95% Confidence Interval	Effect Size With Sophisticated Controls	95% Confidence Interval	Overall Effect Size
General parental involvement					
Overall	.53****	.26, .80	.38*	.07, .69	.46[a]
Grades	.49***	.18, .86	.27*	.05, .49	.40[a]
Standardized tests	.55****	.27, .83	.37*	.07, .67	.47[a]
Other	.34**	.09, .51	.53****	.33, .73	.43[a]
Programs of parental involvement					
Overall	.36*	.03, .69	N/A	N/A	.36
Grades	.25***	.11, .39	N/A	N/A	.25
Standardized tests	.36		N/A	N/A	.36
Other	.25***	.10, .40	N/A	N/A	.25

a. Confidence intervals tabulation not undertaken for combined effect size because of difference in sample distributions for the two sets of studies.
*$p < .05$. **$p < .01$. ***$p < .001$. ****$p < .0001$.

were included, the effect sizes were .40 ($p < .01$) for those studies that did use sophisticated controls and .55 ($p < .0001$) for those that did not. When studies rated 1 to 3 were included, the respective effect sizes were nearly the same at .40 ($p < .01$) and .54 ($p < .0001$). As noted in Table 3, the correlation between the study's quality and its effect size was .02. As a result, across all the parental variables examined in this study, no statistically significant differences in effect sizes emerged from adjusting for study quality.

Effect Sizes for Parental Involvement Programs

Among the parental involvement programs, the effect sizes were smaller than those that emerged for parental involvement overall. All the programs included in this meta-analysis did not include controls for SES. The overall effect size was statistically significant at .36 ($p < .05$) of a standard deviation. Of the three specific measures of academic achievement, the effect sizes for grades and other measures were statistically significant, but the result for standardized tests was not.

Table 3
Correlations Between Measures Assessing the Quality of Study, Whether a Random Sample Was Used, Year of Study, and Sample Size for the 52 Studies Included in the Meta-Analysis

	Correlation with Year of the Study	Correlation with Effect Size of the Study	Correlation with Quality of the Study	Correlation with Quality of Study's Definition of Parental Involvement	Correlation with Whether a Random sample was Used
Year of study	—	.02	.17	.19	.22*
Effect size from study	.02	—	.02	.03	.08
Quality of study	.17	.02	—	.57***	.55***
Quality of study's definition of parental involvement	.19	.03	.57***	—	.25*
Random sample	.22*	.08	.55***	.25*	—

*$p < .05$. **$p < .01$. ***$p < .001$. ****$p < .0001$.

Table 4
Effect Sizes for Specific Aspects of Parental Involvement

Parental Involvement and Academic Variables	Effect Size Without Sophisticated Controls	95% Confidence Interval	Effect Size With Sophisticated Controls	95% Confidence Interval	Overall Effect Size
Expectations					
Overall	.88****	.72, 1.04	N/A	N/A	.88
Standardized tests	N/A	N/A	N/A	N/A	N/A
Grades	.85****	.80, .90	N/A	N/A	.85
Other	1.09****	.84, 1.34	N/A	N/A	1.09
Parental style					
Overall	.40*	05, .75	N/A	N/A	.40
Grades	.45****	22, .68	N/A	N/A	.45
Standardized tests	.39*	04, .74	N/A	N/A	.39
Other	.65[b]		N/A	N/A	.65[b]
Communication					
Overall	.32*	.01, .63	.15		.24[a]
Grades	.29*	.03, .55	.04[b]		.29[a]
Standardized tests	.30**	.07, .53	.14		.23[a]
Other	.24		.22[b]		.24[a]
Homework					
Overall	.38*	02, .74	.13	.14, .20	.32[a]
Grades	.39*	.03, .75	–.10[b]		.35[a]
Standardized tests	.24		.14		.20[a]

a. Confidence intervals tabulation not undertaken for combined effect size because of difference in sample distributions for the two sets of studies.
b. Based on one study.
*$p < .05$. **$p < .01$. ****$p < .0001$.

Effect Sizes for Specific Components of Parental Involvement

Parental Expectations

Table 4 lists the results for the various specific components of parental involvement. The largest effect sizes emerged for parental expectations. For overall academic achievement, the effect size for parental expectations was .88 ($p < .0001$) of a standard deviation. The results were similar for standardized tests and other measures. The results for parental expectations were quite consistent among the various studies examined. Therefore, the confidence intervals were generally narrow, especially for standardized tests.

Parental Style

For parental style, the effect sizes were quite consistent across the different academic measures. In the case of overall achievement, the effect size was .40 ($p < .05$) of a standard deviation. The grades and standardized test variables yielded results of .45 ($p < .0001$) and .39 ($p < .05$), respectively.

Communication

The results for family communication about school were stronger when no sophisticated controls were used than when they were. For all the educational measures combined, the beta was .32 ($p < .05$). The effect sizes for standardized tests and grades were also statistically significant, but they were not statistically significant for other measures. When sophisticated controls were used, the effect sizes for overall achievement and standardized were in the positive direction but were not statistically significant.

Checking Homework

The impact of parents checking homework was somewhat similar to that of family communication regarding school. When no sophisticated controls were used, the effect size for overall academic achievement was .38 ($p < .05$) of a standard deviation. In terms of the specific measures of academic achievement, the impact of grades was statistically significant but the beta for standardized tests was not. When sophisticated controls were used, the regression coefficients for overall achievement and standardized tests were in the positive direction, but they were not statistically significant.

Other Parental Involvement Variables

Table 5 lists the effect sizes for specific variables for parental involvement, parents attending and participating in school events, and having household rules regarding schoolwork. Overall, the effect sizes for overall achievement for the specific parental involvement variable were .40 of a standard deviation variable, .29 when no sophisticated controls were used, and .61 when these controls were used. Contrary to the general patterns evident for the other specific variables, the effect sizes for specific aspects of parental involvement were larger when sophisticated controls were used. The effect size for other measures when sophisticated controls were in place were .33 ($p < .05$) for grades, .59 ($p < .0001$) for standardized tests, and .99 for other measures.

The pattern that emerged for parental participation and attendance is that, for studies not using sophisticated controls, statistically significant

Table 5
Effect Sizes for Additional Specific Aspects of Parental Involvement

Parental Involvement and Academic Variables	Effect Size Without Sophisticated Controls	95% Confidence Interval	Effect Size With Sophisticated Controls	95% Confidence Interval	Overall Effect Size
Specific parental involvement					
Overall	.29**	.09, .49	.61**	.21, 1.01	.39[a]
Grades	.32**	.11, .53	.33*	.07, .59	.32[a]
Standardized tests	.28*	.04, .52	.59****	.41, .77	.34[a]
Other	.25*	.04, .46	.99***	.37, 1.61	.94[a]
Rules					
Overall	–.00	.02, .74	.02	.14, .20	.02[a]
Grades	.07	.03, .75	.07[b]		.07[a]
Standardized tests	.00		.02		.02[a]
Other	.12*	.02, .22	.13[b]		.12[a]
Attendance and participation					
Overall	.14		.03		.11[a]
Grades	.21**	.06, .36	.07[b]		.18[a]
Standardized tests	.09		.05		.07[a]
Other	.50**	.13, .87	.21[b]		.38[a]

a. Confidence intervals tabulation not undertaken for combined effect size because of difference in sample distributions for the two sets of studies.
b. Based on one study.
*$p < .05$. **$p < .01$. ***$p < .001$. ****$p < .0001$.

results emerged for grades, .21 ($p < .01$) and other measures, .50 ($p < .01$), but not for overall achievement and standardized tests. When sophisticated controls were used, no statistically significant results emerged.

Of all the parental involvement variables examined, the regression coefficients for rules yielded the smallest effect sizes. Overall, the effect size for overall achievement was .00 (n.s.) when no sophisticated controls were used. Of the individual academic variables examined, only the beta for other measures was statistically significant, .12 ($p < .05$). It was in the positive direction. When sophisticated controls were used, the effect sizes for overall achievement and standardized tests were not statistically significant. For grades and other measures, only one study was done that included sophisticated controls. Although no meta-analysis could therefore be done for these specific variables, the regression coefficients were roughly the

Table 6
Effect Sizes for General Parental Involvement for Studies With Mostly Minority and All Minority Students, With 95% Confidence Intervals in Parentheses

Parental Involvement and Academic Variables	Effect Size Without Sophisticated Controls	95% Confidence Interval	Effect Size With Sophisticated Controls	95% Confidence Interval	Overall Effect Size
General parental involvement					
Mostly minority					
Overall	.53*	.02, 1.04	.36****	.24, .48	.53[a]
Grades	N/A	N/A	.32[b]		N/A
Standardized tests	1.08[b]		.36****	.24, .48	.43[a]
Other	.52*	.01, 1.04	N/A	N/A	.52[a]
All minority					
Overall	.46***	.17, .75	.33**	.10, .56	.42[a]
Grades	.42****	.33, .51	.26****	.18, .34	.33[a]
Standardized tests	.49***	.10, .88	.27****	.21, .33	.26[a]
Other	.49[b]		.48****	.26, .76	.40[a]

a. Confidence intervals tabulation not undertaken for combined effect size because of difference in sample distributions for the two sets of studies.
b. Based on one study.
*$p < .05$. **$p < .01$. ***$p < .001$. ****$p < .0001$.

same for these individual studies as for the meta-analysis undertaken for the set of studies with no sophisticated controls.

Effect Sizes for Parental Involvement by Child's Race

The effect sizes for parental involvement for minority children (see Table 6) showed consistent statistically significant positive results. For those studies that examined students that were 100% minority, the effect sizes were .46 ($p < .001$) for overall achievement, .42 ($p < .0001$) for grades, and .49 ($p < .0001$) for standardized tests, when sophisticated controls were not used. The effect sizes were generally lower when sophisticated controls were used versus when they were not. The effect size for overall achievement was .33 ($p < .01$). For the specific educational variables, the regression coefficients varied from .26 ($p < .0001$) for grades to .48 ($p < .0001$) for other measures.

For those studies that examined samples of mostly minority students (on average, about 85% minority students), the effect sizes were very close to those found for student samples made up of 100% minority students. The effect size for overall academic achievement was .53 ($p < .05$) when sophisticated controls were not used and .36 ($p < .0001$) when these controls were used.

Discussion

The results of this study indicate that parental involvement has a positive impact on children's academic achievement. This overall result holds for all measures of academic achievement that were examined. This pattern holds not only for the overall student population but for minority students as well.

Research Question 1: Overall Parental Involvement

For the overall population of students, the effect sizes were in the general range of about one half of a standard deviation for overall educational outcomes, grades, and academic achievement when no sophisticated controls were used. The results for studies examining 100% minority students and mostly minority students were also close to about half a standard deviation unit. For overall achievement, the effect size was .46 for studies that examined all minority children and .53 for those studies that included mostly minority children. These results highlight the consistency of the impact of parental involvement.

The results on the influence of overall parental involvement should cheer those who desire to know whether parental involvement holds across populations and cultures. Although the United States is a diverse country, the impact of parental involvement apparently holds across different types of populations of children. Even when sophisticated controls were used, the overall impact of parental involvement was .38 for the overall population of students and nearly that high for racial minority children.

It should be noted that the effect size of slightly more than half a standard deviation were smaller than the .70 to .75 obtained in a meta-analysis of urban elementary school children (Jeynes, 2005b). There are a number of possible reasons for the fact that parental involvement is a better predictor of achievement at the elementary school level than it is at the secondary school level. First, children are generally more influenced by parental values in the lower grades than in their later years of schooling (Eisenberg & Wolchik,

1992; Stevenson & Baker, 1987). Second, research suggests that parents are generally more involved in their children's lives when the children are young than when they are older (Dubas & Gerris, 2002; Stevenson & Baker, 1987). Third, by the time children go to middle school and high school, they are more convinced of their academic and physical strengths and weaknesses (Hagger, Biddle, & Wang, 2005; House, 1995). Therefore, various aspects of parental involvement although perhaps appreciated by teachers and students, may have less of an impact on student achievement (Eisenberg & Wolchik, 1992; Stevenson & Baker, 1987).

Research Question 2: The Influence of Parental Involvement Programs

Another interesting finding of this study is that parental involvement programs also had a positive impact on student achievement. When sophisticated controls were not used, the effect was .36, and when they were used, the effect was a somewhat smaller, .29. As one would expect, these numbers are smaller than those that reflected general parental involvement. It only makes sense that when one measures a parental involvement that is already practiced and is generally voluntary, the numbers will be larger than when a school initiates a program that compels parents to be involved.

The results for parental involvement programs are quite encouraging for those people who wonder whether parental involvement can work, if it is not initiated voluntarily. Nevertheless, the findings of this study suggest that voluntary parental involvement likely works better than parental support programs. Nevertheless, overall parental involvement programs appear to be effective.

Research Question 3: Specific Components of Parental Involvement

One of the most vital aspects of this study was its examination of specific components of parental involvement to see which aspects influenced student achievement. One of the patterns that emerged from the findings is that subtle aspects of parental involvement such as parental style and expectations had a greater impact on student educational outcomes than some of the more demonstrative aspects of parental involvement such as having household rules and parental attendance and participation at school functions.

The effect sizes for parental style were generally around .40 of a standard deviation. The effect sizes for parental expectations were above .80. These regressions coefficients were the largest of all the specific components of parental involvement that were examined. The beta for other measures, under the parental expectations variable, was 1.09. Not only were the results for parental expectations quite large in standard deviation units but they also had 95% confidence intervals that were pretty narrow. This fact yielded effect sizes that were statistically significant at the .0001 level of probability.

The effect sizes for family communication about school were smaller than for either parental style or expectations. Nevertheless, when sophisticated controls were not used, the effect sizes were generally around three tenths of a standard deviation unit. However, when sophisticated controls were used, although the regression coefficients were in the positive direction, they were no longer statistically significant.

Among some of the more ostensible facets of parental involvement, the effect sizes were generally smaller than those found for the more subtle aspects of parental involvement. The effect sizes for the influence of household rules on overall academic achievement were not statistically significant either for studies that used sophisticated controls or those that did not. The effect size for other measures was statistically significant. Nevertheless, for the remaining measures, the size was not statistically significant. Parental participation and attendance had a mixed impact on academic achievement. Parental participation and attendance had no statistically significant impact on overall academic achievement, whether or not sophisticated controls were used. However, parental participation did have an impact on grades and other measures. Some possible explanations for this phenomenon include the following: (a) parental attendance is more likely to help students assimilate material covered in school than it is to help students excel in understanding the broad range of knowledge that is usually covered in standardized tests and (b) parental participation enhances the relationship between parents and teachers, which positively affects grades.

In fact, other measures and grades were somewhat more likely in the various elements of the meta-analysis to produce statistically significant results than standardized test scores. This result likely emerged for many of the same reasons that parental participation influenced other measures and grades more than it did standardized test scores. That is, first, parents generally focus their involvement on school outcomes more than the results of standardized tests. Second, parental involvement generally improves the relationship between parents and teachers, which likely affects school outcomes positively.

Although it is true that the influence of parental involvement largely transcended socioeconomic factors, the inclusion of the SES and other variables somewhat reduced the effects for parental involvement versus those that emerged when no sophisticated controls were used. The fact that the inclusion of these addition variables, especially SES, did have a little impact is not a surprise, given that past research indicates that there is a high correlation between SES and parental involvement. Highly educated parents are often more likely to acknowledge the importance of parental support in education (Legutko, 1998; Mulroy, Goldman, & Wales, 1998; Portes & MacLeod, 1996). Parents with a high SES level are also likely to appreciate the importance of a good education in terms of living a successful adult life (Grayson, 1999; Mulroy et al., 1998; Portes & MacLeod, 1996). Ascertaining the causal relationship between parental involvement and SES is a challenging one.

Clearly, some of the same attributes that help make a parent supportive are also likely to produce high SES parents. For example, a parent who believes diligence in school is important is more likely than most to be highly educated and is also more likely than most to support his or her children in scholastic endeavors. Moreover, a person with a supportive personality is more likely to excel as a boss and is also more likely to excel as an involved parent. One can make the argument that the addition of the SES variables dilutes the effects for parental involvement not because the causal nature of SES so much, as the fact that there are other causal components beyond SES and parental involvement that influence both variables. In terms of SES specifically, a growing number of studies indicate that the level of SES can be a result of various other factors rather than a primary cause (Gortmaker, Steven, Must, Perrin, & Sobol, 1993; Jeynes, 1998; Zakrisson & Ekehammer, 1998). Crane (1996) demonstrated that the influence of SES as a causal variable can be overestimated if mediating family factors are not taken into account. More research is needed to effectively understand the relationship between parental family structure and SES.

Research Question 4: Parental Involvement by Race and Gender

One of the most encouraging patterns that emerged from this meta-analysis is the broad association between parental involvement and school achievement. The correlation generally held across race. The fact that the relationship between parental support and educational outcomes held

across race is particularly important for both educators and parents in an increasingly diverse country.

The results of this study are especially noteworthy, because these findings suggest that parental involvement may be one means of reducing the achievement gap that exists between White students and some racial minority groups (Bronstein, Stoll, Clauson, Abrams, & Briones, 1994; Hampton et al., 1998). Numerous educators and sociologists have advocated this position, and the results of this study support their theories (Bronstein et al., 1994; Hampton et al., 1998; Offenberg, Rodriguez-Acosta, & Epstein, 1979). It is also true that many of the parental involvement programs included in this study focused on minority students. As a result, this meta-analysis not only suggests that parental involvement overall may reduce the achievement gap but that programs of this nature may help as well. The fact that this study suggests that parental involvement may reduce the achievement gap between White and some racial minority groups has important implications. These results confirm the results of other studies that suggest that family and other domestic factors can contribute to reducing this gap (Jeynes, 1999, 2003).

This study's broad range of statistically significant effect sizes for parental involvement supports prior claims about the relationship between parental support and educational outcomes when applied to race (Mau, 1997; Sanders, 1998; Shaver & Walls, 1998; Villas-Boas, 1998) and background (Griffith, 1996; Hampton et al., 1998). Nevertheless, fostering parental involvement is not easy. Some teachers view parental involvement as intruding on their professional opinions (Lindle, 1990; Peressini, 1998). Moreover, some family situations more easily lend themselves to greater parental involvement than others. For example, research indicates strong relationships between parental involvement, SES, and whether a child is from an intact family (Jeynes, 2002a, 2002b; McLanahan & Sandefur, 1994). Nevertheless, results of this meta-analysis indicate the success of parental involvement programs and the worth inherent in efforts to increase parental participation in their children's education

Taken together, the results of this study are very enlightening. First, these findings supporting the notion that parental involvement has salient effects that hold across various populations are fairly substantial. Second, not only does voluntary parental involvement have an effect but parental programs do as well. Third, this meta-analysis suggests that among the most important aspects of parental involvement are some of the more subtle facets of this practice. Among these more subtle aspects of parental involvement are parental style and parental expectations. Fourth, although the influence of parental involvement generally holds across academic variables, it appeared

to produce statistically significant effects slightly more often for grades and other measures than for standardized tests.

The findings of this study give an overall sense of the extent of the influence of parental involvement, based the present body of research. This study also gives teachers and parents guidance about which aspects of parental involvement are most helpful. Further research can examine whether using the most influential aspects of parental involvement, as uncovered by this study, will yield more effective parental involvement and parental support programs.

Limitations of Study

The primary limitation of this meta-analysis or any meta-analysis is that it is restricted to analyzing the existing body of literature. Therefore, even if the researcher conducting the quantitative integrations sees ways the studies included could have been improved, there is no way to implement those changes. A second limitation of a meta-analysis is that the social scientist is limited to addressing the same research questions addressed in the aggregated studies. For example, it would be advisable to have parental expectations measures from all the studies included, but one can only aggregate the existing results.

Recommendations for Further Research

The results of this study are particularly important, given the achievement gap between urban students and their counterparts in nonurban areas (Bronstein et al., 1994; Hampton et al., 1998). Indeed, this study's findings suggest parental involvement may effectively contribute to reducing that gap. Nevertheless, further research is needed to examine why certain aspects of parental involvement, particularly those that involve creating an educationally oriented atmosphere, are more noteworthy than others. Additional research can also help determine why parental involvement strongly influences the achievement of minority children in particular. Future research should also incorporate sophisticated statistical techniques, such as randomization and the use of hierarchical linear modeling.

Two lines of research could prove especially fruitful. Given that this meta-analysis provides evidence that parental involvement programs help struggling urban students, social scientists should undertake more studies to determine which programs work best and why. Qualitative research can also supplement the findings of this study by ascertaining the ways that teachers, parents, and students perceive that parental involvement benefits students the most.

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Asterisks indicate studies included in the meta-analysis.

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Journal of Educational Psychology
2015, Vol. 107, No. 1, 195–206

0022-0663/15/$12.00 http://dx.doi.org/10.1037/a0036981

Gender Differences in the Effects of a Utility-Value Intervention to Help Parents Motivate Adolescents in Mathematics and Science

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A foundation in science, technology, engineering, and mathematics (STEM) education is critical for students' college and career advancement, but many U.S. students fail to take advanced mathematics and science classes in high school. Research has neglected the potential role of parents in enhancing students' motivation for pursuing STEM courses. Previous research has shown that parents' values and expectancies may be associated with student motivation, but little research has assessed the influence of parents on adolescents through randomized experiments. Harackiewicz, Rozek, Hulleman, and Hyde (2012) documented an increase in adolescents' STEM course-taking for students whose parents were assigned to a utility-value intervention in comparison to a control group. In this study, we examined whether that intervention was equally effective for boys and girls and examined factors that moderate and mediate the effect of the intervention on adolescent outcomes. The intervention was most effective in increasing STEM course-taking for high-achieving daughters and low-achieving sons, whereas the intervention did not help low-achieving daughters (prior achievement measured in terms of grade point average in 9th-grade STEM courses). Mediation analyses showed that changes in STEM utility value for mothers and adolescents mediated the effect of the intervention on 12th-grade STEM course-taking. These results are consistent with a model in which parents' utility value plays a causal role in affecting adolescents' achievement behavior in the STEM domain. The findings also indicate that utility-value interventions with parents can be effective for low-achieving boys and for high-achieving girls but suggest modifications in their use with low-achieving girls.

Keywords: academic motivation, educational intervention, STEM motivation, gender differences

In the United States, national education policies have focused on improving the performance of U.S. students relative to their international peers, particularly in areas related to science, technology, engineering, and mathematics (STEM; National Science Foundation [NSF], 2012). Of particular concern are students' decisions not to take advanced science and mathematics courses in high school. For example, only 35% of high school graduates have taken precalculus and only 39% have taken physics (NSF, 2012). Moreover, although gender gaps have closed for course-taking in some STEM areas, they persist in others. For example, although girls and boys take calculus at the same rate, boys are more likely to take physics than girls are (42% vs. 36%) and are more likely to take engineering in high school (6% vs. 1%; NSF, 2012). Recently, a number of interventions have been implemented to increase STEM motivation and to close gender gaps (e.g., Harackiewicz et al., 2014; Hulleman & Harackiewicz, 2009; Miyake et al., 2010; Walton & Cohen, 2011). Here, we report on the moderators and mediators of an intervention shown to help parents motivate their adolescents to take mathematics and science courses in high school (Harackiewicz, Rozek, Hulleman, & Hyde, 2012). We probed

This article was published Online First June 2, 2014.

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This research was supported by the National Science Foundation (Grant DRL 0814750) and by the Institute for Education Sciences, U.S. Department of Education, through Award No. R305B090009 and Grant 144-NL14 to the University of Wisconsin—Madison. The opinions expressed are those of the authors and do not represent views of the National Science Foundation or the U.S. Department of Education. We thank Carlie Allison, Corinne Boldt, Andrew Carpenter, Claire Johnson, Kerstin Krautbauer, Dan Lamanna, Anita Lee, Maria Mens, Michael Noh, Jenni Petersen, Margaret Wolfgram, and Justin Wu for their help conducting this research, and we thank the members of our advisory board (Jacque Eccles, Adam Gamoran, Jo Handelsman, Jenefer Husman, Dominic Johann-Berkel, Ann Renninger, and Judith Smetana) for their guidance. We are most grateful to the families of the Wisconsin Study of Families and Work project for their participation over the years.

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whether the intervention was equally effective for boys and girls depending on their prior performance in mathematics and science courses and what factors mediated the effect of the intervention on students' STEM course-taking.

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Numerous theoretical models have been proposed to help explain student motivation and persistence in academics. One comprehensive model is Eccles's expectancy-value theory (Eccles-Parsons et al., 1983), which frames the research reported here. The expectancy-value model holds that expectations for success (expectancy) and perceived task value are direct predictors of achievement and achievement choices (e.g., Eccles-Parsons et al., 1983; Simpkins, Davis-Kean, & Eccles, 2006; Updegraff, Eccles, Barber, & O'Brien, 1996). In Eccles's model, expectancy for success is defined as how well an individual thinks he or she will do on an ensuing task (Eccles-Parsons et al., 1983). Task value consists of attainment value (how a task is related to one's identity), intrinsic value (enjoyment of the task), utility value (perceived usefulness of a task), and cost (costs to the individual of task engagement, such as what one concedes by choosing one task over others).

The expectancy-value model proposes that adolescents' perceived task values and expectations for success are the most proximal predictors of STEM-related achievement choices. Previous research supports this hypothesis, with students being more likely to choose to take mathematics and science courses when they have either high expectations for success or value for those courses or both (e.g., Eccles, Barber, Updegraff, & O'Brien, 1998; Simpkins et al., 2006; Updegraff et al., 1996; Watt, 2005; Watt, Eccles, & Durik, 2006). In addition, both expectancies and values predict classroom performance (e.g., Hulleman, Durik, Schweigert, & Harackiewicz, 2008; Watt, 2005).

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The expectancy-value model proposes that, more distally, key socializers, such as parents, play an important role in shaping adolescents' values. Previous research has found that parents' values and expectancies for success for their child are linked to adolescents' values in a variety of domains, including mathematics and science (Jodl, Michael, Malanchuk, Eccles, & Sameroff, 2001; Simpkins, Fredericks, & Eccles, 2012). Much of this research has concentrated on adolescents and their achievement motivation in STEM courses throughout middle school and high school (Riegle-Crumb & King, 2010; Watt et al., 2012). Parents' values for mathematics and science are associated with adolescents' values in mathematics and science, which, subsequently, are associated with adolescents' educational choices and outcomes (Jodl et al., 2001; Simpkins et al., 2012).

Parents' expectancies for their adolescents have also been associated with their adolescents' expectancies for success in mathematics and science and educational outcomes, and these associations are even stronger than the associations between parents' values and adolescents' outcomes (Bleeker & Jacobs, 2004; Frome & Eccles, 1998; Jacobs & Eccles, 1992; Yee & Eccles, 1988). For instance, if parents have high expectancies for their adolescents in STEM, they are more likely to have adolescents with high expectancies and better educational outcomes in STEM courses. If parents have low expectancies, they are more likely to have adolescents with low expectancies and worse educational outcomes in STEM (Jacobs & Eccles, 1992). However, studies involving the associations between parents' and adolescents' expectations and values are typically correlational in nature and thus are unable to test for a causal effect of parents' values and expectations on adolescents' values and expectations.

Whereas multiple studies have focused on the role of parental support—such as involvement and support for autonomy—in relation to children's school outcomes (Grolnick & Ryan, 1989; Grolnick, Ryan, & Deci, 1991; Ratelle, Larose, Guay, & Senécal, 2005; Spera, 2005), here we focus on parents' values for their child's education. Such values may be a key resource that educators can leverage to enhance student outcomes, such as STEM course-taking (Harackiewicz et al., 2012). From a process perspective, it is important to understand how parents' values are transmitted to children. Some researchers have examined the specific parental behaviors that contribute to value transmission from parents to adolescents, such as encouragement, provision of educational and other materials, and coactivity (e.g., Simpkins et al., 2012). However, parental behaviors are not the only means of value transmission. Because students' perceptions are featured heavily in the expectancy-value model, it is important to examine whether adolescents are even aware of their parents' values. If adolescents are unaware of their parents' utility-value beliefs, parents' values may have smaller effects on their adolescents' attitudes and behaviors. Such perceptions could serve as an important indicator that parental values are being communicated (Paulson & Sputa, 1996; Spera, 2006; Wood, Kurtz-Costes, & Copping, 2011).

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Two aspects of Eccles's model have been hypothesized to show gender differences that, in turn, may explain differences in STEM achievement: gender differences in expectancies and gender differences in values (e.g., Eccles, Wigfield, Harold, & Blumenfeld, 1993; Updegraff et al., 1996). Compared with boys, girls have lower expectancies for success in STEM domains (Yee & Eccles, 1988). This difference predicts increased enrollment in these courses for boys (Watt et al., 2012). Gender differences in expectancies for success can be influenced by socializers, especially parents. Research indicates that parents can have exaggerated expectancies for success in mathematics and science for their sons and diminished expectancies for success for their daughters (Eccles et al., 1993; Yee & Eccles, 1988).

The amount of value that boys and girls place on mathematics and science as well as the number of valued domains may influence gender differences in STEM achievement choices as well. The results are mixed on whether boys and girls differ in how much they value STEM domains, with many studies showing no gender differences in levels of STEM value (Eccles, 2009). However, there are gender differences in the number of valued domains, suggesting that women place high value on more domains (including non-STEM domains) than men do, which can lead to even high levels of STEM value being relatively less important for women (Eccles, 2007; Eccles, Barber, & Jozefowicz, 1999; Thoman, Arizaga, Smith, Story, & Soncuya, 2013). Additionally,

women, compared with men, tend to believe it is more important to make occupational sacrifices for the family and to have a job that helps people, which is one of the strongest predictors for women not pursing STEM careers (Eccles, 2007). Men, however, are more likely to value making money and having a successful career. This difference may be especially crucial for talented girls, because they are caught between their beliefs in gender stereotypes on the one hand and their accomplishments in mathematics and science courses on the other (Eccles, 2007). Thus, high-achieving girls may shy away from enrolling in challenging STEM courses because of their belief in cultural stereotypes. Parents and other socializers, whose values are influenced by cultural stereotypes, may transmit these stereotyped beliefs to their adolescents.

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Recent studies have focused on understanding the particular role of utility value (UV) in achievement behaviors (Durik & Harackiewicz, 2007; Hulleman et al., 2008; Hulleman, Godes, Hendricks, & Harackiewicz, 2010; Hulleman & Harackiewicz, 2009; Kaufman & Husman, 2004; Shechter, Durik, Miyamoto, & Harackiewicz, 2011). For example, Hulleman et al. (2008) found that students' perceptions of utility value predicted achievement in both a college classroom and a high school sports camp. In another study, students who had higher utility value for their studies persisted longer and performed better than those who had lower levels (Vansteenkiste, Simons, Lens, Sheldon, & Deci, 2004).

On the basis of this correlational research, researchers have recently begun to manipulate utility value with interventions in the lab, classroom, and home (Acee & Weinstein, 2010; Durik & Harackiewicz, 2007; Harackiewicz et al., 2012; Hulleman et al., 2010; Hulleman & Harackiewicz, 2009). They have targeted utility value in particular because it is likely that perceptions of utility value can be changed with interventions. Attainment and intrinsic values are more intrinsic and therefore would be difficult for an outside entity to manipulate. Utility value, in contrast, should be amenable to change by an intervention. Studies have found that these utility value interventions cause an increase in interest and performance in the subject, including STEM topics (Durik & Harackiewicz, 2007; Hulleman et al., 2010; Hulleman & Harackiewicz, 2009; Shechter et al., 2011). Although these UV interventions have had positive effects on motivation, these effects have typically been moderated by past performance or expectations for success, which is consistent with expectancy-value theory (Nagengast et al., 2011; Trautwein et al., 2012). Individuals with high expectations for success responded most positively when told why a topic was relevant to their lives (e.g., Durik & Harackiewicz, 2007), whereas individuals with low expectations for success showed no positive response or responded negatively when given relevance (UV) information (for a review, see Durik, Hulleman, & Harackiewicz, 2013). These results suggest that it is critically important to consider the role of expectations and past performance in studies involving utility-value interventions.

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Based on the documented potential of UV information to promote motivation for many individuals and the associations between parents' values and their adolescent's values in correlational research, we implemented a utility-value intervention aimed at parents (Harackiewicz et al., 2012). The ultimate goal of this intervention was to increase adolescents' STEM UV and STEM course-taking in high school. Previous research had not used randomized experiments to test the influence of parents on adolescents' utility value and achievement choices, but this study was able to evaluate the role of parents by randomly assigning them to an experimental UV intervention versus control condition. In the experimental condition, parents in an ongoing longitudinal study were given information about the relevance or usefulness (utility value) of mathematics and science for their adolescent. Parents in the control group received no information.

The results indicated that adolescents whose parents were in the intervention group took almost a semester more of mathematics and science classes during the last 2 years of high school than those whose parents were in the control group. These results indicated that parents can play a crucial role in increasing important adolescent achievement choices, such as advanced STEM course-taking. Although this intervention was effective for adolescents on average, it is important to consider the possibility that this intervention effect may vary as a function of gender and past performance, as has been observed in previous studies. It is also important to examine how this intervention worked to influence adolescents' course-taking.

This study goes beyond our previous evaluation of the utility-value intervention described above, to investigate for whom the intervention worked best and how it worked. The first research question asked whether gender and past performance (i.e., 9th-grade math and science grade point average) moderated the effects of the intervention. Previously, we found a main effect of the intervention on course-taking in the last 2 years of high school; later we coded past performance from high-school transcripts to use as a proxy for expectancies to test for an expectancy (prior performance) by value (intervention) interaction. Given the underrepresentation of women in many STEM fields (Halpern et al., 2007) and previously documented gender differences in expectancies and values in the STEM domain, we tested both gender and past performance as moderators of the intervention effect. Although in an earlier paper we reported that the intervention effect did not differ as a function of gender (Harackiewicz et al., 2012), we hypothesized that gender differences might emerge once we considered students' past performance. We therefore tested for an interaction among the intervention, gender, and past performance in STEM classes.

Using a mediation model, the second research question asked what mechanisms accounted for the effect of the intervention on students' course-taking (see Figure 1 for the theoretical model). We hypothesized that the intervention would lead to increased STEM UV for parents, which we assessed with questionnaires given to mothers of the adolescents. This increase in mothers' STEM UV was then predicted to be associated with an increase in adolescents' perceptions of parents' STEM values and adolescents' STEM UV. To provide the strongest test of mediation, we capitalized on the longitudinal design of the original study. The outcome variable was 12th-grade STEM course-taking. Mothers' perceived STEM UV, adolescents' perceptions of parents' STEM

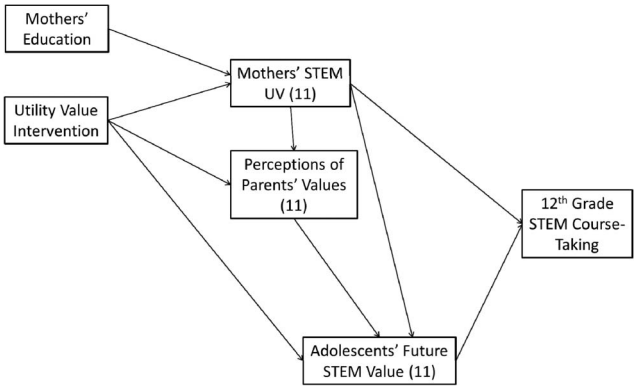

Figure 1. Theoretical model. STEM = science, technology, engineering, and mathematics; UV = utility value.

values, and adolescents' perceived STEM utility value were measured in the summer after 11th grade and therefore could be tested as mediators in the analyses of the effects of the intervention (which occurred during 10th and 11th grades) on 12th-grade STEM course-taking. These variables were predicted to mediate the effect of the intervention on 12th-grade STEM course-taking.

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The sample comprised families participating in the longitudinal Wisconsin Study of Families and Work (WSFW; for details on recruitment, see Hyde, Klein, Essex, & Clark, 1995). The current sample consisted of 188 adolescents (88 girls, 100 boys) and their parents who participated in a randomized experiment during high school (Harackiewicz et al., 2012). With regard to ethnicity, 90% of the adolescents were White (not of Hispanic origin), 2% were African American, 1% were Native American, and 7% were biracial or multiracial; this distribution is characteristic of the state of recruitment, in which 90% of the population is White (U.S. Census Bureau, 2006). At the time of data collection, participants attended 108 different high schools, increasing the generalizability of the findings. In 2010, the majority of adolescents (98%) had graduated from high school, and 94% reported plans to attend college or technical school. Average parents' years of education was 15.42 years (SD = 1.92) on a scale where 12 years is equivalent to high school graduation or GED completion.

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The intervention was implemented in October 2007 (10th grade) and again in January 2009 (11th grade). Families were followed through the teens' graduation from high school in June 2010. Families were randomly assigned to one of two experimental conditions and were blocked on gender of teen and mothers' educational level. Of these 188 families, 83 were in the experimental group and 105 were in the control group.

The intervention materials (two brochures and a website) were delivered exclusively to parents and focused on the usefulness of mathematics and science for adolescents. In particular, these materials explored potential connections between mathematics and science and current and future goals of adolescents (Harackiewicz et al., 2012). A first brochure, titled "Making Connections: Helping Your Teen Find Value in School," was sent to each household, addressed to the parents, in October of 10th grade. A second brochure, titled "Making Connections: Helping Your Teen with the Choices Ahead," was sent to each parent separately in January of 11th grade. This mailing included a letter giving them access to a dedicated, password-protected website called "Choices Ahead." Additionally, in the spring of 11th grade, parents in the experimental group were asked to complete an online questionnaire to evaluate the Choices Ahead website, which resulted in more parents visiting the website. A high percentage of parents (86%) reported using these resources, and a high percentage of adolescents (75%) reported exposure to this information. Parents in the control group did not receive any of these materials.

The 10th-grade brochure provided information about the importance or usefulness of mathematics and science in daily life and for various careers; it also provided parents with information about how to talk with adolescents about these issues. The 11th-grade brochure focused on these same themes but with different examples, and it gave greater emphasis to everyday activities (e.g., video games, cell phones) and preparation for college and careers. The 11th-grade brochure provided additional information for parents about communicating with their children about these issues and personalizing the relevance of mathematics and science for their 11th grader. The website featured clickable links to resources about STEM fields and careers. It also presented interviews with current college students who explained the usefulness of the mathematics and science courses that they had taken in high school. Parents were able to e-mail specific links from the site to their teens.

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Transcripts were obtained for 181 of the 188 students in the sample and came from 108 different high schools. Receipt of transcripts did not vary due to experimental condition or gender. The remaining sample of 181 families included 47 girls and 53 boys in the control group and 39 girls and 42 boys in the intervention group. For the outcome measure, we coded transcripts for the number of semesters of mathematics and science taken during 12th grade (12th-grade STEM course-taking). (Note that Harackiewicz et al. (2012) used number of mathematics and science courses taken in 11th and 12th grades as the outcome variable. Here we used just the number taken in 12th grade, so that a mediation model could be tested with mediators measured in 11th grade.)

For the measure of prior STEM performance, we created a standardized measure of ninth-grade STEM grade point average (GPA) by individually calculating each adolescent's GPA for mathematics and science courses taken in ninth grade on a GPA scale that ranged from 0 (F) to 4.0 (A/A+). The scale distinguished between grades by one third of a grade point (e.g., A = 4.0, A− = 3.67, B+ = 3.33). The final measure was a weighted, cumulative STEM GPA from ninth grade that took into account

the number of credits each course counted to weight the course grade.

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Questionnaires given to mothers and adolescents in the summer after 11th grade included one measure from mothers (mothers' STEM UV for their adolescent) and two adolescent measures (perceptions of parents' STEM values and adolescents' STEM value). Response rates on the questionnaires were 83% for mothers and 77% for adolescents. All measures were based on items developed by Eccles and colleagues (e.g., Eccles & Wigfield, 2002; Eccles-Parsons et al., 1983). Mothers' STEM UV was measured with four items that asked about the mother's perceptions of the utility value of mathematics and science for her adolescent (e.g., *In general, how useful will* [biology] be for your teen in the future? $\alpha = .79$). This question was asked about four STEM topics: biology, mathematics, chemistry, and physics. Responses were on a scale from 1 (*not at all useful*) to 5 (*very useful*). Fathers also reported on STEM UV for their adolescent. However, the response rate for fathers at 11th grade was only 62%, creating substantial missing data. Therefore, we used only the variable from mothers.

For adolescents' perceptions of parents' values, adolescents rated how important their parents thought mathematics and science would be in their lives with two items (e.g., *My parents think math and science are important for my life*; $\alpha = .78$). Adolescents' perception of the value of mathematics and science for their future (future STEM value) was measured with four items that focused on the current and future value of mathematics and science for themselves (e.g., *Math and science are important for my future*; $\alpha = .79$). Adolescent measures were rated on a scale from 1 (*strongly disagree*) to 7 scale (*strongly agree*).

a a In the current sample ($N = 181$), mothers averaged 15.42 years of education ($SD = 2.10$), and fathers also averaged 15.42 years of education ($SD = 2.41$). A variable of parents' average years of education ($M = 15.42$, $SD = 1.92$) was created by averaging these two variables ($r = .44$). In this paper, we use mothers' education for analyses involving mother variables and parents' education for analyses not involving mothers' reports.

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We used multiple regression followed by structural equation modeling to analyze these data in two stages. First, multiple regression was used to investigate the direct effects of the predictors on 12th-grade STEM courses taken, which was the primary outcome variable. Second, a structural equation model was estimated based on the theoretical model (see Figure 1) to examine the relationships among the predictors, mediators (mothers' UV, perceptions of parents' values, and adolescents' future STEM value), and the outcome in a single model. In this model, we tested whether the total indirect effect of the predictors on the outcome through the mediators was significant (Preacher & Hayes, 2008). Cases with missing data were included by using full information maximum likelihood methods (Arbuckle, 1996).

There were seven predictors involving the intervention and the moderators of the intervention (*base predictors*): the intervention (coded as 1 for intervention group and −1 for control group), adolescent's gender (coded 1 for boys and −1 for girls), ninth-grade STEM GPA (measured continuously and standardized), and two- and three-way interactions (the interaction of the intervention by adolescent's gender, the interaction between the intervention and ninth-grade STEM GPA, the interaction between adolescent's gender and ninth-grade STEM GPA, and the three-way interaction among the intervention, adolescent's gender, and ninth-grade STEM GPA). Finally, we included a term to test parental education.

Zero-order correlations and descriptive statistics for all variables are shown in Table 1, separately by adolescent's gender.

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To address the first research question, we regressed 12th-grade STEM courses taken on the base predictors and parents' education.[1] For 12th-grade STEM courses taken, there was one significant effect: the three-way interaction among the intervention, adolescent's gender, and ninth-grade STEM GPA ($z = -2.44$, $p < .05$, $\beta = -.18$).[2] In contrast to the main effect of the intervention reported by Harackiewicz et al. (2012), the pattern of the three-way interaction (see Figure 2) suggests that, when prior performance and gender are taken into consideration, the intervention increased course-taking for low-GPA boys ($\beta = .27$, $p < .05$) and high-GPA girls ($\beta = .22$, $p < .10$), whereas the intervention did not help low-GPA girls ($\beta = -.20$, trend toward a negative effect of the intervention) and had no effect on high-GPA boys ($\beta = -.04$). The graph of the three-way interaction in Figure 2, as for all interaction graphs in this paper, follows the convention of graphing high values at 1 *SD* above the mean of GPA and low values at 1 *SD* below the mean (Aiken & West, 1991).

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To address the second research question, we used structural equation modeling in Mplus to test whether the direct effect of the intervention (as moderated by gender and prior STEM performance) on 12th-grade STEM course-taking was mediated by indirect effects through the mediators. In the model (see Figure 1), we estimated paths from the base predictors (the intervention, gender, prior STEM performance, and their interactions) to mothers' STEM UV, perceptions of parents' values, and adolescents' future STEM value. To be consistent with previous analyses (Harackiewicz et al., 2012), we also included mothers' years of education as a predictor of mothers' STEM UV and of STEM course-taking. In accordance with the theoretical model, mothers' STEM

[1] The results remain the same if mothers' education is substituted for parents' education here. The three-way interaction is still the only significant predictor ($z = -2.39$, $p < .05$, $\beta = -.18$).

[2] These regression analyses were repeated with STEM course-taking in 11th and 12th grades as the outcome measure, the one used in the Harackewicz et al. (2012) paper. The results were the same, that is the three-way interaction among intervention, gender, and prior performance significantly predicted 11th- plus 12th-grade STEM course-taking. We report results in detail here only for the 12th-grade course-taking outcome, to preserve the temporal sequence for mediation analyses.

Table 1
Zero-Order Correlations and Descriptive Statistics for Major Variables by Gender

Variable	1	2	3	4	5	6	7
1. Ninth-grade STEM GPA	—	0.34**	0.36**	0.26*	0.26*	0.24*	0.18
2. Mothers' STEM UV	0.21	—	0.54**	0.39**	0.27*	0.30*	0.27*
3. Adolescents' future STEM UV	0.40**	0.52**	—	0.55**	0.34**	0.28*	0.15
4. Perceptions of parents' values	0.37**	0.39**	0.61**	—	0.15	0.25*	0.16
5. STEM courses (12th grade)	0.16	0.34**	0.36**	0.18	—	0.11	0.04
6. Parents' education	0.42**	0.15	0.10	0.17	0.26*	—	0.79**
7. Mothers' education	0.42**	0.27*	0.26*	0.34*	0.21	0.86**	—
Girls, *M* (*SD*)	3.15 (0.84)	4.08 (0.79)	5.23 (1.43)	5.75 (1.06)	3.77 (1.71)	15.35 (2.09)	15.41 (2.33)
Boys, *M* (*SD*)	2.92 (0.88)	4.11 (0.81)	5.03 (1.63)	5.62 (1.26)	3.45 (1.85)	15.48 (1.76)	15.43 (1.88)

Note. Correlations above the diagonal are for boys. Correlations below the diagonal are for girls. There were no mean differences due to gender. STEM = science, technology, engineering, and mathematics; GPA = grade point average; UV = utility value.
* $p < .05$. ** $p < .01$.

UV was an additional predictor of perceptions of parents' values and adolescents' future STEM value. Furthermore, perception of parents' values was a predictor of adolescents' future STEM value. Additionally, paths were estimated from the base predictors, mothers' STEM UV, and adolescents' future STEM value to 12th-grade STEM courses taken. Thus, by examining the indirect effects of the base predictors through the mediators to STEM course-taking, this model tested whether the intervention, as moderated by GPA and adolescent's gender, influenced STEM course-taking through mothers' STEM UV, adolescents' perceptions of parents' values, and adolescents' future STEM value. Because this is a saturated model, it does not allow for a meaningful test of model fit.

Overall, the model accounted for 16.8% of the variance in 12th-grade STEM course-taking, 13.9% of the variance in mothers' STEM UV, 26.7% of the variance in perceptions of parents' values, and 50.8% of the variance in adolescents' future STEM value. See Figure 3 for the path models showing these results.

The base predictors and years of mothers' education were used to predict mothers' STEM UV. There was a nearly significant effect of ninth-grade STEM GPA ($z = 1.94$, $p = .06$, $\beta = .17$) showing a trend for mothers to perceive more STEM utility value when their adolescent had a higher ninth-grade STEM GPA. In addition, the predicted three-way interaction among the intervention, adolescent's gender, and ninth-grade STEM GPA was significant ($z = -1.96$, $p = .05$, $\beta = -.16$); it is graphed in Panel A of Figure 4. The pattern of this interaction effect is similar to the one for the course-taking outcome in the multiple regression analysis (see Figure 2). Finally, mothers' education was a significant predictor of mothers' STEM UV ($z = 2.32$, $p < .05$, $\beta = .20$), such that mothers with more years of education showed higher levels of STEM UV.[3]

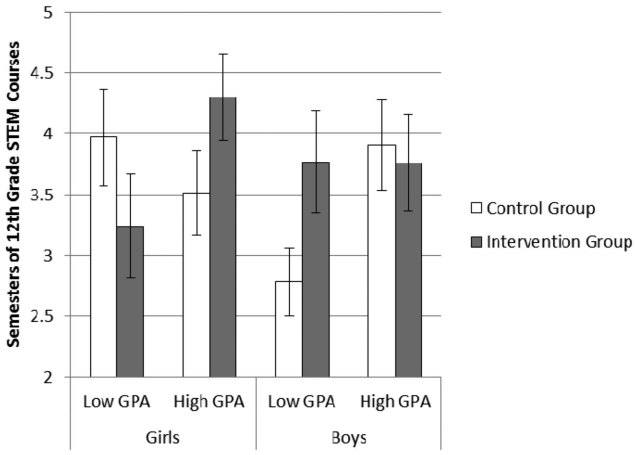

Figure 2. Direct effects of the intervention, adolescent's gender, and ninth-grade STEM GPA on STEM course-taking (12th grade). Predicted values were generated for high (1 *SD* above the mean) and low (−1 *SD*) ninth-grade STEM GPA from the multiple regression models. Error bars represent ±1 *SEM*. STEM = science, technology, engineering, and mathematics; GPA = grade point average; *SEM* = standard error of the mean.

a **a** The base predictors and mothers' STEM UV were used to predict adolescents' perceptions of parents' values. There were significant effects of ninth-grade STEM GPA ($z = 2.64$, $p < .05$, $\beta = .23$), such that parents were perceived as seeing the value of STEM course-taking more when the adolescent had a higher STEM GPA. The two-way interaction between adolescent's gender and the intervention was significant ($z = 2.41$, $p < .05$, $\beta = .19$), suggesting that the intervention increased boys' perceptions of parents' values and decreased girls' perceptions of parents' values; however, this two-way interaction was qualified by the three-way interaction among the intervention, adolescent's gender, and ninth-grade STEM GPA, which was nearly significant ($z = -1.89$, $p = .06$, $\beta = -.17$). The pattern of the interaction is similar to the one for course-taking; in particular, the intervention appeared to decrease low-GPA girls' perceptions of their parents' values for them (see Figure 3, Panel A, and Figure 4, Panel B). That is, low-GPA girls in the intervention group perceived a lack of support for STEM from their parents. Finally, mothers' STEM UV was a significant predictor of adolescents' perceptions of parents' values ($z = 3.70$, $p < .01$, $\beta = .29$), such that mothers with higher levels of STEM UV tended to have adolescents with higher levels of perceptions of parents' values.

a **a** The base predictors, mothers' STEM UV, and perceptions of parents' values

[3] The model was also tested using parents' education instead of mothers' education, and the results for the overall model did not change; however, parents' education was a nonsignificant predictor of mothers' STEM UV ($z = 1.77$, $p > .05$, $\beta = .15$).

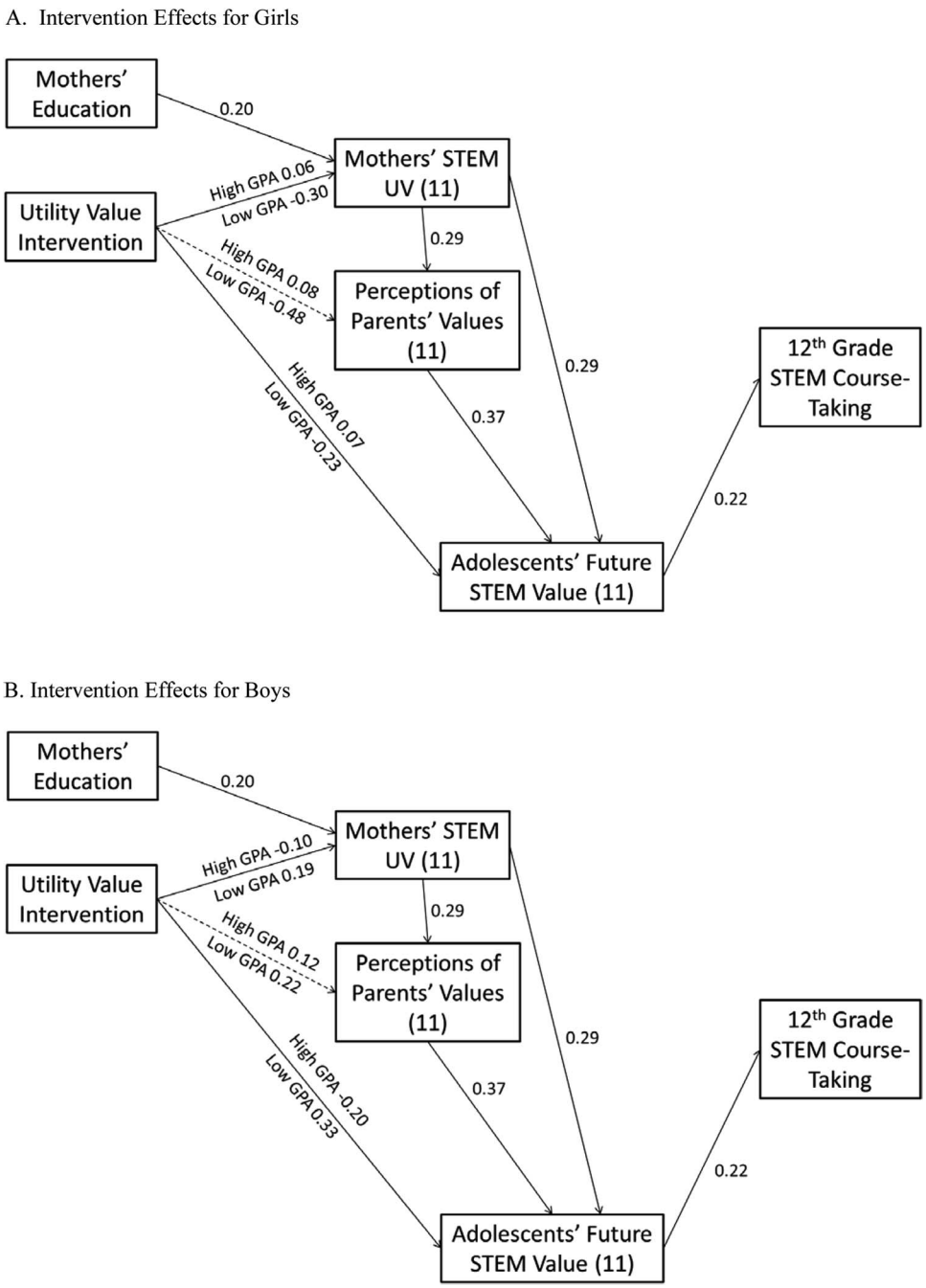

Figure 3. Empirical path model. Only significant paths are shown. The effect of the intervention on STEM course-taking in 12th grade differs by gender and ninth-grade STEM GPA and is mediated by mother's utility value (UV), perceptions of parents' values, and adolescents' future STEM value. The different intervention effects are shown (A) for girls and (B) for boys. Dashed line indicates $p = .06$ (the three-way interaction involving the intervention to perceptions of parents' values). STEM = science, technology, engineering, and mathematics; GPA = grade point average.

were used to predict adolescents' future STEM value (see Figure 3). The three-way interaction among the intervention, adolescent's gender, and ninth-grade STEM GPA was significant, as predicted ($z = -2.85$, $p < .05$, $\beta = -.21$). The three-way interaction is shown in Panel C of Figure 4; the pattern of the interaction is also similar to the one for STEM course-taking and suggests that the intervention increased adolescents' future STEM value particularly for low-GPA boys. The effect of mothers' STEM UV was significant ($z = 4.35$, $p < .01$, $\beta = .29$); higher levels of mothers' STEM UV predicted higher levels of adolescents' future STEM

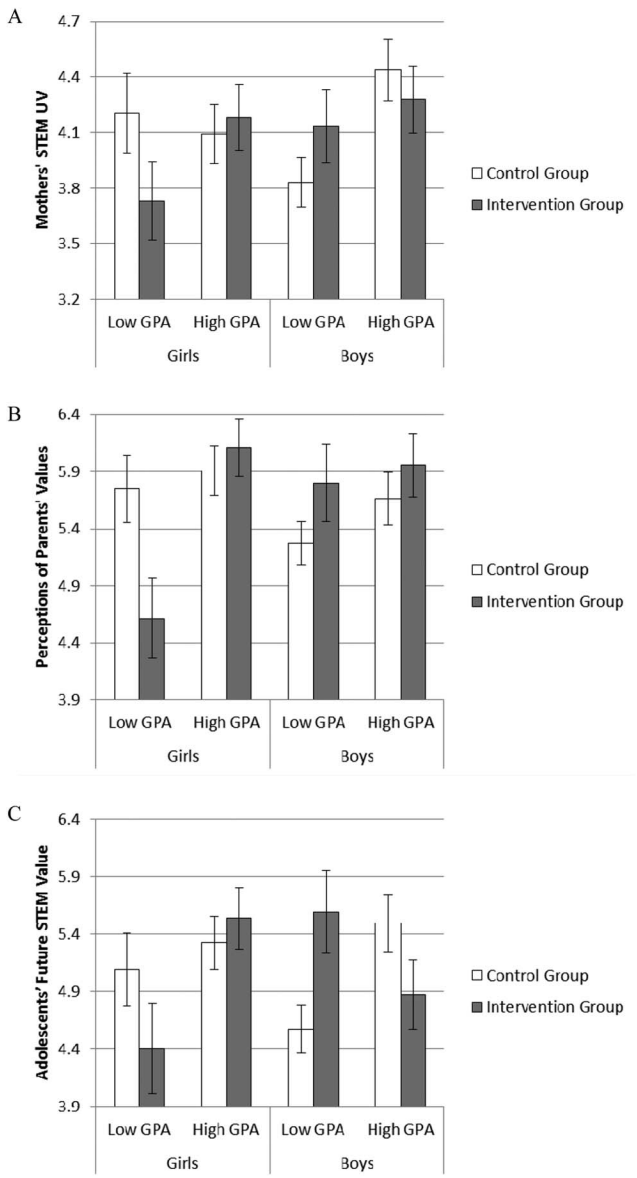

Figure 4. Direct effects of the intervention, child gender, and ninth-grade STEM GPA on the hypothesized mediators: (A) mothers' STEM UV, (B) perceptions of parents' values, and (C) adolescents' STEM utility value. Predicted values were generated for high (1 *SD* above the mean) and low (−1 *SD*) ninth-grade STEM GPA from the multiple regression models. For (A) the range of possible values is 1 to 5. For (B and C) the range of possible values is 1 to 7. Error bars represent ±1 *SEM*. STEM = science, technology, engineering, and mathematics; GPA = grade point average; UV = utility value; *SEM* = standard error of the mean.

value. Perceptions of parents' values was a significant predictor as well ($z = 5.36$, $p < .01$, $\beta = .37$); higher levels of perceptions of parents' values predicted higher levels of adolescents' future STEM value.

a **a** The base predictors, mothers' STEM UV, adolescents' future STEM value, and mothers' years of education were used to predict 12th-grade STEM course-taking.[4] There was a significant effect of adolescents' future STEM UV ($z = 2.18$, $p < .05$, $\beta = .22$). Higher levels of adolescents' future STEM value predicted more 12th-grade STEM courses taken, for both boys and girls.

a **a** In the structural equation model, we hypothesized that the base predictors (specifically the three-way interaction) would influence 12th-grade STEM course-taking through the mediators, so the direct effects of the base predictors to 12th-grade STEM course-taking shown in the direct effects model should be reduced in a model containing the mediators; additionally, there should be significant indirect effects of the three-way interaction through the mediators to 12th-grade STEM course-taking. We hypothesized that the mediation would work in a specific way; that is, the three-way interaction should predict mothers' STEM UV, perceptions of parents' values, and adolescents' future STEM UV. Mothers' STEM UV should predict perceptions of parents' values and adolescents' future STEM UV, and perceptions of parents' values should predict adolescents' future STEM UV. Additionally, we specified that mothers' STEM UV and adolescents' future STEM value would predict STEM course-taking. Using procedures described by Preacher and Hayes (2008), we tested the total indirect effect of the intervention through the three mediators, as well as the specific indirect effect of mothers' STEM UV through adolescents' perceptions of parents' values and adolescents' future STEM UV.

Therefore, two indirect pathways were tested in order to test for the indirect effect of the three-way interaction on 12th-grade STEM course-taking as well as the indirect effect of mothers' STEM UV on 12th-grade STEM course-taking. For the first, we tested whether the three-way interaction had a significant total indirect effect on 12th-grade STEM course-taking through the three mediators and found support for this hypothesis ($z = -2.40$, $p < .05$). Therefore, the intervention, as moderated by adolescent's gender and ninth-grade STEM GPA, had a significant total indirect effect on course-taking through the mediating variables: mothers' STEM UV, perceptions of parents' values, and adolescents' future STEM value. Additionally, the model with the mediators reduced the direct effects of the predicted three-way interaction on 12th-grade STEM course-taking (direct effect, $\beta = -0.18$, $p < .05$; with mediators in the model, $\beta = -0.09$, *ns*).

For the second, we tested for the specific indirect effect of mothers' STEM UV to 12th-grade STEM course-taking through perceptions of parents' values and adolescents' future STEM value. Results indicated a significant specific indirect effect ($z = 2.06$, $p < .05$). This indicated that mothers' STEM UV had a significant specific indirect effect on 12th-grade STEM course-taking through perceptions of parents' values and adolescents' future STEM value.

To address concerns about low rates of adolescents taking advanced STEM courses in high school in the United States, we implemented an intervention, based in expectancy-value theory, with parents of adolescents (Harackiewicz et al., 2012). In the results reported here, we examined whether the intervention was differentially effective for girls compared with boys in the context

[4] The analyses were repeated using parents' education instead of mothers' education. Findings remained unchanged.

of past performance and what factors mediated the effects of the intervention on course-taking. In response to the first research question, the results from multiple regression analysis indicated that the intervention increased STEM course-taking in 12th grade for girls who had done well in ninth-grade STEM courses (high GPA) and for boys who had not done well (low GPA). However, the intervention did not increase course-taking for low-GPA girls (trending toward a negative effect), and it had no effect for high-GPA boys. The absence of an effect for high-GPA boys is most likely due to a ceiling effect on the measure of number of STEM courses taken in 12th grade.

In regard to the second research question, mediation analyses suggested that these intervention effects (specifically the three-way interaction among the intervention, gender, and prior STEM performance) occurred through changes in both mother and adolescent variables. The intervention was targeted exclusively at parents, so we predicted and found that the intervention increased mothers' STEM utility value for their adolescents. The intervention also led adolescents to perceive higher levels of parental STEM values and increased adolescents' future STEM value, and the changes in mothers' STEM utility value contributed to these changes in adolescent variables. Overall, the effect of the intervention on high-school STEM course-taking was mediated by the effects of the intervention on mothers' STEM utility value and adolescents' STEM utility value. This suggests that parents' utility value does indeed influence adolescents' utility value and achievement behavior.

Considerable support for Eccles's expectancy-value theory has been amassed through correlational and longitudinal research, but experimental support has been lacking. One strength of an experimental approach to this theory is that researchers can assess the causal effect of task values on achievement motivation and behavior. In particular, when studying families, an association has been shown between parents' beliefs and their children's beliefs and achievement-related behaviors (e.g., Chhin, Bleeker, & Jacobs, 2008), but the direction of the effect has been unclear. To explore whether parents' values could influence adolescents' values, we experimentally manipulated parents' utility value through a randomized intervention to assess the causal impact of parents' beliefs on their children's beliefs and behaviors (Harackiewicz et al., 2012). Although the original study showed that an increase in adolescents' STEM course-taking over the final 2 years of high school occurred as a result of this intervention, mediation analyses of this effect were not conducted.

In the current paper, we examined the hypothesis that the intervention worked by changing parents' and adolescents' STEM utility value. We found support for this hypothesis. In our previous paper (Harackiewicz et al., 2012), the results indicated that the intervention affected mothers' STEM utility value, which provides crucial support that this utility value intervention for parents had its intended effect. In the current analyses, this increase in mothers' STEM utility value was related to an increase in adolescents' perceptions of how much their parents valued STEM for them and also adolescents' future STEM value. Thus, both mothers and adolescents had increased perceptions of STEM value due to the intervention. Because the intervention was targeted exclusively at parents, it is reasonable to conclude that adolescents were influenced by their parents.

Two paths in Figure 3 warrant additional discussion. First, the direct path (specifically the three-way interaction among the intervention, gender, and prior STEM performance) from the intervention to adolescents' perceptions of their parents' values was significant, above and beyond the indirect path through mothers' STEM utility value. That is, the intervention appeared to have some effect on adolescents' perceptions beyond the effect it had on mothers' STEM UV for them. This might involve a process such as a mother sharing the intervention website with her adolescent while not expressing her beliefs in the value of STEM. Second, the direct path from mothers' STEM UV to adolescents' future STEM value was significant, beyond the indirect effect through adolescents' perceptions of their parents' values. This effect might involve some changes in mothers' behavior that are not consciously perceived by the adolescent but that nonetheless have an effect.

a b a a

In this paper we also considered whether the intervention, which had an overall positive main effect on course-taking, might be differentially effective based on the adolescent's gender and prior STEM performance. The results indicated that, in fact, adolescents' prior STEM grades moderated the effect of the utility value intervention differently for girls and boys. The intervention had positive effects on STEM course-taking for low-GPA boys and high-GPA girls, but it had no effect (trending toward a negative effect) for low-GPA girls and had no effect for high-GPA boys.

Why were low-GPA girls not helped by the intervention when low-GPA boys were helped by it? The measure of prior performance, ninth-grade STEM GPA, should be linked tightly to both mothers' and adolescents' expectations for future success in STEM and has been used as a proxy for expectations in previous utility intervention research (Hulleman et al., 2010). Yet, research shows that parents are more likely to have inflated expectancies for success for boys in this domain in comparison to girls (Eccles, Jacobs, & Harold, 1990; Gunderson, Ramirez, Levine, & Beilock, 2012; Jacobs, Davis-Kean, Bleeker, Eccles, & Malanchuk, 2005; Yee & Eccles, 1988). Thus, parents may assess all boys as capable of success in STEM, even if they have had low grades in school. Therefore, even low-GPA boys may benefit from a utility-value intervention targeted at parents, because parents will still deem them capable of succeeding. Boys with higher prior STEM achievement did not benefit from the intervention, probably due to a ceiling effect in the number of semesters of mathematics and science taken during 12th grade. That is, their STEM course-taking was constrained by factors such as the number of class periods in the day and requirements that they take non-STEM courses. Positive effects of the intervention for high-GPA boys might be revealed in situations with fewer constraints (e.g., in college).

For girls, low STEM GPA may create low expectations for success—both for the girl and her mother—that negate the beneficial effects of the UV intervention; even if parents see the value of STEM, their low expectations for success for their low-GPA daughters mean that parents have low STEM aspirations for them, rendering the utility value of STEM irrelevant. These effects are consistent with the predicted effects in Eccles's expectancy-value theory. Moreover, they are consistent with past research showing

that UV interventions are less effective for those with low expectations for success (e.g., Durik & Harackiewicz, 2007).

In addition, girls and their mothers observe the unbalanced gender composition of many adult occupations (Ridgeway, 2011), which may contribute to the findings. Whereas girls with a high STEM GPA may aspire to traditionally masculine careers requiring substantial mathematics and science and be responsive to the intervention, girls with a low STEM GPA may see no reason to consider such aspirations and, simultaneously, may be drawn to traditionally feminine careers such as child-care worker (95% female, Bureau of Labor Statistics, 2011) or elementary- or middle-school teacher (82% female), which appear to require little mathematics and science (Beilock, Gunderson, Ramirez, & Levine, 2010). Moreover, if parents share these beliefs, they may not encourage their daughters to pursue STEM careers. This interpretation is supported by the relatively low level of parental valuing of STEM that low-GPA girls reported (see Figure 4, Panel B). On balance, then, girls with low prior STEM performance may have little interest in STEM courses and careers and receive little encouragement from parents, despite the intervention, while simultaneously experiencing a strong pull toward traditionally female careers that appear to require little mathematics and science and where they feel that they "belong" (Thoman et al., 2013).

It will be important for future interventions to take into account the role of expectancies in designing utility-value interventions that will be successful for all students. Recent research has shown that, although the interactive effects of expectancy and value are mixed, this interaction does occur in some studies (Nagengast et al., 2011; Trautwein et al., 2012). This intervention was in the STEM domain, so it is likely that both parents' and adolescents' expectancies would be affected not only by prior achievement but also by the adolescent's gender. Future interventions may be strengthened by the inclusion of information that enhances not only perceptions of utility value but also expectations for success.

a a a

Several limitations should be kept in mind when interpreting these results. First, the sample was representative of the state of Wisconsin but not racially diverse, so future research should extend these findings to more diverse groups. Previous studies have shown that the effects of utility-value interventions are consistent across racial groups (Hulleman & Harackiewicz, 2009), suggesting that our results would extend to more diverse contexts. Additionally, although the sample size was sufficiently large to have the power to detect the intervention effects, future studies would benefit from scaling up the intervention to larger samples.

Second, although the utility-value intervention affected mothers' and adolescents' perceptions of utility value and adolescents' course-taking behavior, we do not have measures of the precise interpersonal processes by which these increases in mothers' utility value changed adolescents' attitudes. Correlational research has shown that these effects may be explained through a variety of parental behaviors, such as modeling, encouragement, and coactivity (e.g., Simpkins et al., 2012). Future studies could also assess these behaviors to understand how parents' perceptions of utility value result in behavioral change that affects their children. It is likely that parents use a variety of methods and behaviors to influence their children, so understanding which behaviors are most effective will make an important contribution to future research. We believe that future studies may also benefit from using measures of adolescents' perceptions of their parents' values as we did here, because that measure can capture the effect of a variety of parental behaviors.

Third, this utility-value intervention (and much of the correlational research based on expectancy-value theory) was conducted within a specific domain, STEM. Therefore, we cannot assume that these intervention results would generalize to non-STEM domains, and future research should extend these findings to other domains. Previous research has shown that the relationships between utility value and achievement behavior do extend to non-STEM domains (e.g., Jodl et al., 2001), so the intervention effects should also generalize, but this will need to be tested in future studies.

Finally, although the utility-value intervention had effects that differed due to gender and prior achievement, it is important to recognize that, on average, this intervention had substantial positive effects on STEM course-taking (Harackiewicz et al., 2012). Future studies may modify this intervention to make it more effective, but it had generally positive effects on a key educational outcome needed to enhance STEM preparation. Therefore, we can recommend this intervention as having positive effects and also recommend taking into account expectancies for success to make it more effective in future research.

a

Several implications flow from these results. The findings indicate that parents are a resource—a largely untapped one—that may be used to enhance STEM motivation of adolescents. There is room to increase how much parents value STEM for their adolescents, and changes in parents' utility value can affect adolescents' beliefs and behavior. Therefore, parents—in addition to teachers and curriculum—may be used to increase students' STEM preparation and motivation. Future utility-value interventions should also attend to issues of expectations for success, particularly in regard to gender gaps in STEM.

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Received May 11, 2013
Revision received March 25, 2014
Accepted March 31, 2014 ■

ABSTRACT

Parents believe what they do matters. But, how does it matter? How do parents' beliefs about their children early on translate into the choices those children make as adolescents? The Eccles's expectancy–value model asserts that parents' beliefs about their children during childhood predict adolescents' achievement-related choices through a sequence of processes that operate in a cumulative, cascading fashion over time. Specifically, parents' beliefs predict parents' behaviors that predict their children's motivational beliefs. Those beliefs predict children's subsequent choices. Using data from the Childhood and Beyond Study (92% European American; $N = 723$), we tested these predictions in the achievement domains of sports, instrumental music, mathematics, and reading across a 12-year period. In testing these predictions, we looked closely at the idea of reciprocal influences and at the role of child gender as a moderator. The cross-lagged models generally supported the bidirectional influences described in Eccles's expectancy–value model. Furthermore, the findings demonstrated that: (a) these relations were stronger in the leisure domains than in the academic domains, (b) these relations did not consistently vary based on youth gender, (c) parents were stronger predictors of their children's beliefs than vice versa, and (d) adolescents' beliefs were stronger predictors of their behaviors than the reverse. The findings presented in this monograph extend our understanding of the complexity of families, developmental processes that unfold over time, and the extent to which these processes are universal across domains and child gender.

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This research was supported by Grant HD17553 from the National Institute for Child Health and Human Development to Jacquelynne Eccles, Allan Wigfield, Phyllis Blumenfeld, and Rena Harold, Grant 0089972 from the National Science Foundation to Jacquelynne Eccles and Pamela Davis-Kean, and grants from the MacArthur Network on Successful Pathways through Middle Childhood to Eccles. We would like to thank the principals, teachers, students, and parents of the cooperating school districts for their participation in this project. We would also like to thank the following people for their work on the project: Amy Arbreton, Phyllis Blumenfeld, Carol Freedman-Doan, Rena Harold, Janis Jacobs, Toby Jayaratne, Mina Vida, Allan Wigfield, and Kwang Suk Yoon. Simpkins's work on this monograph was also supported by a William T. Grant Young Scholars Award (#7936) and a CAREER grant from the National Science Foundation (DRL-1054798).

I. INTRODUCTION

Why do children and adolescents choose such different achievement-related activities and have such different achievement-related goals and interests? Why, for example, do some children prefer math to reading or instrumental music to sports or sports to academics? Why do children with fairly similar ability levels have different opinions of their abilities? Why, for example, do girls develop lower estimates of their math ability than boys, even though they get equivalent or higher grades? Most importantly for this monograph, what role do parents play in the socialization of these individual and group differences?

Questions such as these are at the heart of our understanding of the socialization of motivated behavior. Beginning with Winterbottom (1958), developmentalists have been interested in the role that parents play in socializing achievement-related motivation and behavior (see Simpkins, Fredricks, & Eccles, 2015, for a recent review). This work focused on the socialization of what was assumed to be general achievement motivation and demonstrated the importance of four components of parenting: (1) high expectations for children's performance, (2) the provision of developmentally appropriate but challenging tasks, (3) a warm supportive emotional climate, (4) and strong role models of high achievement-oriented behaviors (Crandall, Dewey, Katkovsky, & Preston, 1964; Winterbottom, 1958). These themes continued to be reflected in the work linking parenting styles to school achievement outcomes in Baumrind's seminal studies (Baumrind, 1971; Steinberg, Lamborn, Dornbursch, & Darling, 1992) and in the work based on self-determination theory (Grolnick, Gurland, DeCourcey, & Jacob, 2002; Grolnick & Ryan, 1989). The importance of role models, parental expectations, and the provision of specific experiences has been salient in the work on both gender and social class-related socialization as well (Bradley & Corwyn, 2006; Davis-Kean, Malanchuk, Peck, & Eccles, 2003; Ruble, Martin, & Berenbaum, 2006).

With the social cognitive revolution in the 1960s, much greater attention was placed on beliefs as key to the motivated behaviors of parents and their children, as well as the need for domain specificity rather than a focus on general motivational constructs such as achievement. Developmentalists

became interested in the role of parents' specific beliefs about their children's differential abilities and causal attributions for their children's performances. They proposed several variations of social cognitive models of parental influence, though this work focused primarily on academic achievement-related behaviors and outcomes (Alexander & Entwisle, 1988; Eccles [Parsons], Adler, & Kaczala, 1982; Goodnow & Collins, 1990; Grolnick & Slowiaczek, 1994; Holloway, 1988; Marjoribanks, 2002).

In an effort to address the kinds of questions outlined in our first paragraph in a systematic way, Eccles and her colleagues developed two comprehensive models of achievement-related choices to guide subsequent research efforts (Eccles [Parsons] et al., 1983). The first model, depicted in Figure 1a, focused on the psychological processes linked to achievement-related behaviors and choices (see Figure 1a). It draws heavily from classic theories of expectancy and value, interest, and efficacy models of performance and task choice (Atkinson, 1964; Bandura, 1997; Csikszentmihalyi, 1988; Weiner, 1979). In the second model, depicted in Figure 1b, Eccles and her colleagues elaborated on the diverse pathways through which parents might influence their children's achievement-related activity choices and motivational beliefs (see Eccles, 1993). They proposed that parents can shape children's motivational beliefs (e.g., self-concept of ability, task value) and achievement-related choices through a variety of child-specific beliefs and activity-specific behaviors.

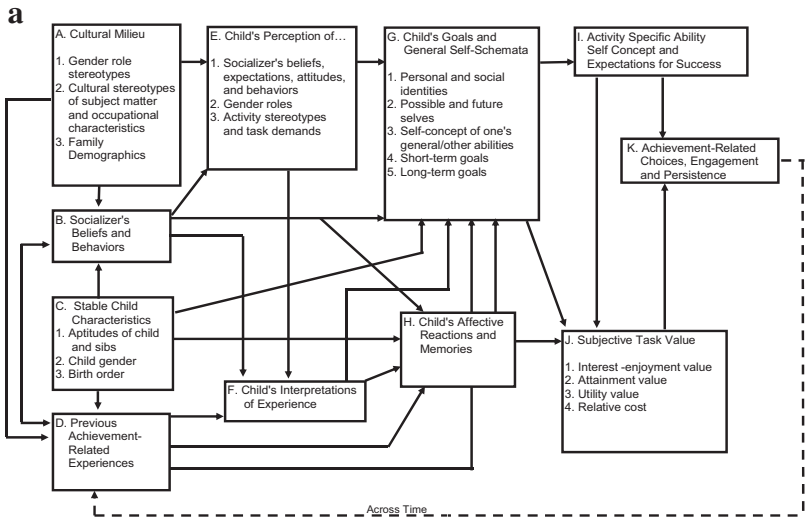

FIGURE 1A.—Expectancy-value model of achievement choices.

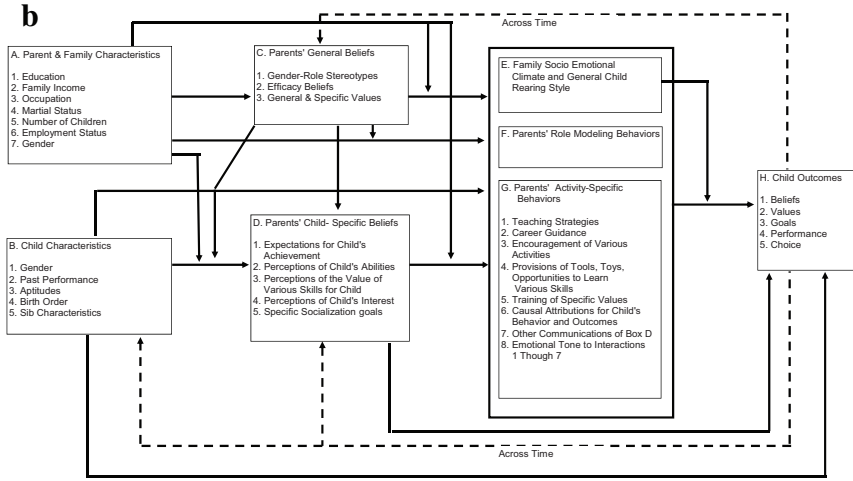

FIGURE 1B.—Model of parents influence on children's achievement related to self-perceptions, values, and behaviors.

In this monograph, we use both of these theoretical frameworks to examine the role of the family in the ontogeny of European American, middle-class adolescents' achievement-related choices. To this end, we tested a developmental model spanning 12 years describing the processes by which parents' beliefs about their children become associated with their adolescent's later achievement-related choices.

Although there has been extensive research on particular subcomponents of this model, this monograph extends previous work in several critical regards. First, few studies, even Simpkins and her colleagues (2012)—the most comparable study to this monograph, address questions about the direction of influence between both mothers' and fathers' beliefs and behaviors, and children's beliefs and achievement-related activity choices from childhood through adolescence. Second, parents' beliefs and behaviors have often been examined in separate studies. Third, much of the research on parents' beliefs is quite general. Fourth, much of the research in motivation has focused on children's academic motivation and school achievement. Fifth, few researchers have examined whether children's gender moderates the strength of relations within the theoretical model being tested. Sixth, and perhaps most importantly, we investigate the responsiveness of parents' beliefs and behaviors to their children's characteristics.

In this monograph, we focus on four achievement domains: sports, instrumental music, math, and reading because comparisons across these

domains are related to several important theoretical debates and because participation in each domain has implications for individuals' well-being into adulthood. Adolescents' motivational beliefs and engagement in math and reading have clear implications for educational achievement, college majors, and occupational choices. With regard to sports and instrumental music, adolescents who participate in either of these skill-based domains often evidence more positive adjustment than adolescents who do not participate in these leisure domains (Burton, Horowitz, & Abeles, 2000; Fredricks & Eccles, 2006; Kahn et al., 2008; North, Hargreaves, & O'Neill, 2000; Pedersen & Seidman, 2005; Pfeiffer et al., 2006). Participation in these domains also can play a key role in identity formation leading to a positive and agentic view of one's self.

These four domains were also chosen because they cover theoretically important distinctions. First, these domains vary in terms of whether they are generally stereotyped as a masculine (i.e., math and sports) or feminine (i.e., reading) domain (Eccles, Wigfield, & Schiefele, 1998; Wigfield, Eccles, Schiefele, Roeser, & Davis-Kean, 2006). Second, these domains include mandated academic pursuits (i.e., math and reading) and voluntary but highly skilled leisure pursuits (i.e., sports and instrumental music). These distinctions are theoretically important in that the predictors may vary for particular groups (e.g., girls, thus helping us understand gender role socialization better) and/or for particular types of domains (e.g., leisure pursuits, thus helping us understand the role of context in achievement socialization). Inclusion of domains that cover the distinctions created by gender and academic/leisure pursuit provides insight into the generalizability of findings across key dimensions of achievement-related choices, as well as provides tests of specific hypotheses about gender and domain differences.

THEORETICAL PERSPECTIVES ON ACHIEVEMENT-RELATED BEHAVIORAL CHOICES

Our main focus in this monograph is on understanding the precursors of adolescents' achievement-related choices and engagement during high school. Studying choices and engagement during adolescence is important for several reasons. First, these choices are related to well-being during adolescence (see Eccles & Gootman, 2002). Second, adolescents' choices will shape the options available to them as they move into and through their adulthood (Bates, 1987; Eccles & Gootman, 2002). Adolescence is a critical developmental stage in terms of increased opportunities for decision-making (Eccles, Jacobs, et al., 1993; Smetana, 2010). Adolescents also have an increasing sense of who they are and whom they would like to become (Eccles, 2009; Erikson, 1982).

There are also several sociocultural changes that make the high school years a particularly important time for studying differential engagement across various achievement-related activities (Eccles, Jacobs, et al., 1993). Adolescents typically have more opportunities to make choices among high school courses than they had as elementary and middle school students. These choices can have significant implications for subsequent educational and occupational pathways (Farmer, Wardrop, Anderson, & Risinger, 1995). In addition, adolescents' after-school environments become more competitive than those during childhood (e.g., a slot on the football team), often requiring a greater skill and time investment. Adolescents also have greater demands on their after-school time than do younger children, such as paid employment (Larson & Verma, 1999). These shifts make adolescence a particularly interesting period to study achievement-related choices because it is both a time of greater opportunity to make choices and a time in which these choices become more consequential.

According to ecological theory and expectancy–value theory, adolescents' achievement-related choices are shaped by the immediate contexts in which they are embedded and their prior developmental history, as well as by the broader culture in which they live (Bronfenbrenner & Morris, 2006). Certainly, sociocultural studies have shown that the broader cultural setting shapes the likelihood that adolescents will pursue specific activity domains (Rogoff, 2003). Furthermore, the larger contexts in which adolescents and families are embedded, such as adolescents' school or neighborhoods, influence children and families (Furstenberg et al., 1999). However, what is really interesting is the variability within similar contexts. For example, not all adolescents from families with high resources participate in organized activities even though they are likely to have the resources to support participation (Mahoney & Eccles, 2007; Simpkins, Ripke, Huston, & Eccles, 2005). More importantly, some children and adolescents in families with very limited resources participate in organized activities (Lareau, 2003; Mahoney & Eccles, 2007; Simpkins, Ripke, et al., 2005). Several researchers have shown that parents' beliefs and behaviors are key determinants of how children invest their time within and after school (Eccles, 1993; Fredricks & Eccles, 2005; Lareau, 2003; Simpkins, Ripke, et al., 2005). However, few studies have been couched within a broad and integrative theoretical model.

Adolescents' choices also are based on a developmental process with roots in childhood. Several motivational theories note that adolescents' choices are based, in part, on their prior ability self-concepts and values as shown in Figure 1a (Deci & Ryan, 1985; Eccles, 1993; Marsh & Craven, 1997). One of the next critical questions is: What are the contextual factors that promote adolescents' ability self-concepts and values? Many social cognitively oriented socialization theorists argue that parents shape children's motivational beliefs and choices through their own beliefs and behaviors (Eccles,

1993; Eccles [Parsons] et al., 1983; Goodnow & Collins, 1990; Grolnick, Ryan, & Deci, 1991; McGillicuddy-DeLisi, 1982). The family socialization model illustrated in Figure 1b summarizes these theoretical perspectives (Eccles, 1993). This perspective on the socialization and enactment of behavioral choices is consistent with recent theoretical work focused on cascades of experience and outcomes (Masten & Coatsworth, 1998; Masten et al., 2005). According to a cascade perspective, experiences have immediate and long-term consequences because they set in motion processes that change individual's developmental trajectories through their impact on options, skills, assets, and risks across time.

Foundational Issues in the Expectancy–Value Model

In this next section, we discuss three important theoretical debates concerning the relations outlined in the Eccles's socialization model that we address in this monograph: (1) origin of parents' beliefs, (2) direction of influence, and (3) gender. A full review of the literature relevant to these issues is included later in the introduction where specific components of the model are discussed.

Origins of Parents' Beliefs

Inherent in the Eccles's et al. model illustrated in Figure 1b, as well as in other sociocultural theories of social development, is the idea that parents' beliefs and behaviors do not emerge in a vacuum (Furstenberg et al., 1999; McLoyd, 1990). They are influenced by characteristics of their children and by their own circumstances, values, histories of experience, and sociocultural positioning (see the boxes to the far left). For example, two characteristics that should influence parents' beliefs and behaviors is the child's gender and abilities. In fact, one could argue that these characteristics, circumstances, and histories begin the cascade. But they can also influence all subsequent steps in the socialization stream through ongoing feedback loops. For example, parents' estimates of their children's abilities in various domains should be responsive to information they receive about their children's performance in these domains—information obtained from others like teachers or coaches, as well as information obtained through parents' own interactions with their children. Similarly, the value parents attach to their children acquiring particular competencies or interests should be responsive to information they get about their children's competencies and the emerging interests their children develop over time.

Direction of Influence

The importance of feedback systems was initially discussed most extensively by Bell (1968) who argued that we should not assume that the statistical associations we find between parenting constructs and children's

characteristics reflect a unidirectional influence from parents to children. Instead, we should consider the possibility that parents are responding to characteristics of their children. This view is now widely endorsed and most developmental theoreticians now argue for the importance of taking a reciprocal view of parent–child patterns of influence (Bronfenbrenner & Morris, 2006; Bugental & Johnston, 2000; Mischel, 1973; Pardini, 2008; Rogoff, 2003; Sameroff, 2000). Although the influence of children on parents has been at the forefront of research on some areas of development, such as child temperament (Bates, 1987; Belsky, 1984), children's effects on their parents have not received much attention in the field of achievement-related motivation and behavior, even in studies based on the Eccles model (Simpkins, Fredricks, & Eccles, 2012). One of our goals is to fill this gap with regard to the possible influence of children's gender, competencies, and beliefs on their parents' beliefs and behaviors.

A secondary feedback system detailed in the Eccles's expectancy–value model is the reciprocal relations between individuals' beliefs and their behaviors over time. As in most social cognitive theories of behavior, Eccles et al. (1983) assume that beliefs cause behaviors. However, there is a long tradition within the social psychology of the link between attitudes and behaviors in which scholars question this assumption. For example, in his classic work, Bem (1970) argued that people infer their beliefs from their behaviors. Scholars within the attitude behavior tradition, now argue that the association between beliefs and behaviors are stronger when the attitudes are quite specific and directly tied to the behaviors being studied (Eagly & Chaiken, 1993). In this monograph, we investigated several of these possibilities.

Gender

Gender differences are a pervasive theme throughout the literatures on achievement-related engagement and performance. This is particularly true in the domains of sports, math, and reading. These three domains, plus instrumental music, were selected, in part, due to the traditional gender stereotypes associated with each of these areas. Sports and math are often considered to be masculine domains, whereas reading/English and instrumental music are often deemed as feminine domains during childhood (Wigfield et al., 2006). In fact, particular initiatives have been developed to try to reduce these gender differences. For example, Title IX addresses equality in school sports opportunities for boys and girls. The National Science Foundation also has placed a spotlight on increasing women's and ethnic minority individual's pursuit of science, technology, engineering, and math. Furthermore, the underachievement of boys in reading and English is receiving renewed attention (Fredricks, 2014).

Gender differences in youths' behavioral engagement in each of these domains emerge early in elementary school. Boys are more physically active

and more likely to participate in organized sports than girls (Duncan, Duncan, & Strycker, 2005; Fredricks & Eccles, 2006; Jacobs, Vernon, & Eccles, 2005; Kahn et al., 2008). In contrast, girls are more likely to participate in music (Jacobs et al., 2005) and reading during out-of-school time than boys (Baker & Wigfield, 1999; Coles & Hall, 2002; Nippold, Duthie, & Larsen, 2005). The findings for math depend on whether it is in school or out of school; boys are *less* likely to engage in math activities outside of school (Eccles & Harold, 1991; Simpkins, Davis-Kean, & Eccles, 2005), but *more* likely to enroll in the most advanced math courses during high school than girls (Eccles [Parsons] et al., 1984; Farmer et al., 1995; Updegraff, Eccles, Barber, & O'Brien, 1996). The gender differences in instrumental music may also change during adolescence when boys become increasingly interested in rock music and garage bands. The next critical step that we undertake in this monograph is to understand the role of gender in the precursors of these gendered choices.

Gender effects can take two forms: (a) mean-level differences between girls and boys on key constructs and (b) differences in the patterns of associations among constructs. The existing research has largely focused on mean-level gender differences in the types of constructs included in this investigation. Mean-level differences speak to whether boys or girls, on average, are more likely to engage in certain activities or hold different motivational beliefs. These findings are critical to identify areas of discrepancy and to pinpoint particular segments of the population that should be targeted with policy and practice initiatives.

It is equally important, however, to understand if the nature of the associations among constructs for the various groups are similar. For example, it is important to know if the subjective task value an individual places on math versus English is an equally powerful predictor of taking advanced math courses for boys and girls. Eccles and her colleagues found that it was not—subjective task values were more powerful predictors for girls' than for boys' intentions to take more math courses—in contrast, ability self-concepts were more powerful predictors for boys than for girls (Eccles [Parsons] et al., 1983). Other research suggests there may not be differences in the predictors between girls and boys (Simpkins, Davis-Kean, & Eccles, 2006). If policy makers and practitioners want to change outcomes, they need to know whether the same program or intervention should be designed for both genders. This type of information is gathered by testing whether gender is a moderator of the relations among constructs. Relatively few such studies have been done.

It is important to note that moderation can occur regardless of mean-level differences. In math, boys have higher math motivational beliefs and enroll in a higher number of elective advanced math and physical science high school and college courses than girls (Updegraff et al., 1996). Despite these differences, the associations between math beliefs and the number of math

courses are similar for both boys and girls (Simpkins, Davis-Kean, et al., 2006). In other words, if an adolescent believes s/he is good at math, he *or* she is more likely to enroll in a math course than an adolescent who does not believe s/he is good at math. Thus, boys and girls with high beliefs about their math abilities are likely to enroll in math courses (i.e., lack of moderation based on gender). However, boys are more likely than girls to have high math-related ability beliefs (i.e., significant mean-level differences based on gender). Although we have consistent research findings on mean-level gender differences, particularly in sports and math, much less is known concerning whether the relations among indicators vary based on gender. In the next two sections, we review the support for the relations between (a) parenting and children's motivational beliefs, and (b) children's motivational beliefs and choices.

A MORE DETAILED PERSPECTIVE ON PARENTING BELIEFS AND BEHAVIORS

As children's first socializers, parents play an important role in the creation of gender-differentiated beliefs and values by giving children their first messages about gender roles and by providing them with opportunities and experiences that support the development of certain competencies (Coltrane & Adams, 1997; Eccles, 1993; Eccles [Parsons] et al., 1983). Many developmentalists believe these early experiences play an important role in shaping children's views of their capabilities (Bandura, 1997; Eccles, 1993; Goodnow & Collins, 1990; Harter, 1999). Parents may be particularly influential in shaping children's beliefs and abilities when they are in elementary school because children are highly focused on these activities as well as on forming their ability self-concepts around these activities during this period (Eccles & Midgley, 1989; Erikson, 1982; Stipek & MacIver, 1989).

Another factor that contributes to parents' importance in elementary school is the degree of control they have over the kinds of experiences their children are exposed to and how they spend their time (Eccles, 1993; Parke et al., 2003). When children are young, parents play an important role in getting their children initially involved in activities, such as by buying equipment and books to support their continued involvement, and spending time with them to develop their skills. As children get older, parents begin to relinquish some control and give children more responsibility for making their own decisions. Children begin to play a role in planning their activities during the after-school hours near the end of elementary school (Savage & Gauvain, 1998).

Parent Beliefs

Parents can play a role in shaping children's competence and value beliefs by conveying general messages to children about their view of the

world and more specific messages about children's varying abilities in different activity domains. As shown in Figure 1b, parents convey these messages to children in a variety of ways including: (1) causal attributions about children's success in various domains, (2) specific expectations for success, (3) perceptions of the value of various activities, and (4) perceptions of the difficulty of various tasks (Eccles, 1993). In this study, we focus on parents' perceptions of their children's ability and perceptions of the value of each domain as they are the two dimensions that have received the most attention in prior research.

Parents' estimates of their children's academic competencies have been found to be important predictors of children's own ability self-concepts and actual performance (Alexander & Entwisle, 1988; Eccles, 1993). There is an extensive literature linking parents' ratings of their children's ability to children's estimates of their ability and interest in sports, math, and English (Andre, Whigham, Hendrickson, & Chambers, 1999; Bhanot & Jovanovic, 2005; Bleeker & Jacobs, 2004; Fredricks & Eccles, 2002, 2005; Frome & Eccles, 1998; McCullagh, Matzkanin, Shaw, & Maldonado, 1993; Simpkins et al., 2012; Shumow & Lomax, 2002; Tiedemann, 2000). In fact, parents' beliefs of children's math and sport abilities predicted slower declines in children's competence beliefs from grades 1–12 using the same data as is reported in this monograph (Fredricks & Eccles, 2002). Very little comparable work has been done in the domain of instrumental music, though scholars have suggested parents' perceptions of their children's musical ability and talent may be important factors in children's music motivation (Dai & Schader, 2002; Davidson, Howe, Moore, & Sloboda, 1996; Eccles, 1993; Simpkins et al., 2012). Furthermore, researchers have yet to link these experiences in a cascading fashion to achievement-related choices made during adolescence.

Parents' value of a domain may also predict their children's own competence and value beliefs, but less research has addressed this question. When parents perceived that participating in schoolwork and sports was important, elementary and junior high school students had increased academic and sport competence beliefs (Bandura, Barbaranelli, Caprara, & Pastorelli, 1996; Eccles & Harold, 1991; Fredricks & Eccles, 2005; Simpkins et al., 2012) as well as increased participation in sports (Fredricks & Eccles, 2005; Kahn et al., 2008). In contrast, other studies have failed to document a relation between parents' perception of importance and children's ability self-concepts and interest in math and reading (Andre et al., 1999; Simpkins et al., 2012) and between parents' value beliefs and children's sport participation (Eccles & Harold, 1991; Kimiecik & Horn, 1998). Preliminary evidence is also mixed on whether these relations differ depending on the gender of the parent and gender of the child (Fredricks & Eccles, 2005; McGrath & Repetti, 2000).

In contrast to the extensive literature on parents' general beliefs (e.g., the valuing of achievement and school competence, child rearing beliefs, values and goals, gender-typed beliefs, and cultural-based beliefs), only a handful of studies have examined the links between parents' child-specific beliefs (i.e., perceptions of their child's competence and value) and parenting practices. In a previous study using the same data as this monograph, researchers tested portions of the Eccles's parental socialization model in sports, instrumental music, math, and reading (Simpkins et al., 2012); mothers' behaviors mediated the link between mothers' and youth's beliefs in sports, music, and math, but not in reading. Additionally, Jodl and coworkers (2001) found that in sports, fathers' behaviors mediated the relation between parents' and youth's sport values. In contrast, they also found that parents' values in academics predicted adolescents' values directly rather than indirectly through their behaviors.

Parent Behaviors

Historically, family researchers have largely focused on face-to-face interactions and parenting styles. Parents also promote children's development by managing children's environments through such strategies as choosing where to live, designing peer networks, providing objects that structure children's activities, and seeking specific experiences outside of their home (Bradley et al., 1989; Eccles, 1993; Furstenberg et al., 1999; Parke et al., 2003). Theories of sociocultural psychology and motivation, posit that parents play a central role in adolescents' choices through these types of promotive behaviors (Rogoff, 1990). According to the Eccles's socialization model (Eccles, 1993), parents influence their children's beliefs through five basic mechanisms: (1) role modeling, (2) encouragement and reinforcement, (3) interpreting their children's experiences and the events they observe around them, (4) provision of activity-related experiences (e.g., sport equipment), and (5) parent–child coactivity (e.g., parents practicing sports with their child).

Modeling

Parents' leisure pursuits, or their modeling of behavioral choices, have the potential to influence their children's choices through processes associated with observational learning and with the desire to be like their parents (Bandura, 1997; Eccles, 1993). The process of role modeling has been suggested as one of the ways in which children absorb social norms, especially those associated with gender-typed choices (Maccoby & Jacklin, 1974). The handful of studies on the effects of role modeling on academic outcomes has not found strong associations (Andre et al., 1999; Eccles [Parsons] et al., 1982), though adult modeling may have a modest influence on children's

reading (Neuman, 1986; Pluck, Ghafari, Glynn, McNaughton, 1984). The findings concerning the effects of role modeling in sports and music are also mixed. Some studies have shown significant relations between parents' and children's activity level, especially with young children (Kahn et al., 2008; Moore et al., 1991; Sallis, Prochaska, Taylor, Hill, & Geraci, 1999; Vilhjalmsson & Thorlindsson, 1998), whereas others found no relation between parent and child activity level (Dempsey, Kimiecik, & Horn, 1993; Fredricks & Eccles, 2005; Kimiecik & Horn, 1998; Welk, Woods, & Morss, 2003). Finally, although only a minority of parents are performing musicians or play an instrument themselves (McPherson & Davidson, 2006; Sloboda & Howe, 1991), parental modeling in terms of listening to music predicted children's music competence (Davidson et al., 1996). There are a variety of reasons for the mixed findings concerning modeling. Parental modeling may be a weak unique predictor relative to other behaviors (e.g., coactivity) because it is likely to occur with other behaviors. In contrast, modeling may have a weak influence on activities that are more cognitive in nature and require instruction, such as completing a math problem or reading a book.

Encouragement

Parental encouragement can directly promote children's ability self-concepts and values through positive reinforcement (Eccles, 1993). Encouragement may also indirectly support children's ability self-concepts and values by creating a positive affective association with particular activities. Studies consistently highlight the importance of parental encouragement. Talented adolescents and elite adult athletes, artists, and musicians reported that parental encouragement was one of the key dimensions of parenting that shaped their pathways (Bloom, 1985; Csikszentmihalyi, Rathunde, & Whalen, 1993; Sosniak, 1990). Parental encouragement and support in reading and math has been linked to children's time spent reading (Neuman, 1986) as well as math self-efficacy beliefs, perceptions of the importance of math, and career interests in math and science (Ferry, Fouad, & Smith, 2000; Turner, Stewart, & Lapan, 2004). Several studies have linked parental encouragement in sports to children's sport interest and athletic participation (Bauer, Nelson, Boutelle, & Neumark-Sztainer, 2008; Brustad, 1993; Fredricks & Eccles, 2005; Pugliese & Tinsley, 2007; Sallis et al., 1999). In addition, individuals who achieved high musical competence reported having had supportive parents who provided ongoing encouragement and general support for music practice (Davidson et al., 1996; Howe & Sloboda, 1991; McPherson & Davidson, 2002; Sosniak, 1985).

Provision of Materials

According to sociocultural theory, materials in the home expose children to particular experiences and value systems (Vygotsky, 1978). Parents actively manage the home environment as a way to structure children's experiences

through the provision of toys, equipment, books, and other learning activities (Furstenberg et al., 1999; Parke et al., 2003). Higher exposure leads to children's comfort, engagement, and learning in a domain, as well as engagement in a domain with their parents (e.g., reading a book with their parents). Materials provided in the home have been core to the research on supporting children's academic achievement as noted in the work by Bradley et al. (1989), research on family involvement in children's education (Epstein, 1995), and research on the socialization of gender-typed activity patterns and preferences (Ruble et al., 2006).

Indicators of logistic support, such as sport equipment and transportation, predicted adolescents' sport motivational beliefs and physical activity (Davison, Cutting, & Birch, 2003; Dowda, Dishman, Pfeiffer, & Pate, 2007; Fredricks & Eccles, 2005; Pugliese & Tinsley, 2007). Furthermore, children who had increased access to literature-related activities in the home had more positive attitudes about reading, engage in more leisure reading, and had increased reading achievement (Neuman, 1986; Rowe, 1991; Whitehurst & Lonigan, 2001). Provision of music opportunities, in terms of purchasing instruments, books, and CDs, also is critical for children's ongoing music participation (McPherson, 2009; McPherson & Davidson, 2006). However, few studies have looked at the provision of materials as part of a larger model of parental influence and none have looked at this type of influence across activity domains.

Coactivity

Parent–child participation in an activity together (i.e., coactivity) is another strategy parents might use to promote children's activity participation. Parent–child coactivity can occur through informal activities at home, involvement in organized activities such as being a coach or going to a museum together, and attending a community event together (Simpkins, Vest, Dawes, & Neuman, 2010). Parent–child coactivity provides a context for parents to offer verbal encouragement, convey the value of an activity, provide feedback, and both model and teach skills.

Parents' involvement in children's sport activities (e.g., attending children's sporting events) predicted children's sport interest, ability self-concept, and participation (Babkes & Weiss, 1999; Duncan et al., 2005; Fredricks & Eccles, 2005). In music, parents' involvement in music lessons, going to concerts together, or informal music activities with the child was important for children's music success and persistence in both prospective and retrospective studies (Davidson et al., 1996; Howe & Sloboda, 1991; Sloboda & Howe, 1991; Sosniak, 1985, 1990; Zdzinski, 1994, 1996). Family joint reading in the home has also been related to young children's motivation to read (Baker, Scher, & Mackler, 1997; Bus, 1994; Morrow, 1983), though a few studies have failed to document a relation between parents'

involvement and children's reading motivation (Baker & Scher, 2002; Loera, Rueda, & Nakamoto, 2011). Finally, parent–child math coactivity predicted children's math knowledge and fluency (LeFevre et al., 2009).

How Do These Parental Behaviors Work Together?

Multiple parental behaviors can influence children. However, few studies have adopted a holistic integrated view of the family context. Instead, much of the previous research predicting activity participation from parental indicators has focused on only one or two behaviors, one parent, and/or one activity domain (Fredricks & Eccles, 2005; Simpkins et al., 2012). The qualitative literature on talent development demonstrates that families influence children simultaneously through multiple behaviors. For example, Bloom (1985) found that parents in the homes of elite athletes, musicians, and artists supported children's talents through multiple strategies, including helping to gain access to special teachers or coaches, helping to develop plans for practicing their skills, and providing money for lessons and equipment. Other scholars have also pointed to the importance of a holistic perspective on parenting that takes into account the variety of ways in which parents can interact with and influence their children (Lareau, 2003; Rogoff, 1990).

Most quantitative studies, however, include only a limited subset of parental behaviors and many use regression techniques that assess the unique contribution of each predictor adjusting for the other variables in the model rather than taking a more holistic view. Such analytic models are based on the assumption that influences relate additively to the outcome being studied and that the most important thing to understand is the unique effect of each individual component. Although this is a quite acceptable approach to studying multiple influences on a particular outcome as well as being the theoretical underpinning of multiple linear regression approaches to data analysis, it does reflect a strong theoretical stance regarding the nature of parental influences on their children—one that should be open to questioning in light of the qualitative studies that highlight a more nuanced and integrative perspective on family influences (Laureau, 2003; Rogoff, 1990).

The multiple regression approach also is being questioned for mathematical reasons. Including moderately to highly correlated predictors in regression models can obscure meaningful associations of individual predictors and the outcome variable due to deflated parameter estimates (Mosteller & Tukey, 1977). Given these theoretical and methodological considerations, we believe a holistic or pattern-centered approach, such as cluster analysis, multidimensional scaling, and cumulative models hold promise for assessing the more synergistic nature of families. In this methodological approach, individual factors are examined in conjunction with other factors rather than comparing the relative importance of each individual variable (Bergman, Magnusson, & El-Khouri, 2003).

There are three areas of research on family socialization that have taken a holistic approach to examining parental socialization. First, several scholars examining the parental correlates of children's physical activities have incorporated multiple indicators of parental behaviors, including indicators of praise, coactivity, encouragement, provision of necessary sport equipment/transportation, and parent's physical activity into an overall scale of parental support. This overall indicator predicts children's self-efficacy (Dowda et al., 2007) and physical activity (Beets, Vogel, Forlaw, Pitetti, & Cardinal, 2006; Davison et al., 2003; Dowda et al., 2007). A recent meta-analysis showed that an overall indicator of parents' behaviors had a small, but significant relation to children's physical activity (Pugliese & Tinsley, 2007).

Second, the literature on family involvement in children's education exemplifies a multivariate approach to studying families. For example, several scholars have argued that parents influence their children's academic performance through a variety of mechanisms, such as coactivity, involvement in the school, and providing an educationally enriching environment inside and outside of the home (Eccles, 1993; Eccles [Parsons] et al., 1983; Epstein, 1995; Lareau, 2003; Saracho, 2002). Parents' behaviors across these areas were predictive of children's academic achievement and motivational beliefs (see Jeynes, 2007, for a meta-analysis).

The other notable exception is work on parental socialization and achievement motivation by Eccles and her colleagues using the same dataset as used in this monograph (Fredricks & Eccles, 2005; Fredricks, Simpkins, & Eccles, 2005; Simpkins, Fredricks, Davis-Kean, & Eccles, 2006). Building on risk and resilience models (Rutter, 1988; Sameroff, Bartko, Baldwin, Baldwin, & Seifer, 1998), the researchers created indicators representing the extent to which a family included no, a few, or many supports for children's domain-specific competence beliefs, value beliefs, and activity engagement. This single indicator of parental support was linearly related to increases over time in children's ability self-concepts, values, and activity participation in math, sports, music, and science. This finding contradicted analyses with the same set of parental variables using regression techniques. These analyses showed that many of the behavioral socialization factors, such as time spent doing sports with children, were not related to children's competence and value beliefs after controlling for parents' beliefs and the children's actual competence.

Direction of Influence

The socialization of children is not a unidirectional process by which parents simply shape children. Although Bell emphasized this point as early as 1968, the majority of research has focused on how indicators of parenting predict children's adjustment (Bell, 1968). In the few relevant studies testing

the influence of children's beliefs and choices on parents, researchers have found that parents' promotive behaviors were predicted by children's previous sport ability self-concepts (Davison et al., 2003) and music involvement (Davidson et al., 1996). Similarly, Simpkins and her colleagues (2010) used latent growth curve modeling to examine the association between children's motivational beliefs and changes in parents' behavior in sports and instrumental music. They found that high child sport motivational beliefs predicted slower increases in fathers' sport-related behavior from grades 1–6. In contrast, fathers had steeper increases in behavior if their sons expressed an interest in instrumental music. Finally, using cross-lagged SEM, Eccles and her colleagues found that mothers' perceptions of their elementary school-aged children's ability more strongly predicted changes in children's ability self-perceptions across a 2-year period than vice versa (Eccles, Freedman-Doan, Frome, Jacobs, & Yoon, 2000).

Gender

Parents use a variety of factors including objective indicators to form their beliefs about their child's competencies and interests. Gender is one such salient characteristic that parents attend to in forming an impression of their child. Parents hold certain beliefs about girls' and boys' abilities in different domains, which may be partly influenced by the larger cultural beliefs about appropriate gender roles (e.g., men excel in mathematics and science).

The findings concerning differences in parents' beliefs based on children's gender in all domains are mixed. There is some evidence that parents rated children's math ability (Bhanot & Jovanovic, 2005; Eccles, Jacobs, & Harold, 1990; Herbert & Stipek, 2005; Jacobs & Eccles, 1992; Tiedemann, 2000) as well as sport competence and importance beliefs (Brustad, 1993; Eccles, 1993; Fredricks & Eccles, 2005; Jacobs & Eccles, 1992) higher for sons than daughters in childhood and adolescence. Additionally, there is evidence that parents of daughters rated their children as more competent in reading than do parents of sons (Bhanot & Jovanovic, 2005; Eccles, Jacobs, et al., 1993; Frome & Eccles, 1998; Lummis & Stevenson, 1990). However, it is important to note that other studies have failed to document gender differences in parents' perceptions of ability in and importance of math (Andre et al., 1999; Eccles et al., 1993; Frome & Eccles, 1998; Jacobs & Eccles, 1992), sports (Babkes & Weiss, 1999; Bois, Sarrazin, Brustad, Trouilloud, & Cury, 2002; Kimiecik & Horn, 1998), and reading (Andre et al., 1999; Herbert & Stipek, 2005).

The evidence that parents treat daughters and sons differently depends on the activity domain. Several researchers have shown that parents' differential engagement in behaviors for their sons and daughters follow

traditional gender stereotypes (Eccles & Hoffman, 1984; Lytton & Romney, 1991; Tenebaum & Leaper, 2003). For example, parents were more likely to purchase math and science items for their sons than their daughters in both childhood and adolescence (Bleeker & Jacobs, 2004; Jacobs et al., 2005). Additionally, parents have been found to provide more sport opportunities for boys than for girls (Fredricks & Eccles, 2005; Greendorfer, Lewko, & Rosengren, 1996; Welk et al., 2003), though a small number of studies on physical activity (which is broader than organized sports) showed no differences in behaviors based on child gender (Bauer et al., 2008; Duncan et al., 2005; Pugliese, & Tinsley, 2007). In contrast, parents reported similar reading-related behaviors for their sons and daughters (Neuman, 1986). The limited research testing gender as a moderator of the associations between parents' behaviors and children's outcomes indicated that parents' activity-related behaviors had similar associations with boys' and girls' beliefs and participation in a variety of activities (Fredricks et al., 2005; Simpkins, Davis-Kean, et al., 2005; Simpkins et al., 2010, 2012).

Parent gender also is important. Mothers and fathers may play different roles in gender socialization. According to reciprocal role theory (Johnson, 1975), fathers socialization practices are more likely to promote sex-typing in children because fathers tend to make a greater distinction between their sons and daughters. The evidence in support of reciprocal role theory is mixed. Delineating the role mothers *and* fathers play in socialization is complicated by the limited number of studies that have collected data from fathers. Additionally, some studies include mothers and fathers in the same model and suggest that fathers make a relatively minimal contribution to child development. We know this is not the case. Our goal in this monograph is to contribute to the literature by testing the parental processes at hand for mothers and for fathers. As such, our hypotheses and analyses focus on similar processes for each parent, but do not focus on the comparison across parents or the relative contribution of each parent.

A MORE DETAILED PERSPECTIVE ON CHILDREN'S AND ADOLESCENTS' MOTIVATIONAL BELIEFS AND PARTICIPATION

According to the Eccles's expectancy–value model, contextual influences on adolescents' choices are mediated by adolescents' motivational beliefs (Eccles [Parsons] et al., 1983). According to this model (see Figure 1a), there are two key motivational beliefs underlying adolescents' participation in academic and nonacademic skill-based activities: individuals' confidence in their ability to be successful at an activity (now assessed in terms of the individuals' ability self-concepts) and the subjective task value they attach to engaging in an activity. Consistent with social constructivist perspectives,

individual differences in self- and task-perceptions come not from reality itself, but from children's interpretation of reality.

Competence Beliefs

Ability self-concept is defined as children's beliefs about their competence in different areas as well as how well they expect to do on the task (Eccles [Parsons] et al., 1983). Ability self-concept has been the cornerstone of many other theories whose goal is to predict performance and choices, including Bandura's (1977) seminal work on self-efficacy, Covington's self-worth theory (1992), and Marsh's reciprocal effects model (Marsh, Gerlach, Trautwein, Lüdtke, & Brettschneider, 2007). In fact, according to self-determination theory, people's need for competence will drive them to seek out situations in which they can express and build their competencies (Ryan & Deci, 2000). Harter (1999) also asserted that children's ability self-concepts have implications beyond choices; such that, ability self-concepts in highly valued activity domains are the building blocks of one's overall self-esteem.

Although several studies have linked ability self-concepts to choice, effort, persistence, and performance in mathematics, English, computer activities, and sports (Marsh, Chanal, Sarrin, & Bois, 2006; Marsh et al., 2007; Wigfield et al., 2006), the findings are mixed across domains. For example, math ability self-concept did not predict the number of math and science courses taken in high school once actual performance history was controlled in some studies (Joyce & Farenga, 1999; Updegraff et al., 1996), but it was predictive in other studies (Simpkins, Davis-Kean, et al., 2006). Ability self-concept in reading was associated with the amount and breadth of leisure time reading in elementary school (Baker & Wigfield, 1999; Guthrie & Wigfield, 2000; Wigfield & Guthrie, 1997) as well as the number of language courses taken and time spent reading for pleasure in high school (Durik, Vida, & Eccles, 2006). Furthermore, children's self-concept of sport ability predicted children's athletic participation (Bois et al., 2002; Fredricks & Eccles, 2005; Kimiecik & Horn, 1998; Sabiston & Crocker, 2008). Finally, there is limited evidence that self-concept of music ability predicts interest and participation for both in-school and out-of-school music activities (Austin, 1990; Klinedinst, 1991; Simpkins et al., 2012). No studies have looked at multiple domains simultaneously so we do not know whether these inconsistencies across studies and domains reflect methodological or substantive issues.

Value Beliefs

Eccles and her colleagues have developed the most extensive theory of subjective task value (see Eccles [Parsons] et al., 1983; Wigfield & Eccles, 1992, for a full description). Subjective task value is broadly defined as the relative

value individuals attach to doing different tasks. Individuals should engage in tasks they positively value and avoid tasks that they do not highly value. Subjective task value is a function of at least four distinct components: intrinsic value (enjoyment of the activity), attainment value (importance of doing well on the task for confirming aspects of one's self-schema), utility value/importance (importance of task for current or future goals), and cost (negative aspects of engaging in task) (Eccles [Parsons] et al., 1983). Intrinsic value is related to the construct of intrinsic motivation (Deci & Ryan, 1985; Harter, 1981), and to the constructs of interests and flow (Csikszentmihalyi, 1988; Renninger, 2000; Schiefele, 1991). In contrast, attainment value and utility value are related to the link of the task to other short- and long-term goals. In this investigation, we focus on intrinsic value (henceforth labeled interest) and attainment/utility value (henceforth labeled importance) as they are the two dimensions that have received the most attention in prior research.

There is strong empirical support for interest and importance being central to children's choices. Adolescents' values (i.e., a combination of interest and importance) were strong predictors of their *intentions* to enroll in elective math and science courses (Atwater, Wiggins, & Gardner, 1995; Crombie et al., 2005; Ethington, 1991) and the actual number of math and science courses adolescents took in high school (Joyce & Farenga, 1999; Simpkins, Davis-Kean, et al., 2006; Simpkins et al., 2012; Updegraff et al., 1996). Math values were also important in whether adults pursue a career in science (Farmer et al., 1999). The findings for reading are mixed. Interest in reading was related to time spent reading for pleasure, but not to time spent reading in school (Cox & Guthrie, 2001; Durik et al., 2006). In addition, some studies have linked reading importance to reading time use and course taking (Durik et al., 2006; Simpkins et al., 2012), whereas others have failed to document a relation between reading importance and time spent reading for pleasure (Baker & Wigfield, 1999; Wigfield & Guthrie, 1997). Furthermore, children's values were positively associated with sport involvement (Eccles & Harold, 1991; Sabiston & Crocker, 2008; Simpkins et al., 2012) and negatively associated with dropping out of athletics (Guillet, Sarrazin, Fontayne, & Brustad, 2006). Finally, a few studies have linked music task value to time spent practicing music (McPherson & McCormick, 1999; O'Neill, 1999; Simpkins et al., 2012).

Direction of Influence

Up to this point, we have discussed the relations between adolescents' motivational beliefs and choices in terms of how adolescents' motivational beliefs predict their choices. Motivation models explicitly state that the relations between beliefs and choices are reciprocal across time (Eccles, 1993; Marsh, Byrne, & Yeung, 1999; Marsh & Craven, 2006). The research that has

been conducted focuses on the reciprocal associations between motivational beliefs and performance, not choices. For example, in a series of studies in both academic and non-academic domains, Marsh (1990), Marsh and Perry (2005), Marsh and his colleagues (2006, 2007) found that ability self-concept was associated with increases in performance, and in turn, that higher performance was related to increased ability self-concept.

Participation in math out-of-school activities and the number of high school elective math and science courses has been found to predict adolescents' subsequent motivational beliefs in math and science (Farmer et al., 1995; Jacobs, Finken, Griffin, & Wright, 1998; Simpkins, Davis-Kean, et al., 2006). Participation in sports also positively predicted subsequent sport interest, importance, and self-concept of ability (Fredricks, 1999; Simpkins, Fredricks et al., 2006; Simpkins et al., 2010). Although these studies provide preliminary evidence that children's choices are associated with beliefs. One central goal of this study is to test the strength of the reciprocal relations between choices and motivational beliefs across time through a series of cross-lagged models.

Gender

Boys' and girls' domain-specific ability self-concepts differ in gender role stereotypic ways during childhood and adolescence. For example, several studies have shown that girls have lower math ability self-concepts even though boys and girls perform equally well in this domain (Evans, Schweingruber, & Stevenson, 2002; Fredricks & Eccles, 2002; Herbert & Stipek, 2005; Jacobs, Lanza, Osgood, Eccles, & Wigfield, 2002; Marsh & Yeung, 1998; Tiedemann, 2000; Watt, 2005). In addition, girls have consistently reported lower self-concepts of sport ability than boys in both childhood and adolescence (Eccles & Harold, 1991; Evans et al., 2002; Fredricks & Eccles, 2002, 2005; Klomsten, Skaalivk, & Espnes, 2004; Sabiston & Crocker, 2008). In contrast, girls have reported higher reading and language arts ability self-concepts than do boys (Andre et al., 1999; Baker & Wigfield, 1999; Evans et al., 2002; Lummis & Stevenson, 1990; Marsh, 1989). Finally, limited research suggests that elementary school-aged girls had more positive self-concepts of ability in instrumental music than do boys (Eccles, Wigfield, Harold, & Blumenfeld, 1993; Evans et al., 2002).

Gender differences in the value children and adolescents attach to different activities also tend to follow gender norms and stereotypes. Consistent differences in values are evident in sports and reading across a variety of ages. Boys placed greater value on sports than girls (Eccles, Wigfield, et al., 1993; Fredricks & Eccles, 2002; Jacobs et al., 2002; Klomsten, Marsh, & Skaalvik, 2005; Sabiston & Crocker, 2008; Wigfield et al., 1997), whereas, boys placed lower value on reading and language arts than girls (Andre et al., 1999; Baker & Wigfield, 1999; Evans et al., 2002; Jacobs et al., 2002; Marinak &

Gambell, 2010; VanSchooter, Oostdam, & de Glopper, 2001; Wigfield et al., 1997). The findings regarding gender differences in math value have been mixed. Some studies show no gender differences in math value (Eccles, Wigfield, et al., 1993; Fredricks & Eccles, 2002; Jacobs et al., 2002). In contrast, other studies show that boys report greater interest in math in high school (Hyde, Fennema, Ryan, Frost, & Hopp, 1990) and rate the importance of math higher than do girls (Andre et al., 1999). Very little research has addressed gender differences in instrumental music value. One exception is work by Eccles and her colleagues (1993) who found that girls had more positive value beliefs in music than did boys.

The majority of research addressing gender differences in motivational beliefs has examined whether boys and girls differ according to their means. A second and completely independent question is whether gender moderates or alters the associations between the constructs in the models. Tests of gender moderation examine if similar processes operate for girls and boys. If the various self- and task-related beliefs of the early adolescents predict subsequent activity choices differently for girls and boys, then interventions aimed to increase the participation of girls and boys in math and science, for example, will need to focus on different beliefs. More specifically, if the task value beliefs are stronger predictors of girls' than of boys' subsequent course-taking in math and vice versa for math ability self-concepts, then interventions to increase girls' enrollments will need to focus on task value beliefs whereas interventions to increase boys' enrollments should focus on raising their ability self-concepts. The few researchers who have tested gender as a moderator have found that the relation between youths' motivational beliefs with participation and performance are similar for boys and girls in academic and nonacademic domains (Marsh et al., 2007; Sabiston & Crocker, 2008; Simpkins, Davis-Kean, et al., 2006; Valentine, Dubois, & Cooper, 2004). Given the small but growing literature on adolescent gender as a moderator of these relations and the potential importance of the issue for designing effective interventions, we explored whether child gender moderated relations between motivational beliefs and participation.

OUR HYPOTHESES

Our overarching goal in this monograph is to test the predicted relations outlined in Figure 1b. Consistent with cascade-type models of human development, this model includes three main portions: the first focuses on the association of child characteristics with their parents' beliefs, the second focuses on parents' possible influence on their children's beliefs, and the third focuses on the relations of children's beliefs to their own achievement-related task engagement. Because we assume that the first two portions

precede the third in developmental time, we use data from early elementary school to investigate the first parts of the model and data from late elementary school through high school to investigate the second half of the model. Throughout, we control for the exogenous characteristics shown in the far left boxes of Figure 1b in order to provide as strong a test as possible of the proposed causal linkages. In addition, we use cross-lagged analytic techniques to provide a further test of the proposed causal links in the model. We examine these hypotheses across two mandatory school-based achievement domains (math and reading) and two voluntary but highly skilled leisure activities (sports and instrumental music), all four of which are gender-typed in the United States.

We have five general hypotheses. First, parents' views of their children's abilities will be reciprocally related to the teachers' estimates of their children's natural talent in each domain and to the gender of their child. Second, parents' beliefs will positively predict changes in their children's motivational beliefs and participation. Third, parents' beliefs will positively predict changes in their own behaviors over time (i.e., role modeling, encouragement, expectancies for success, provision of activity-related experiences, and parent–child coactivity). Fourth, parents' behaviors will positively predict changes in their children's ability self-concepts and values. Fifth, youth's ability self-concepts and values will positively predict changes in their own subsequent participation.

In relation to the direction of influence questions, based on prior literature, we have two specific hypotheses. First, although there will be reciprocal relations between parents' and their children's constructs, the direction of influence will largely flow from parents to youth in childhood. Second, although there will be reciprocal relations between parents' beliefs and behaviors, as well as youths' beliefs and behaviors, the direction of influence will largely flow from parents' beliefs to behaviors, and youth's beliefs to behaviors.

In terms of youth gender, we have two specific hypotheses. First, parents of daughters will hold higher beliefs and engage in more behaviors for reading and instrumental music than parents of sons. The opposite pattern will emerge for sports and math. Second, girls will have higher motivational beliefs and participation in reading and instrumental music as well as lower motivational beliefs and participation in sports and math than boys.

Because so little work has been done comparing different activity domains, we cannot base hypotheses on existing empirical literature. However, given that developing skills and interests in both sports and instrumental music in the United States depend more on parental efforts than do developing skills and interests in math and reading, we expect the consistency of evidence and the strength of the associations to be higher for parental influences in sports and instrumental music than in math and reading.

II. METHODS

Participants

The data are from the Childhood and Beyond Study (CAB), which has a cohort-sequential design. This school-based study includes families with children in 12 public schools in four school districts in Southeastern Michigan (Eccles, Harold, & Wigfield, 1993). These districts served largely European American working- and middle-class families. The study began in 1987 in two school districts with children in three cohorts in kindergarten, first grade, and third grade. During the second and third year of the study, students were added to the study because two additional school districts were added and because siblings were added. Each recruitment year, letters describing the study and permission slips were given to families by children's teachers. Overall, 75% of the families agreed to participate.

Three of the four school districts consisted of medium to large suburban communities. The fourth was a medium-sized university city. Each district was primarily European American (95%), and included a small minority population of African Americans, Native Americans, Asian Americans, and Hispanics. These school districts were explicitly selected so that family income and neighborhood resources would not be obstacles to children's activity participation and course-taking, allowing researchers to investigate the impact of other parent and child factors on these choices. For example, each district had resources in terms of gifted or enrichment programs, computer programs, and instrumental music.

The CAB study included 987 children. In addition, 723 of their mothers and 541 of their fathers also agreed to participate. In order to keep our sample as representative as possible of the full population in these 4 school districts, we used data from the 723 families with data from the mothers and their children for all analyses that did not involve father data. We used the sample of 541 for those analyses that included father data, because this is the full sample of those families in which the father participated. Given the relative scarcity of studies based on fathers using data collected directly from fathers, we wanted to include our sample of fathers in this monograph but we also wanted to

report the data for the larger sample of 723 for those analyses involving only the mother and child data in order to increase the power and the representativeness of the sample for these analyses. We provide information on our treatment of missing data in Chapter 3.

The families were largely European American, spoke English, and had lived in the United States for several generations. As shown in Table 1, annual family income, which was created using data from Waves 1 through 4 (i.e., from 1987 to 1990), ranged from $10,000 to over $80,000 with a median of $40,000–$49,999. Ninety-eight percent (98%) of parents had received a high school degree and over 37% had received a bachelor's degree. Within each cohort of youth, the sample was split equally by gender.

Procedures

Data for this report came from multiple waves of CAB. Table 2 displays the overall design of CAB, including children's grade levels at each wave. For example, Wave 3 data were collected in 1989 when children were in grades 2, 3, and 5. Most waves were spaced 1 year apart, but there were two exceptions

TABLE 1

PARTICIPANT DEMOGRAPHIC INFORMATION

	Youngest Cohort		Middle Cohort		Oldest Cohort	
	Mothers	Fathers	Mothers	Fathers	Mothers	Fathers
Parent information						
European American	97%	95%	92%	92%	95%	94%
Parents' education[a]						
Less than high school	2%	3%	3%	1%	1%	1%
High school degree	22%	11%	18%	9%	20%	12%
Some college	40%	37%	42%	38%	39%	37%
Bachelor's degree	19%	31%	28%	28%	16%	32%
Advanced degree	15%	18%	10%	23%	13%	20%
Family income[a]						
Median	$40,000–$49,999		$40,000–$49,999		$50,000–$59,999	
Child information						
Age at Wave 1 [*M* (*SD*)]	6.42 (.37)		7.37 (.38)		9.37 (.37)	
Females	49%		50%		52%	
European American	94%		92%		90%	
Recruited at						
Wave 1: *n* (%)	148 (52%)		182 (60%)		152 (39%)	
Wave 2: *n* (%)	116 (40%)		111 (36%)		85 (21%)	
Wave 3: *n* (%)	23 (8%)		13 (4%)		157 (40%)	

[a]These indicators are based on data reported across Waves 1 through 4.

TABLE 2

DATA COLLECTION SCHEDULE OF THE YOUNGEST, MIDDLE, AND OLDEST COHORTS

		Grade Level												
Spring of	Wave	K	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	11th	12th
1987	1	Young	Middle		Oldest									
1988	2		Young	Middle		Oldest								
1989	3			Young	Middle		Oldest							
1990	4				Young	Middle		Oldest						
1991														
1992														
1993														
1994	5								Young	Middle		Oldest		
1995	6									Young	Middle		Oldest	
1996	7										Young	Middle		Oldest
1997														
1998	8													Middle
1999	9													Young

to this rule. First, Wave 5 (grades 7, 8, and 10) occurred four years after Wave 4 (grades 3, 4, and 6) due to a funding gap. Second, Waves 8 and 9 occurred when children in the middle and youngest cohorts were in grade 12. Data used in this investigation were collected from children, parents, and teachers.

Data from all parents were collected in Waves 1, 2, 3, 4, and 6. However, we only used parent data from Waves 2 through 4 for the analyses reported in this monograph. Waves 1 and 6 parent data were not included because these waves did not include all of the constructs of interest. These waves also included a large amount of missing data because recruitment was not complete at Wave 1 and because of parent attrition at Wave 6. Self-administered parent questionnaires were mailed home with a stamped, return envelope in the spring of Waves 2 through 4. Children provided information during the spring of Waves 2 through 9. Questionnaires were administered in their school classroom under project staff supervision, except in Wave 6 when questionnaires were mailed to youth. During Waves 2 through 4, questionnaires were read aloud to the entire class. At Waves 5, 7, 8, and 9, the child questionnaires were self-administered in the classroom. Teachers reported information on children during Waves 1 through 4. Teacher data from Waves 1 through 3 were used in the analyses. These questionnaires were self-administered during the spring of each wave. Children also completed IQ and athletic ability assessments when they joined the study.

Parent-Reported Indicators

In this study, we used data from parent questionnaires, which included information about their demographic characteristics, beliefs, and behaviors. Parents' beliefs and behaviors were specific to the four domains included in this investigation: sports, instrumental music, math, and reading. Mothers and fathers separately reported information on all indicators.

Parents' Beliefs

Two parental beliefs were used in the current investigation at Waves 2 through 4: Perceptions of their child's ability and their valuing of a domain for their child. The specific items are listed in Table 3. *Parents' perceptions of their child's ability* were measured with three items in each domain at each wave. The reliability of this three-item scale was acceptable across parents, domains, and waves (Table 4). *Parents' valuing of a domain* was assessed with one item at Wave 2 and with two items in each domain at Waves 3 and 4.

Parents' Behaviors

There were five indicators of parents' behavior in each domain measured at Waves 2–4. Generally, the same items were used to measure each indicator

TABLE 3

ITEMS OF PARENTS' BELIEFS

Items
Parents' perception of their child's ability
1a. How good is this child at (sports/music/math/reading)? (1 = *not at all good*, 7 = *very good*)
1b. Compared with other children, how much innate ability or talent does this child have in (sports/instrumental music/math/reading)? (1 = *much less than*, 7 = *much more than*)
1c. How well do you think this child will do in each of these areas next year (for sports/music/math/reading)? (1 = *not at all well*, 7 = *very well*)
Parents' valuing of a domain for their child
2a. How important is it to you that this child do well in (sports/music/math/reading) (1 = *not at all important*, 7 = *very important*)
2b. How useful to do think each of these activities (sports/music/math/reading) will be to this child in the future? (1 = *not at all useful*, 7 = *very useful*)[a]

[a]Item was not assessed at Wave 2.

across parents, domains, and waves (see Table 5 for a complete listing). Exceptions to this rule are noted in Table 5 and the text below. For instance, in sports, there was one additional item for parental coaching that was not assessed in the other three domains. The means and standard deviations are presented in Table 6. Similar response scales were used across waves unless noted otherwise in Table 5.

Parents' encouragement described the extent to which they "encouraged their child to participate" in each domain. Encouragement in all four domains was assessed at Waves 2 and 3. Sports and music encouragement also were measured at Wave 4. As shown in Table 5, encouragement was measured with a single item with the exception of music encouragement at Wave 3. The two music encouragement items were averaged to create the Wave 3 indicator of music encouragement.

Parent-child coactivity was measured with two items: how often parents: (1) participated in child's daily activities and (2) took child to community events/institutions related to each domain. Parents indicated how often they generally participated in their child's daily activities in the four domains. Coactivity in sports and music was assessed with a single item at all three waves as listed in Table 5. Math coactivity was measured with one item at Waves 2 and 3 and two items at Wave 4. At all waves, parents reported how often they did math and science activities with their child. The additional item at Wave 4 assessed the extent to which parents helped the child with his/her math and science homework. Reading coactivity was assessed with two items at Waves 2 and 3: (1) how often the parent read to the child and (2) how often the child read to the parent. There was not an indicator of parent–child coactivity in children's daily reading activities at Wave 4.

TABLE 4

Reliability, Means (Standard Deviations), and Gender Differences of Parents' Perception of Their Child's Ability and Value of a Domain

	Mothers					Fathers				
Indicator	α	Females	Males	r^a	r^b	α	Females	Males	r^a	r^b
Sports										
Ability—W2	.92	4.75 (1.24)	5.32 (1.29)	−.19***	−.12**	.92	4.50 (1.27)	5.15 (1.27)	−.20***	−.15***
Ability—W3	.89	4.87 (1.16)	5.24 (1.31)	−.15***	−.06	.90	4.54 (1.32)	5.09 (1.28)	−.13***	−.07
Ability—W4	.87	4.93 (1.23)	5.28 (1.24)	−.09*	−.00	.89	4.60 (1.29)	5.04 (1.28)	−.13***	−.07
Value—W2	n/a	4.05 (1.38)	4.47 (1.28)	−.12**	−.08*	n/a	4.07 (1.46)	4.63 (1.34)	−.15***	−.11**
Value—W3	.73	4.08 (1.30)	4.58 (1.31)	−.15***	−.12**	.77	3.80 (1.32)	4.30 (1.29)	−.13***	−.08*
Value—W4	.75	4.13 (1.34)	4.47 (1.34)	−.10**	−.07	.78	4.04 (1.31)	4.45 (1.26)	−.08*	−.05
Music										
Ability—W2	.86	4.73 (1.57)	4.01 (1.66)	.19***	.16***	.87	4.46 (1.45)	3.80 (1.41)	.16***	.11**
Ability—W3	.90	5.14 (1.40)	4.26 (1.65)	.21***	.18***	.91	4.88 (1.35)	3.88 (1.51)	.19***	.15***
Ability—W4	.90	5.05 (1.46)	4.30 (1.64)	.16***	.14***	.91	5.03 (1.37)	3.68 (1.67)	.19***	.13***
Value—W2	n/a	4.30 (1.60)	3.87 (1.57)	.12**	.11**	n/a	4.15 (1.44)	3.75 (1.61)	.07	.05
Value—W3	.84	4.38 (1.59)	3.80 (1.72)	.16***	.14***	.84	4.17 (1.46)	3.35 (1.56)	.14***	.09
Value—W4	.84	4.30 (1.65)	3.61 (1.70)	.16***	.13**	.84	4.31 (1.42)	3.23 (1.64)	.19***	.12**
Math										
Ability—W2	.90	5.62 (1.09)	5.81 (1.12)	−.07	−.05	.89	5.50 (1.02)	5.79 (.95)	−.11**	−.11**
Ability—W3	.88	5.65 (1.11)	5.75 (1.09)	−.06	−.05	.87	5.41 (1.08)	5.68 (.97)	−.12**	−.13***
Ability—W4	.86	5.69 (1.05)	5.75 (1.10)	−.05	−.05	.86	5.70 (.96)	5.71 (.96)	−.03	−.04
Value—W2	n/a	6.28 (.94)	6.42 (.80)	−.06	−.06	n/a	6.02 (1.02)	6.37 (.91)	−.10*	−.09*
Value—W3	.51	6.48 (.64)	6.63 (.49)	−.09*	−.08*	.70	6.23 (.85)	6.41 (.69)	−.05	−.06
Value—W4	.50	6.60 (.61)	6.66 (.51)	−.04	−.03	.74	6.42 (.65)	6.51 (.64)	−.05	−.06
Reading										
Ability—W2	.92	5.98 (1.07)	5.71 (1.29)	.11**	.08*	.86	5.89 (.97)	5.62 (1.03)	.07	.03
Ability—W3	.88	6.04 (1.06)	5.68 (1.12)	.12**	.08*	.91	5.99 (1.06)	5.60 (1.14)	.09*	.04
Ability—W4	.88	6.00 (1.04)	5.66 (1.11)	.09*	.05	.88	6.04 (.89)	5.55 (1.12)	.11**	.10*
Value—W2	n/a	6.49 (.87)	6.59 (.72)	−.04	−.03	n/a	6.44 (.70)	6.48 (.93)	−.01	−.01
Value—W3	.45	6.66 (.53)	6.68 (.45)	−.00	−.00	.67	6.57 (.70)	6.57 (.60)	.01	.02
Value—W4	.47	6.76 (.44)	6.74 (.43)	.03	.03	.76	6.67 (.54)	6.60 (.56)	.02	.01

Note. W, Wave. n/a, only one item was assessed in Wave 2. *r* refers to the effect size of differences between males and females where a minus sign denotes that males were higher.

*$p < .05$.

**$p < .01$.

***$p < .001$.

[a]Findings from regressions with child gender as the predictor.

[b]Findings from regressions with child gender, cohort, family income, parent education, and ability as predictors.

The second component of parent–child coactivity was how often parents took children to community events or institutions related to these domains. This type of community coactivity was measured at Waves 2–4 in sports, music, and reading, but not in math. Parent–child attendance at paid sporting events was measured with one item. Two items measured parent–child attendance at music concerts: (a) took child to a rock concert and (b) took child to a classical music concert. These two items were averaged to create a subscale of attendance at concerts. Parents also reported how often they took the child to the library at Wave 4. This reading coactivity item was not assessed at Waves 2 and 3.

TABLE 5

INDICATORS OF PARENTS' BEHAVIORS

	Sports			Music			Math			Reading		
Indicators	W2	W3	W4	W2	W3	W4	W2	W3	W4	W2	W3	W4
A. Encouragement												
Please indicate the extent to which you encourage the following activities for this child (1 = *strongly discourage*, 7 = *strongly encourage*)												
Playing competitive sports	x	x	x									
Taking music lessons				x	x	x						
Playing a musical instrument					x							
Doing math- or science-related activities at home							x	x				
Reading										x	x	
B. Coactivity: Daily activity												
Please indicate how often you do each of these things to get involved with this child's daily activities (1 = *never*, 7 = *almost every day for a long while*)												
Play sports with this child	x	x	x									
Play a musical instrument with this child				x	x	x						
Do math or science activities with this child							x	x	x			
Help this child do his/her math and science homework									x			
Read to this child										x	x	
Have this child read to you										x	x	
C. Coactivity: Community events												
Please indicate how often you have done each of the following activities in the past year (W2 and W3: 1 = *never*, 7 = *almost every day for a long while*; W4: 1 = *never*, 7 = *weekly*)												
Take child to paid sporting events	x	x	x									
Take child to classical music concerts				x	x	x						
Take child to rock music concerts				x	x	x						
Take child to the library												x

(*Continued*)

TABLE 5. (*Continued*)

	Sports			Music			Math			Reading		
Indicators	W2	W3	W4	W2	W3	W4	W2	W3	W4	W2	W3	W4
D. Provision of materials												
Check all that were bought or rented for this child in the past year (1 = *yes*, 0 = *no*)												
Sports equipment	x	x	x									
Sports books or magazines	x	x	x									
Musical instruments				x	x	x						
Music or dance books, supplies, clothing				x	x	x						
Math-related books, games, toys, or magazines							x	x	x			
General interest books										x	x	
General interest magazines										x	x	
General interest in books or magazines												x
E. Parents' participation												
Use the following scale to estimate the amount of time spent last week on each of the following activities (1 = *0 hours*, 8 = *>20 hours*)												
Organized competitive sports	x	x	x									
Playing sports with friends	x	x	x									
Doing athletic activities alone (like running)	x	x	x									
Playing musical instruments				x	x	x						
Math- and science-related activities							x	x	x			
Reading books, magazines, or newspapers for pleasure										x	x	x
F. Coaching												
Do you coach of one of your children's sports teams (1 = yes, 0 = no)	x	x	x									

Note. W, Wave. The response scale is the same at each wave unless noted otherwise.

TABLE 6

MEANS (STANDARD DEVIATIONS) AND GENDER DIFFERENCES OF PARENTS' BEHAVIORS

	Mothers				Fathers			
Indicator	Females	Males	r^a	r^b	Females	Males	r^a	r^b
Sports								
Encouragement—W2	4.33 (.87)	4.97 (1.17)	−.25***	−.19***	4.52 (1.02)	5.31 (1.14)	−.17***	−.14***
Encouragement—W3	3.42 (1.48)	4.16 (1.65)	−.16***	−.13***	3.69 (1.44)	4.68 (1.50)	−.21***	−.18***
Encouragement—W4	3.43 (1.55)	4.29 (1.68)	−.20***	−.17***	3.81 (1.52)	4.68 (1.53)	−.16***	−.14***
Daily coactivity—W2	2.52 (1.41)	2.98 (1.52)	−.12***	−.10*	3.08 (1.48)	3.94 (1.28)	−.19***	−.17***
Daily coactivity—W3	2.34 (1.25)	2.82 (1.53)	−.13***	−.12**	2.96 (1.28)	3.92 (1.47)	−.21***	−.17***
Daily coactivity—W4	2.34 (1.26)	2.51 (1.40)	−.04	−.03	2.80 (1.37)	3.83 (1.38)	−.14**	−.12**
Events—W2[c]	.52 (.50)	.82 (.38)	−.23***	−.20***	.63 (.48)	.80 (.39)	−.16***	−.13***
Events—W3[c]	.65 (.47)	.81 (.39)	−.17***	−.13***	.69 (.46)	.89 (.31)	−.12**	−.11**
Events—W4	2.25 (1.03)	2.75 (1.05)	−.19***	−.16***	2.38 (1.11)	2.92 (1.03)	−.08*	−.07
Provision—W2	.71 (.62)	1.36 (.62)	−.40***	−.38***	.73 (.61)	1.33 (.63)	−.28***	−.25***
Provision—W3	.84 (.58)	1.45 (.61)	−.35***	−.32***	.87 (.59)	1.42 (.61)	−.26***	−.21***
Provision—W4	.77 (.63)	1.46 (.65)	−.39***	−.35***	.89 (.68)	1.41 (.70)	−.18***	−.16***
Modeling—W2	1.67 (.64)	1.80 (.69)	−.06	−.05	2.08 (.94)	2.07 (.87)	.05	.05
Modeling—W3	.74 (.71)	.78 (.75)	−.02	−.01	1.12 (.92)	1.06 (.89)	.03	.05
Modeling—W4	.77 (.84)	.70 (.73)	.02	.02	1.22 (.97)	1.12 (.94)	.01	.03
Coaching—W2[c]	n/a	n/a			.14 (.35)	.27 (.45)	−.14***	−.10**
Coaching—W3[c]	n/a	n/a			.14 (.35)	.36 (.48)	−.15***	−.12**
Coaching—W4[c]	n/a	n/a			.16 (.36)	.31 (.46)	−.09*	−.07
Music								
Encouragement—W2	4.82 (1.21)	4.56 (1.08)	.09*	.06	4.70 (1.14)	4.34 (.96)	.07	.04
Encouragement—W3	4.33 (1.96)	3.69 (1.94)	.14***	.11**	4.23 (1.83)	3.43 (1.70)	.13***	.10**
Encouragement—W4	4.33 (1.91)	3.42 (1.84)	.17***	.14***	4.28 (1.65)	3.17 (1.54)	.14***	.09*
Daily coactivity—W2[c]	.34 (.47)	.29 (.45)	.05	.03	.23 (.42)	.17 (.38)	.05	.05

(*Continued*)

TABLE 6. (*Continued*)

Indicator	Mothers				Fathers			
	Females	Males	r^a	r^b	Females	Males	r^a	r^b
Daily coactivity—W3[c]	.37 (.47)	.29 (.45)	.05	.03	.23 (.42)	.20 (.40)	.01	.01
Daily coactivity—W4[c]	.30 (.46)	.22 (.42)	.05	.03	.19 (.39)	.17 (.37)	.02	.01
Events—W2	.36 (.48)	.27 (.44)	.06	.03	.28 (.45)	.19 (.39)	.06	.08*
Events—W3	.39 (.49)	.36 (.48)	.06	.04	.35 (.48)	.27 (.44)	.05	.06
Events—W4	1.48 (.54)	1.34 (.49)	.09*	.07	1.30 (.48)	1.24 (.42)	.00	.02
Provision—W2	.79 (.69)	.46 (.67)	.20***	.20***	.83 (.71)	.48 (.68)	.17***	.16***
Provision—W3	1.96 (.99)	1.43 (1.04)	.19***	.16***	1.93 (1.00)	1.46 (1.08)	.13**	.11**
Provision—W4	.97 (.71)	.54 (.72)	.20***	.19***	1.09 (.75)	.50 (.68)	.18***	.17***
Modeling—W2[c]	.15 (.36)	.19 (.39)	−.04	−.08*	.09 (.29)	.09 (.29)	.05	.06
Modeling—W3[c]	.17 (.38)	.17 (.38)	.01	.02	.10 (.30)	.11 (.31)	−.00	−.01
Modeling—W4[c]	.17 (.38)	.16 (.37)	.02	.03	.09 (.29)	.14 (.34)	−.02	−.02
Math								
Encouragement—W2	4.76 (.89)	5.08 (1.10)	−.11**	−.10**	4.82 (1.06)	4.99 (1.07)	−.02	−.01
Encouragement—W3	4.09 (1.59)	4.39 (1.55)	−.07	−.06	4.06 (1.52)	4.30 (1.45)	−.04	−.03
Daily coactivity—W2	3.41 (1.35)	3.39 (1.29)	.03	.03	3.24 (1.12)	3.16 (1.22)	.02	.01
Daily coactivity—W3	3.44 (1.41)	3.31 (1.35)	.03	.04	3.21 (1.16)	3.26 (1.21)	−.01	−.01
Daily coactivity—W4	3.33 (1.28)	3.20 (1.23)	.06	.05	3.23 (1.15)	3.10 (1.00)	.04	.03
Provision—W2	.66 (.47)	.60 (.49)	.06	.07	.69 (.46)	.59 (.49)	.04	.06
Provision—W3	.54 (.50)	.53 (.50)	.02	.03	.48 (.50)	.49 (.50)	−.02	−.02
Provision—W4	.37 (.48)	.32 (.47)	.05	.06	.38 (.49)	.35 (.48)	.01	.01
Modeling—W2	2.48 (1.42)	2.51 (1.52)	−.01	−.00	2.35 (1.47)	2.36 (1.50)	−.05	−.05
Modeling—W3	1.32 (1.42)	1.49 (1.53)	−.03	−.02	1.68 (1.83)	1.51 (1.74)	.03	.02
Modeling—W4	1.23 (1.37)	1.34 (1.54)	−.03	−.03	1.57 (1.81)	1.28 (1.32)	.08*	.07
Reading								
Encouragement—W2	6.57 (.66)	6.35 (.82)	.16***	.16***	6.20 (.87)	5.98 (.95)	.04	.02

(*Continued*)

TABLE 6. (*Continued*)

	Mothers				Fathers			
Indicator	Females	Males	r^a	r^b	Females	Males	r^a	r^b
Encouragement—W3	6.14 (1.15)	6.01 (1.10)	.05	.05	6.01 (1.08)	5.40 (1.27)	.12**	.10**
Daily coactivity—W2	4.01 (1.36)	3.88 (1.35)	.03	.06	3.24 (1.30)	3.07 (1.33)	.01	.01
Daily coactivity—W3	3.35 (1.44)	3.37 (1.36)	−.01	−.06	2.73 (1.24)	2.61 (1.18)	.03	.03
Events—W4	5.00 (1.24)	4.66 (1.20)	.08*	.08*	3.80 (1.50)	3.64 (1.41)	.05	.04
Provision—W2	1.59 (.65)	1.52 (.68)	.04	.04	1.62 (.61)	1.54 (.67)	.06	.06
Provision—W3	1.60 (.58)	1.53 (.67)	.06	.06	1.58 (.61)	1.51 (.73)	.01	.01
Provision—W4	.84 (.36)	.86 (.34)	−.02	−.01	.82 (.39)	.77 (.42)	.04	.02
Modeling—W2	4.11 (1.32)	4.09 (1.37)	.00	.00	3.69 (1.20)	3.75 (1.18)	.00	.00
Modeling—W3	3.15 (1.30)	3.09 (1.43)	.03	.03	2.84 (1.31)	2.84 (1.19)	.01	.02
Modeling—W4	3.38 (1.29)	3.25 (1.45)	.00	.01	3.06 (1.23)	2.98 (1.15)	.01	.03

Note. W, wave. *r* refers to the effect size of differences between males and females where a minus sign denotes that males were higher. n/a coaching for mothers was not included in the analyses.

*$p < .05$.

**$p < .01$.

***$p < .001$.

[a]Findings from regressions with child gender as the predictor.

[b]Findings from regressions with child gender, cohort, family income, parent education, and ability as predictors.

[c]This indicator was dichotomized.

Parents' provision of activity-related materials assessed whether activity-related materials were bought or rented for their child in the past year. For instance, parents reported if they bought or rented (1 = *yes*, 0 = *no*): (a) sports equipment or (b) sports books or magazines in the last year. The specific items for each domain are listed in Table 5. Within each domain, the items were summed to create indicators of parents' provision of materials. In the case of sports, the range of the sport provision variable was 0–2 at Waves 2–4. The music items had the same range as those for sports. Math provision of materials ranged from 0 to 1 at Wave 2–4. Reading materials ranged from 0 to 2 at Waves 2 and 3 and 0–1 at Wave 4. In addition, fathers did not report provision of activity-related materials at Wave 2. Thus, we used mothers' report of this item for Wave 2 in the father models.

Parents' modeling or participation in activities indicated how much time they spent at home or after work on several activities during the previous week at Waves 2–4. These included playing three types of sport activities, playing a musical instrument, participating in math- and science-related activities, and reading for pleasure (Table 5). The three indicators of parents' sport activities were averaged to create a scale. All other items were single indicators.

Coaching assessed if parents coached their children's sports team in the last year (1 = yes, 0 = no). Because so few mothers coached sports teams (e.g., $n = 17$ at Wave 3), we dropped mothers' data on coaching from the analyses.

Child-Reported Indicators

The focus of this study is children's beliefs and behaviors in sports, instrumental music, math, and reading. Comparable measures were collected across these four domains. Specifically, children reported their self-concept of ability, value, and participation in each of these domains after and during school (e.g., elective classes).

Self-Concept of Ability

Children's self-concept of ability represents children's beliefs about their abilities or the extent to which they believe they are good in a particular domain. In this investigation, we used children's self-concept of ability in each of the four domains reported at Waves 2 (grades 1, 2, and 4) through 5 (grades 7, 8, and 10). Children's self-concept of ability was measured with the same four items in each domain and at each wave as listed in Table 7. The only exception was that one item was not measured at Wave 2 for music (i.e., "if you were to list the students…"). The scale reliabilities (Cronbach's alpha) and descriptive statistics by gender are noted in Table 8. These scales have excellent face, convergent, and discriminant validity, as well as strong psychometric properties (Eccles, Wigfield, et al., 1993; Jacobs et al., 2002).

TABLE 7

INDICATORS OF YOUTHS' SELF-CONCEPT OF ABILITY AND VALUE

Youths' self-concept of ability
- 1a. How good at (sports/music/math/reading) are you? (1 = *not very good*, 7 = *very good*)
- 1b. If you were to list all the students from best to worst in (sports/music/math/reading) where are you? (1 = *one of the worst*, 7 = *one of the best*)
- 1c. Compared to other subjects how good are you at (sports/playing a musical instrument/math/reading)? (1 = *a lot worse*, 7 = *a lot better*)
- 1d. How good would you be at learning something new in (sports/to play a new musical instrument/math/reading)? (1 = *not very good*, 7 = *very good*)

Youths' value
- 2. Youths' ratings of importance
  - 2a. Compared to other activities how useful is learning (sports/to play a musical instrument/math/reading)? (1 = *not as useful*, 7 = *a lot more useful*)[a]
  - 2b. For me being good in (sports/music/math/reading) is (1 = *unimportant*, 7 = *important*)
- 3. Youths' ratings of interest
  - 3a. I find working on (sports/a musical instrument/math assignments/reading assignments) (1 = *boring*, 7 = *interesting*)
  - 3b. How much do you like (sports/playing a musical instrument/math/reading)? (1 = *a little*, 7 = *a lot*)

[a]This item was not assessed at Wave 2.

Task Value

Children's perceptions of task value incorporate aspects of importance (i.e., attainment and utility value) and interest (i.e., intrinsic value). The importance of each domain was assessed with questions about how much children believe a particular domain is important to them and how useful it is to them now and in the future. Two indicators of importance were measured for each domain at Waves 2 (grades 1, 2, and 4) through 5 (grades 7, 8, and 10). These are the first two items in Table 7. At Wave 2, one of the two importance items was not used. This item required children to compare a domain to other domains (i.e., the item in Table 7 that starts with "compared to other activities"). This item was not included at Wave 2 because such comparisons about the utility of a domain were too difficult for young children. The second component of task value is children's interest. Two questions addressed children's interest in each domain at Waves 2 through 5 (see Table 7). The scales had adequate reliability and excellent convergent and discriminate validity (Jacobs et al., 2002). The scale reliability (Cronbach's alpha) and descriptive statistics for importance and interest are presented in Table 8.

Activity Participation and Courses

Several indicators of children's participation in the four domains are available in CAB. We included indicators from Waves 2 to 9. Youth can

TABLE 8

RELIABILITY (CRONBACH'S alpha), MEANS (STANDARD DEVIATIONS), AND GENDER DIFFERENCES OF FEMALES' AND MALES' SELF-CONCEPT OF ABILITY AND VALUE

	Self-Concept of Ability					Value				
Indicator	α	Females	Males	r^a	r^b	α	Females	Males	r^a	r^b
Sports										
Wave 2	.84	4.94 (1.30)	6.01 (1.13)	−.36***	−.31***	.68	5.78 (1.41)	6.33 (1.19)	−.18***	−.14***
Wave 3	.83	4.80 (1.19)	5.97 (1.04)	−.44***	−.41***	.84	4.98 (1.30)	5.80 (1.07)	−.31***	−.26***
Wave 4	.89	4.71 (1.28)	5.89 (1.16)	−.38***	−.32***	.88	4.63 (1.47)	5.62 (1.22)	−.32***	−.25***
Wave 5	.92	4.66 (1.41)	5.49 (1.32)	−.26***	−.20***	.91	4.73 (1.55)	5.43 (1.50)	−.20***	−.15***
Music										
Wave 2	.75	5.01 (1.48)	4.34 (1.74)	.18***	.20***	.81	5.57 (1.66)	4.61 (2.07)	.22***	.21***
Wave 3	.82	5.04 (1.22)	4.47 (1.61)	.20***	.18***	.88	4.68 (1.51)	3.84 (1.83)	.23***	.21***
Wave 4	.89	4.28 (1.55)	3.66 (1.81)	.18***	.16***	.91	4.08 (1.57)	3.40 (1.81)	.20***	.17***
Wave 5	.93	4.31 (1.71)	3.65 (1.84)	.17***	.16***	.95	3.76 (1.94)	3.31 (1.96)	.11**	.09*
Math										
Wave 2	.64	5.18 (1.13)	5.54 (1.07)	−.15***	−.15***	.65	5.46 (1.47)	5.18 (1.68)	.08*	.08*
Wave 3	.75	5.01 (1.07)	5.48 (1.07)	−.21***	−.21***	.75	5.00 (1.17)	5.15 (1.28)	−.06	−.06
Wave 4	.81	5.00 (1.14)	5.49 (1.11)	−.19***	−.19***	.81	4.88 (1.13)	5.01 (1.21)	−.05	−.05
Wave 5	.88	4.79 (1.26)	4.95 (1.27)	−.03	−.03	.88	4.41 (1.17)	4.35 (1.21)	.04	.03
Reading										
Wave 2	.78	5.67 (1.12)	5.70 (1.14)	−.01	−.03	.67	5.77 (1.35)	5.15 (1.70)	.17***	.16***
Wave 3	.81	5.55 (1.08)	5.27 (1.25)	.11**	.10**	.78	5.40 (1.07)	4.90 (1.35)	.19***	.19***
Wave 4	.83	5.44 (1.13)	5.25 (1.12)	.09*	.07	.76	5.23 (1.02)	4.92 (1.21)	.14***	.13***
Wave 5	.90	5.01 (1.20)	4.65 (1.23)	.12**	.10**	.84	4.55 (1.17)	4.14 (1.23)	.14***	.11**

Note. r refers to the effect size of differences between males and females where a minus sign denotes that males were higher.

*$p < .05$.

**$p < .01$.

***$p < .001$.

[a]Findings from regressions with child gender as the predictor.

[b]Findings from regressions with child gender, cohort, family income, parent education, and ability as predictors.

participate in these domains through (a) informal activities, such as a neighborhood pick-up sport game, (b) organized activities, such as participating on a little league baseball team, and (c) elective coursework. Activities also vary in terms of whether they are community or school based. For instance, children may have opportunities to participate on organized teams in their community and on organized school sports teams. Youth make choices and can get involved in these domains through settings that take place during the school hours (e.g., elective courses) and after school hours. In this study, we included a variety of participation indicators that span these various distinctions. As expected, the available opportunities and choices vary by the four domains and across development.

For the high school indicators, we calculated the average across high school due to the design of the study. Participants were assessed a different number of times during Waves 6 through 9. For example, the oldest cohort was assessed twice during these waves whereas the middle and youngest cohorts were assessed three times. As a result of the different number of assessments, we used data from Waves 6 through 9 to create the average across these years. A complete listing of the items in all four domains is presented in Table 9. The means and standard deviations are presented in Table 10.

Children can participate in *sports activities* through organized and informal avenues. During Waves 2 through 5, children reported on how much time they spent in organized sports (Table 9). During the high school years (i.e., Waves 6–9), we used four indicators of sport participation. These included: (a) time spent in organized sports, (b) time spent in other informal sports, (c) number of organized school-based sports youth participated in, and (d) number of organized community-based sports youth participated in. Each of these indicators was averaged across the high school years. For example, time spent in organized sports was the average amount of time they spent in organized sports per year throughout high school. The number of sport teams was the average number of sport teams per year throughout high school.

Children have opportunities to engage in *instrumental music activities* in and outside of school. At Waves 2 (grades 1, 2, and 4) through 5 (grades 7, 8, and 10), children reported how much time they practiced a musical instrument (Table 9). This indicator of music participation focuses on instrumental music and not choral or other forms of music, which do not require equipment and may often occur in churches or other venues. Music practice focused on time spent practicing outside of school. During the high school years, we had two indicators of music participation. Youth reported how much time they practiced a musical instrument and whether they participated in a school or community band each year. The high school indicators were based on data reported when adolescents were in grades 9 through 12, which included Waves 6 through 9 depending on the cohort. Time practicing was the average amount of time they practiced each year

TABLE 9

INDICATORS OF YOUTHS' PARTICIPATION

Indicator	W2	W3	W4	W5	W6	W7	W8	W9
Sports								
A. Time in organized sports								
How often do you play sports on organized teams where someone keeps score? (W2: 0 = *Never*, 4 = *Everyday*; W3: 0 = *Never*, 7 = *Almost every day for a lot of time*; W4: 0 = *Never or Almost never*, 5 = *Almost every day for a lot of time*)	x	x	x					
Time spent each week taking part in organized sports? (W5–W9: 0 = *none*, 7 = *21 or more hours*)				x	x	x	x	x
B. Time in other sports								
Time spent each week doing other athletic or sports activities? (1 = *none*, 8 = *21 or more hours*)					x	x	x	x
C. Number of sport teams at school								
Do you (did you) compete in any of the following school teams (varsity, junior varsity, or other organized school program) outside of Physical Education? Baseball, gymnastics, softball, football, ice hockey, volleyball, tennis, basketball, cheerleading, wrestling, track/cross country, swimming/diving, soccer, ice skating, field hockey, other					x	x	x	x
D. Number of sports in the community								
Do you (did you) participate **regularly and often** in any of the following sports outside of school? Baseball, gymnastics, dancing, softball, basketball, track, soccer, swimming, rollerblading, skateboarding, weightlifting, aerobics, football, martial arts, ice skating, hockey, skiing, wrestling, tennis, other					x	x	x	x
Music								
A. Time								
How often do you practice an instrument? (W2: 0 = *Never*, 4 = *Everyday*; W3: 0 = *Never*, 7 = *Almost every day for a lot of time*; W4: 0 = *Never or Almost never*, 5 = *Almost every day for a lot of time*; W5–W9: 0 = *none*, 7 = *21 or more hours*)	x	x	x	x	x	x	x	x

(*Continued*)

TABLE 9. (*Continued*)

Indicator	W2	W3	W4	W5	W6	W7	W8	W9
B. Band or orchestra								
Which of the following activities or clubs at school did you do in the school year? Band or orchestra (yes/no)					x	x	x	x
Do you participate in any of the following clubs or activities outside of school? Band (yes no)								
Math								
A. Time								
How often do you do math games (i.e., flash cards, playing with calculators, doing math on computer)? (W2: 0 = *Never*, 4 = *Everyday*; W3:0 = *Never*, 7 = *Almost every day for a lot of time*; W4: 0 = *Never or Almost never*, 5 = *Almost every day for a lot of time*)	x	x	x					
B. Math/Science clubs at school								
Which of the following activities or clubs at school did you do in the school year? (Check): math club, science fair, environmental group, chess club, computer club					x	x	x	x
C. Math classes—drawn from their record data					x	x	x	x
Reading								
A. Time								
How often do you read comic books, magazines, newspapers or other books that are not for your schoolwork? (W2: 0 = *Never*, 4 = *Everyday*; W3: 0 = *Never*, 7 = *Almost every day for a lot of time*; W4: 0 = *Never or Almost never*, 5 = *Almost every day for a lot of time*)	x	x	x					
Time spent each week reading for fun? (1 = *none*; 8 = *21 or more hours*)				x	x	x	x	x
B. Literary clubs								
Which of the following activities or clubs at school did you do in the school year? (Check): foreign language club, literary magazine					x	x	x	x
C. English courses—drawn from their record data					x	x	x	x

Note. W, Wave. The response scale is the same at each wave unless noted otherwise.

TABLE 10

MEANS (STANDARD DEVIATIONS) AND GENDER DIFFERENCES OF FEMALES' AND MALES' PARTICIPATION

Indicator	Females	Males	r^a	r^b
Sports				
Time in organized sports				
Wave 2	1.21 (1.39)	2.23 (1.18)	−.29***	−.26***
Wave 3	1.97 (1.96)	3.57 (2.00)	−.35***	−.31***
Wave 4	2.79 (1.73)	4.40 (1.77)	−.38***	−.33***
Wave 5	3.50 (2.07)	4.02 (2.21)	−.12**	−.06
High school	3.06 (2.05)	3.42 (2.16)	−.07	−.03
Time in other sports				
High school	2.92 (1.32)	3.70 (1.69)	−.21***	−.18***
Number of school sport teams				
High school	.82 (.83)	.96 (1.18)	−.06	−.02
Number of community sports				
High school	2.05 (2.01)	3.06 (2.61)	−.19***	−.17***
Music				
Time practicing				
Wave 2	1.45 (1.61)	1.17 (1.42)	.07*	.08*
Wave 3	2.78 (2.26)	1.94 (2.19)	.18***	.16***
Wave 4	2.65 (1.73)	1.97 (1.57)	.20***	.17***
Wave 5	1.54 (1.86)	1.24 (1.81)	.07*	.05
High school	1.12 (1.51)	1.35 (1.84)	−.04	−.05
Band				
High school	.26 (.44)	.22 (.42)	.04	.03
Math				
Time on math activities				
Wave 2	1.56 (1.27)	1.55 (1.34)	.01	.00
Wave 3	2.75 (1.69)	2.43 (1.93)	.08*	.08*
Wave 4	2.88 (1.62)	3.06 (1.76)	−.05	−.05
Number of AP math courses				
High school	.47 (.62)	.44 (.66)	.01	.01
Reading				
Time reading				
Wave 2	2.98 (1.19)	2.64 (1.30)	.11**	.10**
Wave 3	4.37 (1.64)	4.01 (1.82)	.11**	.10**
Wave 4	4.25 (1.67)	3.70 (1.69)	.14***	.13***
Wave 5	3.04 (1.64)	2.44 (1.49)	.16***	.17***
High school	2.72 (1.09)	2.55 (1.29)	.09*	.08*
Literature clubs				
High school	.36 (.48)	.17 (.38)	.17***	.17***
English courses				
High school	1.99 (.48)	1.99 (.60)	.01	.05

Note. r refers to the effect size of differences between males and females where a minus sign denotes that males were higher.

*$p < .05$.

**$p < .01$.

***$p < .001$.

[a]Findings from regressions with child gender as the predictor.

[b]Findings from regressions with child gender, cohort, family income, parent education, and ability as predictors.

across high school. School band participation indicated whether they participated in a school or community band at any point in high school. This indicator was dichotomized because approximately 75% of the sample did not participate in a school or community band during high school.

Youth also have a variety of avenues through which they can participate in *math-related activities*. Youths' opportunities to engage in math-related pursuits shift across development. During childhood, children can engage in math pursuits after school in formal and informal activity settings. However, as children age into adolescence, few participate in *informal* math activities after school beyond completing their homework (Simpkins, Davis-Kean, et al., 2006). As shown in Table 9, time spent in math-related activities was measured in Waves 2 through 4.

During the high school years, adolescents are able to select in or out of math pursuits through their participation in school clubs associated with those domains and their advanced courses at school. We assessed adolescents' participation in a variety of clubs associated with math. However, because 91% of the sample did not participate in any one of these clubs throughout high school, this indicator was dropped from analyses. Adolescents' math coursework was collected from their high school record data (i.e., when students were in grades 9–12). We computed the average number of AP math courses per year throughout high school. AP math courses included four sets of classes that the four school districts designated as honors/AP courses: (a) Honors Algebra, Enriched Algebra, Accelerated Algebra (I and II), Algebra HS, (b) Pre-Calculus, Accelerated Analysis, (c) advanced math enrichment (math honors general)/Honors Math 3, 4, 5, and 6, and (d) AP Calculus, AP math general.

Youth can engage in *reading activities* through a variety of avenues. At Waves 2 (grades 1, 2, and 4) through 5 (grades 7, 8, and 10), youth reported how much time they spent reading for fun, which is an informal reading activity (Table 9). We used three indicators of reading-related pursuits when adolescents were in high school: (a) time spent reading per year, (b) the percentage of years they participated in school clubs related to reading, and (c) English and literature coursework. For each of these items, we examined adolescents' responses across grades 9–12. First, time spent reading was the average amount of time they spent reading each year across grades 9–12. Second, we created an indicator of participation in the school foreign language club and/or literary magazine by taking the average number of clubs they participated in from grades 9–12. Because 73% of the sample never participated in either of these two clubs at any time in high school, this indicator was dichotomized. Third, the average number of English and literature courses per year was computed based on their record data from grades 9–12. Following procedures outlined in Durik et al. (2006), we included a variety of courses related to English and literature: advanced

English courses, writing courses (e.g., creative writing, composition), literature courses, and applied English courses (e.g., school newspaper, debate). We calculated the average number of English/literature courses taken each year across grades 9–12.

Exogenous Indicators Used as Controls

In the Eccles's models illustrated in Figures 1a and 1b, various exogenous constructs are listed in the boxes in the far left side of each model. We assume these indicators serve as a starting place for the cascade of processes that make up the socialization and enactment of motivated behavioral choice. However, to keep our statistical model as simple as possible, we have included these predictors as control variables rather than as constructs central to the SEMs. This decision is in keeping with the classic treatment within the fields of sociology, economics, and quantitative non-experimental developmental science of constructs assumed to be selection factors that can bias estimates of potentially causal relationships among the endogenous constructs in one's structural model. Including these exogenous constructs as controls allows one to partial out the influence of these constructs on the "outcomes" of interest and thus provides a conservative estimate of the magnitude of the possible causal association of parents' beliefs and behaviors to their children's developing beliefs and achievement-related behavioral choices. However, given that we see these exogenous constructs as theoretically important in their own right, we also present their correlations with all of our endogenous constructs as part of our descriptive analyses.

Parents' Education

Parents indicated their highest level of educational attainment on a list of pre-coded responses (1 = *grade school*, 9 = *Ph.D.*). The highest level of education within a parental pair was used to characterize parents' education (Shumow & Lomax, 2002).

Family Annual Income

Parents described their annual income on a scale listing income brackets in $10,000 increments (minimum = none, maximum = over $80,000). Mothers' and fathers' incomes were summed to create the family annual income.

Assessment Indicators

When children entered the study, they completed the Bruininks-Oseretsky Test of Motor Proficiency (Bruininks, 1978) and the Slosson Intelligence Test (1991 edition; Slosson, Nicholson, & Hibpshman, 1991). The Bruininks-Oseretsky Test of Motor Proficiency has been widely used to assess the proficiency of individuals' gross and fine motor skills (Hattie &

Edwards, 1987). This measure was included in all analyses on sports as an indicator of physical aptitude. Children's overall cognitive skills were measured with the Slosson Intelligence Test—Revised. This measure was included as an indicator and control for the children's starting cognitive aptitude in all analyses.

Teacher Reported Indicators

Teachers completed a questionnaire on each child who participated in the study at Waves 1–3. Teachers assessed children's natural ability or talent in each of the four domains with one item: "Compared to other children, how much innate ability or talent does this child have in each of the following?" (1 = *very little*, 7 = *a lot*). Teachers' ratings from Waves 1 through 3 were averaged to create an indicator of children's natural ability in each domain. We included these ratings as an additional control for the children's natural aptitude in each specific domain in all models. We also report the correlation of these ratings with our several endogenous constructs because we assume that these aptitudes influence parents' perceptions of their children's abilities and thus serve as a starting point for the cascade of developmental processes inherent in the Eccles's models illustrated in Figures 1a and 1b. Of the sample used in the mother models and youth only models ($N = 723$), the rate of missing data was 25% at Wave 2, 17% at Wave 3, and 28% at Wave 4, but only 1 participant was missing teacher rated data at all three waves.

In all models except one set of models in Chapter 4, teachers' rating of children's natural ability was used as a control variable. In the one set of models in Chapter 4, teachers' rating of children's natural ability was one of the focal variables in the cross-lagged models. We present more detailed information on the plan of analysis in the next chapter. However, it is important to note here in this methods chapter that teachers' rating was the average across the 3 years when it was used as a control variable. When it was used as a focal variable in the cross-lagged models in Chapter 4, we used the rating from Waves 2 and 3 as separate indicators to compute all of the paths across Waves 2 and 3 in the cross-lagged models.

III. MISSING DATA, DESCRIPTIVE STATISTICS, AND OVERVIEW OF THE ANALYSES

In this chapter, we provide some information about the data and an overview of the plan of analysis. First, we discuss missing data in the study. Second, we present the descriptive statistics, mean-level gender differences, and bivariate correlations between the control variables and the indicators in the models. Third, we present an overview of the structural equation models that were used to examine the relations in Chapters 4 through 7.

Missing Data

All participants were tracked and asked to participate at each wave. A combination of mailed surveys and telephone interviews (coupled with a variety of tracking strategies, including parent or friend contacts, the State Motor Vehicle Department records, social security numbers, and forwarding address information available from the post office) was used to minimize attrition. The most common source of attrition was moving out of the data collection area. The missing data rates in this study are comparable to rates in other longitudinal studies. The rate of missing data for each participant was as follows: Wave 2 was 24% for mothers, 36% for fathers, 16% for youth; Wave 3 was 31% for mothers, 35% for fathers, 7% for youth; Wave 4 was 37% for mothers, 48% for fathers, 14% for youth; Wave 5 was 31% for youth; Wave 6 was 49% for youth; and high school was 36% for youth.

Parent Missing Data

To examine missing data from parents, we tested differences in family demographics and youth indicators between families based on whether or not the parent participated. These comparisons were computed separately for mothers and fathers as the rate of missing data varied for the two parents. For mothers, we compared families in which the mother participated ($n = 723$) with families in which the mother did not participate ($n = 264$). For fathers, we compared families in which the father participated ($n = 541$) with families in which the father did not participate ($n = 486$). These analyses provide

information on whether there were systematic differences between families in which the parent participated and families with missing parent data. Continuous variables were tested with t tests; categorical variables were examined with chi-square tests. Everything was converted to the effect size r. Only a handful of the differences were statistically significant and they were all small in size.

There were no significant differences between these two groups of mothers and fathers in terms of youth gender or cohort. Parents' education ($r = .17$) and family income ($r = .17$) were higher if the father participated compared to families in which the father did not participate. Of the 32 youth beliefs, 4 beliefs had small effect sizes. Youths' reading self-concept of ability at Wave 5 (Fathers: $r = .12$) as well as their music value and self-concept of ability at Wave 5 were higher for youth whose parent participated compared to youth whose parent did not participate (Mothers: $r = .11$ and .15, Fathers: $r = .12$ and .14, respectively); in contrast, music self-concept of ability at Wave 2 was lower for youth whose parent participated compared to youth whose parent did not participate (Mothers: $r = .11$, Fathers: $r = .12$). Of the 25 indicators of youth participation, 3 indicators evidenced small effect sizes. Youth whose parent participated had a higher number of English ($r = .14$) and math classes (Mothers: $r = .14$, Fathers: $r = .11$) in high school, and spent more time in instrumental music at Wave 5 (Mothers: $r = .16$, Fathers: $r = .12$) than youth whose parent did not participate. Two of the four teacher ratings of children's natural ability were higher for youth whose parent participated than for their peers: teacher ratings of children's natural math and reading ability (Math, Mothers: $r = .11$, Fathers: $r = .12$; Reading, Mothers: $r = .11$ and Fathers: $r = .10$, respectively). Finally, there was no difference in physical aptitude, but youth whose parent participated had a higher IQ score than youth whose parent did not participate (Mothers: $r = .22$, Fathers: $r = .17$).

Youth Missing Data

Of the 723 youth who had maternal data, we examined how many of the youth left the study. We created an early attrition group (participants who left the study during the elementary school years) and a late attrition group (participants who left the study during the high school years). We found that 13% of the sample was in the early attrition group (left during the elementary school years), 32% of the sample was in the late attrition group (left during the middle school or high school years), 15% of the sample had data missing at random, and 39% of the sample had complete data at all measurement points. We compared differences in the indicators across these four groups (i.e., complete data, early attrition, late attrition, and missing randomly) with ANOVA or chi-square tests depending on the outcome. All four groups were compared on demographic indicators, and

indicators from Waves 2 through 3. Three of the four groups were compared on the Wave 4, Wave 5, and high school indicators because the early attrition group left the study before these indicators were collected. In all, 143 tests were calculated.

For 81% of the indicators (116 out of 143 tests), there were no significant differences among the four groups. Twenty-seven of the tests were statistically significant with small effect sizes (eta^2: small $\geq .01$, medium $\geq .06$, large $\geq .14$; phi: small $\geq .10$, medium $\geq .30$, large $\geq .50$; Cohen, 1988). The means and effect sizes for indicators with significant differences are presented in Table 11. Eight out of 10 indicators of youths' demographic characteristics and ability evidenced small differences across groups. Youth with complete data were more likely to be female, had families with higher parents' education and higher family income, had higher IQ score, and higher teacher ratings of natural ability in math, reading, and sports, as compared to youth in at least one of the other missing data groups (see Table 11 for more details).

There were nine significant differences among the 76 indicators of mothers' beliefs and behaviors across the four attrition groups. For example, mothers of youth with complete data rated their youth higher in ability than did mothers of youth in the late attrition group on five of the indicators. In addition, there were four significant differences in maternal behavior in music and reading domains across the four groups. The pattern of these differences was not consistent across these four behaviors and the effect sizes were small in size (see Table 11 for details). Finally, 10 of the 57 indicators of youths' beliefs and participation significantly differed across groups. Three of the motivational beliefs and seven of the participation indicators were statistically significant with small effect sizes (see Table 11). For example, youth with complete data spent more time reading at Wave 2 and 4 and took more AP math courses in high school as compared to any of the other attrition groups.

Mean-Level Gender Differences

Plan of Analysis

Means and standard deviations of parents' beliefs and participation as well as youths' beliefs and behaviors are presented in Tables 4, 6, 8, and 10 (respectively). Mean level differences between males and females were tested with multiple imputation through SAS with regression analysis to incorporate cases with missing data (Enders, 2010). Ten datasets were imputed. Two sets of regression analyses were computed. In the first regression, only child gender was used to predict each indicator. In the second regression, several exogenous indicators were also included as controls to test whether the gender differences persisted. The exogenous control variables included

TABLE 11

STATISTICALLY SIGNIFICANT DIFFERENCES BASED ON YOUTH ATTRITION

	M(*SD*)/%				
Indicator	Complete Data	Missing Randomly	Early Attrition	Late Attrition	Effect Size
Demographic characteristics					
Female	59%	43%	45%	42%	.08[a]
Cohort (youngest/middle)	30%/32%	32%/34%	37%/40%	25%/29%	.09[a]
Parent education	6.11 (1.84)[b]	5.42 (1.73)[b]	5.60 (1.97)	5.84 (1.85)	.02
Family income	5.93 (1.78)[b]	5.54 (2.05)	5.06 (2.00)[bc]	5.87 (2.13)[c]	.02
Youths' ability					
IQ	119.48 (16.20)[bd]	118.79 (16.26)[c]	113.33 (15.61)[d]	113.33 (14.99)[bc]	.03
Physical	48.31 (9.84)[b]	45.92 (9.79)[c]	45.05 (10.54)[d]	51.52 (10.68)[bcd]	.05
Math (teacher rated)	5.36 (1.09)[b]	5.24 (1.03)	5.09 (1.23)	5.00 (1.16)[b]	.02
Reading (teacher rated)	5.45 (1.09)[b]	5.36 (1.12)[c]	5.18 (1.34)	5.00 (1.16)[bc]	.02
Mothers' perception of their children's ability					
Sports W2	4.87 (1.26)[b]	5.16 (1.16)	4.81 (1.49)	5.26 (1.29)[b]	.02
Math W4	5.89 (1.03)[b]	5.62 (1.03)	5.49 (1.12)	5.97 (.94)[b]	.03
Reading W2	6.10 (.97)[b]	5.77 (1.28)	5.80 (1.34)	5.59 (1.35)[b]	.03
Reading W3	6.02 (1.07)[b]	5.84 (1.05)	5.80 (.97)	5.61 (1.16)[b]	.03
Reading W4	6.01 (1.01)[b]	5.75 (1.14)	—	5.56 (1.14)[b]	.03
Mothers' behavior					
Music events W3	.35 (.48)	.51 (.50)[b]	.17 (.39)[b]	.37 (.48)	.02
Music modeling W4	1.28 (.87)[b]	1.32 (.80)	1.70 (1.19)[b]	1.34 (.74)	.02
Reading encouragement W2[+]	6.53 (.71)	6.44 (.76)	6.62 (.59)	6.31 (.81)	.02
Reading provision W4	.89 (.31)[b]	.91 (.28)[c]	—	.76 (.43)[bc]	.03
Youths' self-concept of ability					
Sport W2	5.30 (1.39)[b]	5.30 (1.33)	5.73 (1.14)	5.65 (1.28)[b]	.02
Reading W4	5.48 (1.07)[b]	5.09 (1.22)[b]	—	5.28 (1.15)	.02

(*Continued*)

TABLE 11. (*Continued*)

Indicator	*M*(*SD*) / %				Effect Size
	Complete Data	Missing Randomly	Early Attrition	Late Attrition	
Math W5	4.93 (1.29)[b]	5.06 (1.16)[c]	—	4.56 (1.25)[bc]	.02
Youths' participation					
Reading time W2	2.97 (1.16)[b]	2.76 (1.23)	2.52 (1.44)[b]	2.75 (1.27)	.01
Reading time W4	4.21 (1.66)[b]	4.03 (1.72)	—	3.66 (1.68)[b]	.02
English classes in HS[+]	2.03 (.44)	2.04 (.60)	—	1.86 (.66)	.01
Literature clubs in HS	33%	16%	—	20%	.09[a]
Sport time W4[+]	3.85 (1.36)	4.15 (1.36)	—	4.15 (1.42)	.01
Sport time W5	3.67 (2.17)[b]	4.37 (2.18)[bc]	—	3.47 (2.01)[c]	.02
Math classes in HS	.54 (.67)[b]	.39 (.58)	—	.30 (.56)[b]	.03

Note. [a]Effect sizes are phi (small $\geq .10$, medium $\geq .30$, large $\geq .50$). All other effect sizes are partial eta^2 (small $\geq .01$, medium $\geq .06$, large $\geq .14$). [bcd]The same superscripts within the same row are significantly different. [+]None of the pairwise comparisons were statistically significant. — These cells were not included because early attrition youth had already left the study when these data were collected. The percentages are calculated within each attrition group.

parents' education, family income, cohort, children's IQ score, teacher ratings of children's natural ability in each domain, and children's physical aptitude (in the sport models).

Parents' Beliefs

As shown in Table 4, there were more consistent gender differences in parents' sports and instrumental music beliefs than in their math and reading beliefs even after controls for child aptitude in each domain were entered. In sports, at all three time points, parents of girls placed lower value on sports and had lower perceptions of their child's ability than did parents of boys. In instrumental music, parents of girls placed higher value on music and thought their children were more skilled at music than parents of boys at all three time points. In addition, parents of girls rated their child's reading ability higher than did parents of boys, though there were no gender differences in parents' reading values at any wave. All of these differences were typically small in size (i.e., $r = .10$) after accounting for all of the control variables.

Parents' Behaviors

The domain with the most consistent gender differences in parents' reports of their own behaviors was sports—ranging from small to medium in size even after including all of the exogenous control variables (Table 6). Parallel to parents' beliefs, both mothers and fathers of girls engaged in fewer sport-related behaviors (i.e., encouragement, daily coactivity, events, and provision of opportunities) than did parents of boys. In addition, there were small differences in parents' music behaviors based on child gender. Parents of girls reported providing slightly more reading encouragement and provision of opportunities in the home than did parents of boys. Although aligned with our expectations, only 1 of the 22 differences emerged in math and 3 of the 24 differences emerged in reading. Mothers of boys provided more encouragement in math at Wave 2 than did mothers of girls. In contrast, parents of girls reported providing more encouragement than parents of boys, and mothers of girls went to the library together more often than mothers of boys. Although all four of these differences remained after including the exogenous control variables, they were small in size.

Youths' Motivational Beliefs

As shown in previous studies, youths' self-concept of ability and value declined over time in each domain (Table 8). Furthermore, the gender differences found here parallel those found in previous research. Girls had lower self-concepts of abilities in sports and math as well as higher self-concepts of abilities in music and reading than boys. Similar patterns emerged for youths' values, except that there were few gender differences in youths'

value of math. These differences were small in all domains except sports, in which several of the differences were moderate in size.

Youths' Participation

Gender differences in participation varied across domains. Girls reported spending moderately less time in sports than boys (Table 10). Girls also participated in a slightly smaller number of high school community sports, though there was no gender difference in school sport teams. In contrast, girls reported spending more time practicing music and reading than did boys. Girls also had higher participation rates in high school literature clubs than boys. After controlling for indicators of ability, these differences in music and reading were small in size. There were few significant mean-level differences between girls and boys for high school courses or time spent in math. The one exception was that girls spent slightly more time on math activities outside of school at Wave 3 than did boys.

Correlations of Other Exogenous Constructs With Our Endogenous Constructs

The correlations between our 11 exogenous constructs and our parent and child/adolescent endogenous indicators are summarized in Tables S1 to S6 in the online material. We highlight the main patterns here for all exogenous constructs except child gender, which was summarized in the previous section and are all in the gender-stereotyped direction and consistently significant. In fact, the child's gender is the most consistent correlate of each of our endogenous constructs, suggesting the continuing power of children's gender in socialization processes. As noted above in the section on mean-level differences, most of these gender associations remained significant even when other covariates linked to independent indicators of natural ability were controlled.

Parents' Beliefs

Most interestingly, family income and parents' education show only very weak and mostly nonsignificant associations with these parental beliefs (Tables A and B in the online material). In contrast, as we would expect, parents' estimates of their children's ability in each domain were significantly and fairly highly related to the corresponding independent indicator we had for each domain (i.e., teachers' rating of children's natural ability); these associations were large for math and reading ($rs > .49$ in all cases). Furthermore, the teachers' rating the child's natural ability in math was almost as highly correlated with the parents' ratings of their children's reading ability as with the parents' ratings of the their children's math ability. Additionally, the children's scores on the Slosson IQ Test were moderately correlated (i.e., $rs \geq .30$) with the parents' ratings of their children's ability for both math and reading. Finally, with the exception of parents' valuing of sports for their children and fathers' valuing of music, the indicators of

teachers' ratings of children's natural abilities in each domain were only weakly related to the parents' valuing of each domain for their child.

Parents' Behaviors

In contrast to the patterns for parents' beliefs, parents' behaviors were only weakly related to all of the exogenous constructs except gender in the sport and instrumental music domains (Tables S3 and S4 in the online material). The exceptions were that teachers' ratings of children's natural ability positively predicted parents' sport behaviors and fathers' music behaviors. In addition, co-reading for both parents and provision of math materials for mothers was higher for the youngest cohort compared to the oldest cohort. Again, and even more surprisingly, neither family income nor parents' education correlated very highly with parents' behaviors, with the exception of mothers' provision of music materials and taking children to music events.

Youths' Beliefs

As was true for the parents' beliefs, there was moderate correspondence between teachers' ratings of the children's natural ability in each domain and children's own ability self-concepts in the corresponding domain (Table S5 in the online material). This correspondence was moderate in sports ($rs > .39$ for 3 of the 4 sports scores), small to moderate in math and reading ($rs > .30$ for 2 out the 4 math scores, and $rs > .20$ for all reading scores), and small in instrumental music ($rs = .07$–$.13$). Teachers' ratings of the children's natural ability in sports also correlated significantly with children's valuing of sports. This relation was typically close to zero in the other domains. No other associations other than those associated with child gender showed a consistent pattern.

Youths' Participation

Being a girl correlated negatively with several indicators of sport participation particularly in grades K–9 and with time spent practicing instrumental music during the late elementary school years (Table S6 in the online material). Being a girl also correlated weakly with amount of time spent reading during the elementary school years and with being in a literature club in high school. Teachers' rating of the children's natural ability for sports and reading moderately predicted children's participation in the corresponding domain throughout childhood and adolescence. Finally, children's scores on the Slosson IQ test correlated with the number of high school math courses taken ($r = .42$), participation in reading and literature (rs range from .09 to .21), and playing a musical instrument during the secondary school years ($rs = .18$ and .17).

Overview of the Analyses in the Monograph

We present the plan of analysis in two places in this document. First, we provide a general overview of the analysis that is applicable to all chapters in

this section. Second, we provide additional details specific to the models in a chapter in each results chapter. The central goal of this study was to test the relations posited in the Eccles's expectancy-value models. Consistent with a cascade perspective on development, we broke our analyses down into a series of 2-wave chunks that would allow us to do cross-lagged analyses in order to investigate the most probable directions of influence operating at each point along the cascade, looking first at the most fundamental socialization step—the link between the beliefs of parents and indicators of their children's abilities, beliefs, and participation. Essentially, we begin this study by asking: Does the model begin with parents' beliefs or does it begin with the child? We then move to the more specific sets of relations of beliefs and behaviors within parents, across parents and children, and finally within children.

At each step in the model, our goal was to test the direction of influence. An overview of the analytic plan is presented in Figure 2. We isolate each cross-lagged model depicted in Figure 2 in a separate chapter. Chapter 4 addresses whether the model begins with parent or child effects across Waves 2 (grades 1, 2, and 4) and 3 (grades 2, 3, and 5). Chapter 5 describes the relations between parents' beliefs and their own behaviors at Wave 2 (grades 1, 2, and 4) and at Wave 3 (grades 2, 3, and 5). Chapter 6 describes the relations between parents' behaviors and children's beliefs at Wave 3 (grades 2, 3, and 5) and at Wave 4 (grades 3, 4, and 6). Chapter 7 includes models testing the relations

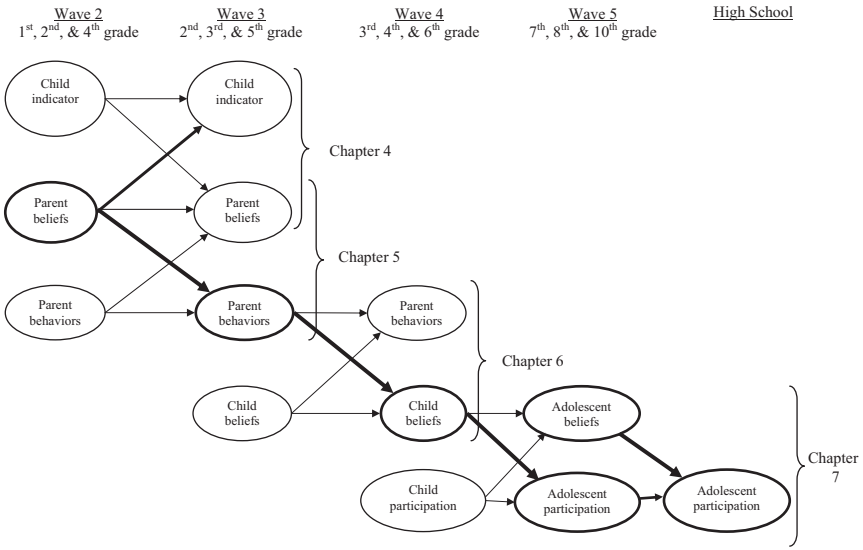

FIGURE 2.—Overall analytic model. The bolded paths show the direction of influence theorized in the Eccles's models.

between youths' beliefs at Wave 4 (grades 3, 4, and 6) and Wave 5 (grades 7, 8, and 10) and youths' participation at Wave 4, Wave 5, and high school.

These specific waves were selected for each model for multiple reasons. Most importantly they were selected so the proposed ordering of the cascading developmental sequence of influences was captured in the sequence of waves represented in each analysis—with the earliest steps in cascade represented by the earliest waves of data. This ordering is logically consistent with our view of the order of causal steps in the socialization and enactment sequence and makes use of time as a tool to help us interpret our findings. We did not use Wave 1 data because only 49% of the families were recruited in Wave 1 and not all questions were in Likert-type scales at this wave. Furthermore, because we needed to test three cross-lagged models with parent data across three waves (i.e., Waves 2 through 4), we decided to analyze the first two sets of cross-lagged models on Waves 2 and 3 (i.e., the results in Chapters 4 and 5) and the last cross-lagged model with parent data at Waves 3 and 4 (i.e., the results in Chapter 6).

What is also evident in our plan for the cross-lagged analyses is that our analyses were largely driven by wave and not cohort (or grade level). This was a decision based on several factors. As evident in Table 2, typically only one or two cohorts were assessed at any single grade level. Restructuring the data from wave to grade would have resulted in a sizeable drop in our sample size. Second, because some of the measures changed from wave to wave, we were unable to collapse measures across grade. Such analyses are possible if you have *both* measures collected at least at one time point. That was not the case here. Third, for a cross-lagged analysis, we wanted the time between each wave to be consistent across youth, which was true when we organized the analyses by wave. Therefore, we designed the models based on wave (rather than grade). Other analyses based on the same data, but driven by different questions, namely the developmental progression of these phenomena over time, were organized by grade level (Fredricks & Eccles, 2002; Jacobs et al., 2002; Simpkins et al., 2010).

All models were structural equation models estimated in AMOS v19. These models were estimated with full information maximum likelihood (FIML) to incorporate cases with missing data (Enders, 2010). We used several indicators of model fit, including the Comparative Fit Index (CFI; Bentler, 1990), the Root Mean Square Error of Approximation (RMSEA; Steiger, 1990), and chi-square. A CFI $\geq$ .95 and a RMSEA $\leq$ .06 are indicative of a model that fit the data well (Hu & Bentler, 1999). A CFI between .90 and .95 and a RMSEA between .06 and .10 indicate that the model fit the data adequately.

Separate models were estimated for each of the four domains (i.e., instrumental music, sports, math, and reading), each parent (i.e., mothers and fathers), and each parent or youth belief (i.e., perceptions of ability and

value). We estimated separate models for mothers and fathers because (a) more mothers participated in the study ($n = 723$) than fathers ($n = 541$), (b) we wanted to use as large a sample as possible for both sets of analyses, and (c) we were not interested in comparing mothers and fathers or estimating mothers' versus fathers' relative contribution, which is what is assessed in GLM models that include both parents. The results of our previous studies that included both mothers and fathers in the same analyses suggested that fathers had relatively little unique influence on their children (Eccles [Parsons] et al., 1982). Such a conclusion is inconsistent with the results of more qualitative studies that suggest a much more important role for fathers. They are also inconsistent with our factor work that finds that mothers' and fathers' reports of their perceptions of their children often load on the same factor—a finding that suggests mothers and fathers, on average, have quite similar views of their children and quite similar socialization goals. If this is true, then putting both mothers' and fathers' data into the same GLM analysis is likely to underestimate the coefficient for one of the two parents due to multicollinearity. We wanted to avoid this statistical problem primarily because so little is known about fathers.

We also estimated separate models for individuals' perceptions of ability and value to avoid statistical problems associated with multicollinearity. We know from our previous work that individual's perceptions of their abilities in and the value they attach to being good at different domains are significantly and often fairly highly correlated even though they factor onto different scales (Eccles & Wigfield, 1995), making multicollinearity a concern. The fact that these two major motivational beliefs are the key components of different theoretical traditions within the field of motivation led us to the conclusion that it was best to run the models separately for these two constructs so that our findings would be maximally useful to both traditions. More specifically, competence-related beliefs are the cornerstone of self-efficacy, self-worth, self-concept, and self-determination theories. In contrast, value beliefs are related more closely to intrinsic motivation and interest theories. Combining these indicators into a single construct would make it virtually impossible for researchers in these fields to compare the findings of this study with prior research in their area.

Measurement Models

Because we were interested in testing longitudinal cross-lagged models for boys and girls, we had to establish that the measurement models were invariant across time and across child gender (Little, 2013; Millsap, 2011). Each latent variable, with the exception of parents' value, had more than three manifest indicators as recommended for identification (Little, 2013; Millsap, 2011). Each latent variable was identified by fixing one of the

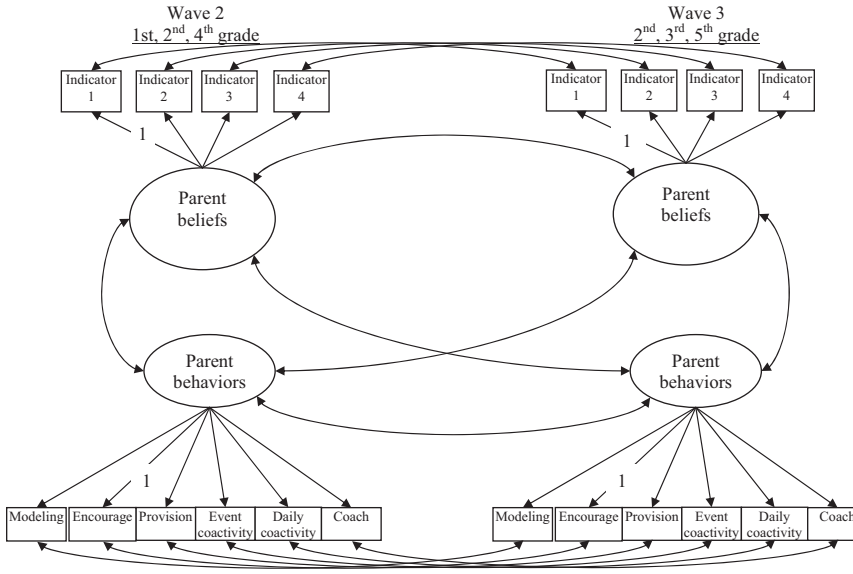

FIGURE 3.—Example of the measurement model of parents' beliefs and parents' behaviors.

loadings to 1.0. These measurement models were different from the full cross-lagged structural models in that they are simply measurement models. An example measurement model is shown in Figure 3. The measurement models did not include control variables, stability or cross-lagged paths, or unique factors for the latent variables. Instead, these measurement models included the latent variables with their manifest (or measured) indicators as well as the covariances among the latent variables and the covariances among the unique factors for the manifest variables.

Following recommendations on estimating cross-lagged models in SEM, we correlated the unique factors of the same measured indicator at the two waves (Little, 2013; Little, Preacher, Selig, & Card, 2007). For example, the covariance between mothers' modeling of sport behaviors at Waves 2 and 3 were estimated. We included two additional covariances among the unique factors for youths' value. Youth value was comprised of two interest items and two importance items. In the expectancy-value model, interest and importance are two aspects of value. As such, we expected the two interest items to be related and the two importance items to be related. We estimated (a) the covariance among the unique factors for the two interest items within each wave, and (b) the covariance among the unique factors for the two importance items within each wave. Thus, for youths' value, we estimated cross-wave covariances among the same indicator over time and within-wave covariances among the interest items and among the importance items. The only

exception to this rule was that we did not include the within wave covariances for the interest items in the reading and math models as the models would not converge with these two additional covariances in the model.

Our goal was to examine the relations among the latent variables. We were not focused on the means (such as, whether beliefs declined over time). Other publications based on this dataset have addressed such questions. Because our goal was to examine the relations among the latent variables, we only needed to establish weak measurement invariance across time and across gender. Weak measurement invariance is when the loadings are similar across time and gender (Millsap, 2011).

Traditionally, scholars have used the change in chi-square across two models to indicate whether the loadings are invariant. However, the chi-square statistic and the change in chi-square test are influenced by sample size. When sample size is large as is true in this study, the change in chi-square test can be statistically significant when the change in the model is relatively small. Although experts agree that there are problems with the chi-square, there is less agreement on the alternative criterion. Because adding constraints often worsens fit of the model, researchers need to make sure that the loss of fit is meaningful and important (Little, 2013; Millsap, 2011; Thompson & Green, 2013). Experts have recommended that scholars use the criterion of $\Delta CFI \geq .010$ to understand if the measurement model is similar across groups or time (i.e., invariant). Although this criterion has only been tested in one study to date (Cheung & Rensvold, 2002), it has been endorsed by experts to examine invariance (Little, 2013; Thompson & Green, 2013). A second CFI criterion of .002 has also been put forward (Meade, Johnson, & Braddy, 2008); however, the criterion of .010 has appeal in part because it has been used more often by statistics experts and has practical meaning to researchers. Imagine we had an unconstrained model where the $CFI = .995$. It would seem like having a constrained model with a $CFI = .993$ and a $\Delta CFI = .002$ is not a large difference, but a constrained model with a $CFI = .985$ and a $\Delta CFI = .010$ might raise some concern. We present the change in chi-square, CFI, and RMSEA in all of our nested models for readers who are interested in these various statistics. As can be seen in the tables presenting the overall model statistics for measurement invariance, typically models that evidenced a $\Delta CFI \geq .010$ also had a ΔX^2 with a $p\text{-value} < .001$. It was infrequent when a model evidenced a $\Delta CFI \geq .010$, but did not have a ΔX^2 with a $p\text{-value} < .001$ or vice versa. Given that we tested measurement invariance in 88 models, we used the criteria of $\Delta CFI \geq .010$ to provide an objective indicator of measurement invariance.

Most published work on invariance addresses invariance across one aspect, such as across time or across groups. Few published studies address invariance across two aspects simultaneously. Little (2013) recommended that unless researchers have greater concerns about one aspect (e.g., time or

gender in this case), invariance across the two aspects should be tested simultaneously rather than sequentially. We did not have greater concerns for one aspect nor a priori expectations about invariance across time and gender. As a result, we first used an initial omnibus test examining invariance across time and gender simultaneously.

The specific steps to our invariance testing are presented in Figure 4. To test invariance across time and gender simultaneously, we examined the difference between two models. The first model was a multi-group model in which nothing was constrained across time and gender (except for the loading fixed to 1.0 to identify each latent variable). The second model was a multi-group model in which the factor loadings were constrained across time and gender. Thus, for any one loading, four separate loadings were estimated in the first model; but, only one loading was estimated in the second model. For example, take fathers' coaching as an indicator of fathers' sport behavior. In the first model, a loading for coaching was estimated at Wave 2 for girls, Wave 2 for boys, Wave 3 for girls, and Wave 3 for boys. In the second model, all four of these loadings were constrained to be equal so that only one loading was estimated. All loadings were constrained in this manner. Sometimes, there were indicators that were only measured at one of the two waves. In this case, this loading was not constrained across time in the second model (because it was not measured at both time points). This loading was still constrained across gender in the second model. Other than this type of situation, all of the loadings were constrained across both time and gender in the second model.

If the omnibus test evidenced invariance across time and gender (i.e., $\Delta\text{CFI} < .010$), we constrained the paths across both aspects and continued with the full cross-lagged structural models. If the omnibus test suggested that the model was not invariant across time and gender (i.e., $\Delta\text{CFI} \geq .010$), we followed up with a series of invariance tests (Figure 4). First, we examined if the model was invariant across time separately from whether it was invariant across gender to understand each of these aspects separately. We compared each of these two models to the fully unconstrained model. If one of these models also evidenced a $\Delta\text{CFI} \geq .010$ suggesting the loadings were not invariant, we conducted another series of follow-up tests to examine if each loading was invariant.

Experts often use the modification indices to identify which loadings may be invariant. However, AMOS does not provide modification indices when estimating models with missing data. Thus, we computed a series of models to help identify which loadings might not be invariant. In most cases, the models were either invariant across time or across gender. Only two models emerged that were not invariant across *both* time and gender. Given that there were only two instances of this in the whole monograph, we discuss those two models in their respective chapters. Here, we describe our steps in examining which

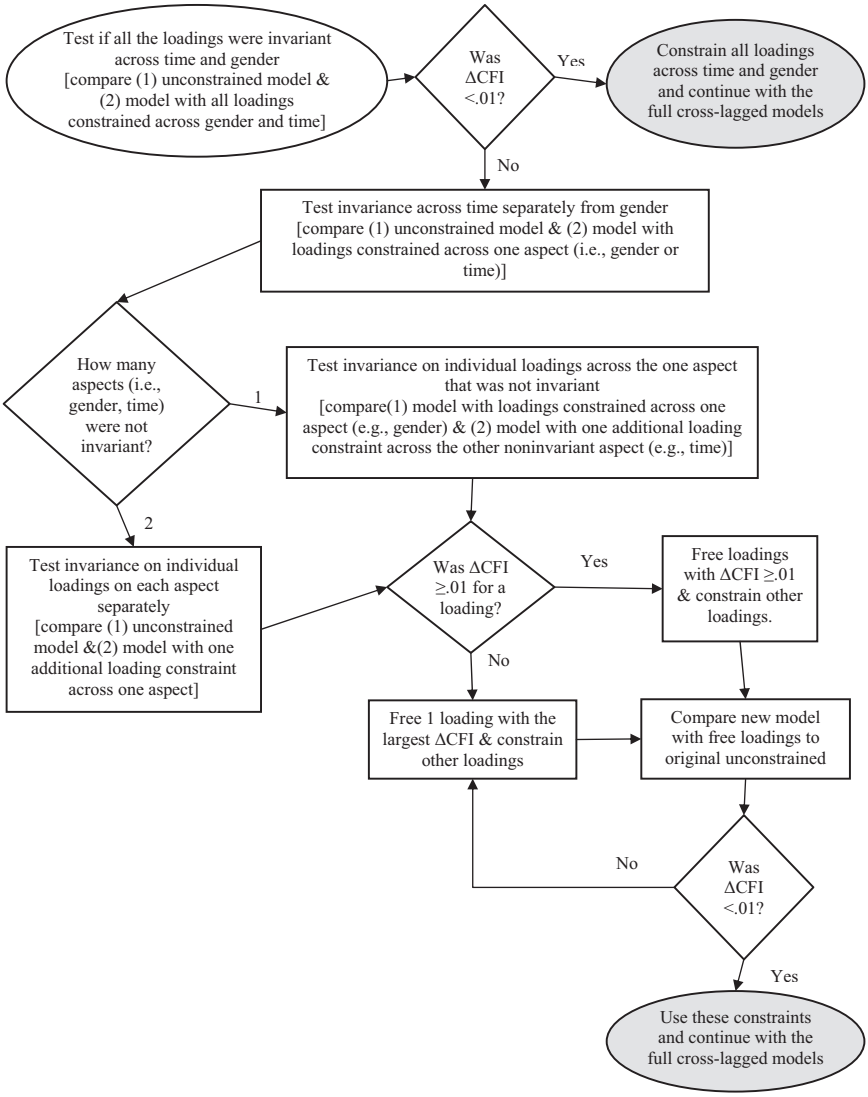

FIGURE 4.—Steps in testing weak measurement invariance across time and gender.

specific loadings were not invariant in one aspect when the other aspect was constrained. If a model was invariant across time but not across gender, the baseline model for our follow-up tests was the model with invariance constraints across time. Then, we estimated models in which we added a gender constraint on the loading of one manifest variables (i.e., constraining

the loading for girls to equal the loading for boys) to test if that single loading was invariant across gender. If a model was invariant across gender but not across time, the baseline model for our follow-up tests was the model with invariance constraints across gender. Then, we estimated models in which we added one time constraint on the loadings of two manifest variables (i.e., constraining the loadings of the two indicators over time to be equal) to test if the loadings for the one indicator were invariant over time. In this step of the analysis, each loading was tested in a separate model to help identify which specific loadings may not be invariant. As in our previous model comparisons, we used the criterion of $\Delta CFI \geq .010$ to determine if a loading was invariant. We constrained all loadings across gender or time if the $\Delta CFI < .010$. Then, we estimated the new final model where we freed individual loadings across gender or time if a $\Delta CFI \geq .010$ was evident in the individual tests. If there was not any one individual loading that had $\Delta CFI \geq .010$, we freed the one loading with the largest ΔCFI.

Because each loading was tested separately in the previous step, we conducted one final comparison. We compared our new final, constrained model (with some loadings that were freed) to the original unconstrained model. If the ΔCFI between these two models was greater than or equal to .010, we freed a single loading with the largest ΔCFI even if the ΔCFI might be less than our criteria of .010. This step was repeated until the ΔCFI between our final model and the original unconstrained model was less than .010.

As noted in texts on invariance (Little, 2013; Millsap, 2011), we needed full or partial weak invariance to test the relations in the full structural model. Weak measurement invariance across time was necessary to estimate the full cross-lagged models. Weak measurement invariance across gender was necessary to test whether the structural portion of the model was invariant across gender. If the measurement model was invariant across gender but not time, we did not estimate the full cross-lagged model nor test gender as a moderator of the relations in the structural portion of the model. If the measurement model was invariant across time but not gender, we estimated the full cross-lagged structural model but we did not test gender as a moderator.

Full Cross-Lagged Structural Models

We tested the direction of influence in every model by estimating full cross-lagged models over two waves of data. For example, in Chapter 5, we estimated the cross-lagged model of parents' behaviors and children's beliefs over Waves 3 and 4. The model included parenting behaviors at Waves 3 and 4 as well as child beliefs at Waves 3 and 4. As shown in Figure 7, the stability of each latent variable from Waves 3 to 4 and the cross-lagged paths across these waves were estimated. By including these stability and cross-lagged paths, we

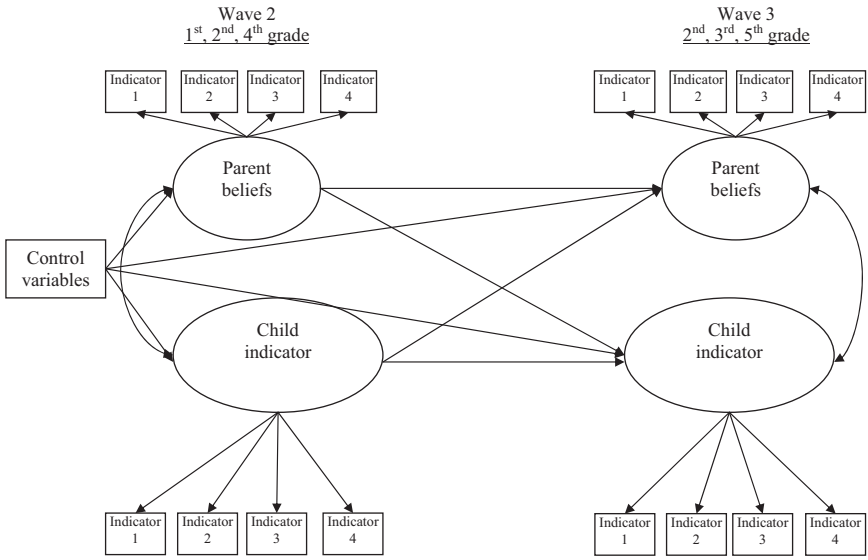

FIGURE 5.—Cross-lagged model of parents' beliefs and child factors.

could examine whether parents' behaviors at Wave 3 predicted changes in children's beliefs over time as well as whether children's beliefs at Wave 3 predicted changes in parents' behaviors over time.

Figures 5–8 show the predictive paths of the full cross-lagged structural models. The additional aspects of the models that are not shown in these overarching figures include (a) the unique factors associated with each latent variable, (b) the unique factors associated with each manifest variable, (c) the covariances among the unique factors of the manifest variables, and (d) the covariances among the control variables. The full list of indicators for each latent variable is presented in the Methods section, and Tables 3, 5, and 7.

Exogenous Control Variables

Several family- and child-level control variables were also included in each model. They were parents' education, family income, teachers' ratings of children's natural ability, children's gender, and children's cohort. Our selection of control variables was based on theory and previous research noting the importance of these indicators in the processes addressed in this monograph. These indicators predicted parents' and youths' beliefs and behaviors at every wave. For example, in the model testing the relations between parents' beliefs and parents' behaviors across Waves 2 and 3, the control variables predicted the four latent variables of parents' beliefs and parents' behaviors at Waves 2 and 3 (see Chapter 5). Although we initially had

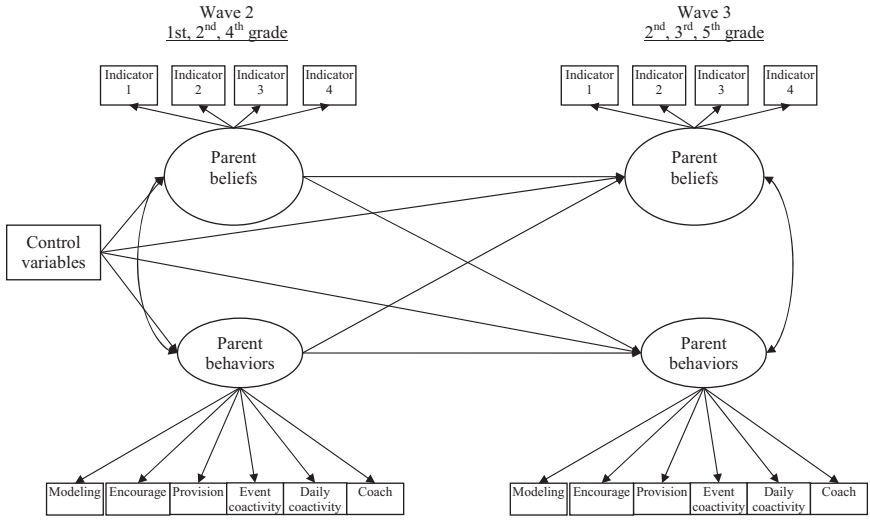

FIGURE 6.—Cross-lagged model of parents' beliefs and parents' behaviors.

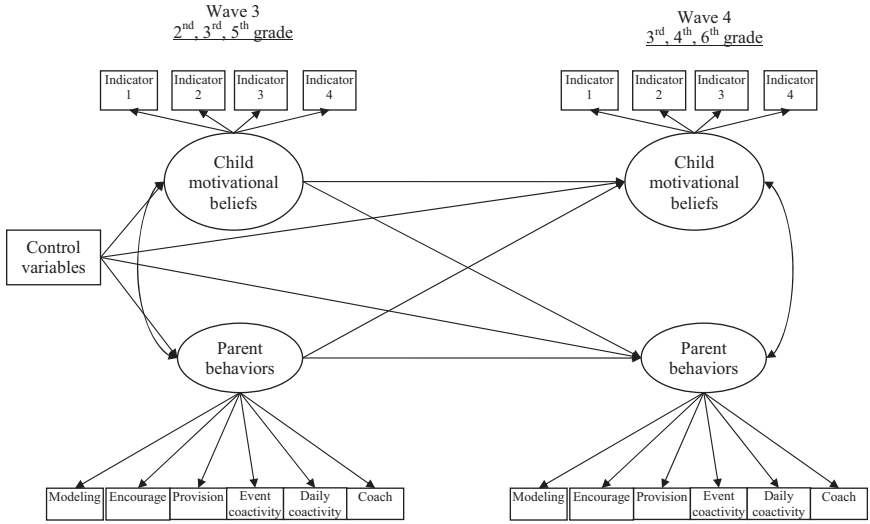

FIGURE 7.—Cross-lagged model of parents' behaviors and children's beliefs.

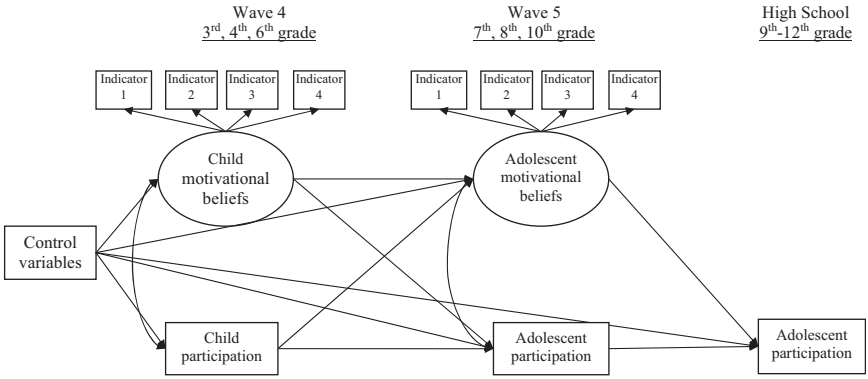

FIGURE 8.—Cross-lagged model of youths' beliefs and youths' participation.

each control variable predict each latent variable of parents' and youths' beliefs and behaviors, this type of analysis can lead to over controlling (Little, 2013). Following recommendations, we dropped paths when a control variable did not significantly predict a particular latent variable at the $p < .10$ level. If a control variable did not significantly predict any of the latent variables representing parents' and youths' beliefs and behaviors in a particular model, it was dropped from that model.

Controlling for these indicators in our analyses at each wave is important so that we can understand the relative contribution of the focal latent variables while controlling for these selection effects. For example, children's Slosson IQ score was included as a control variable in all models. By controlling for this score, we are controlling for the possibility that children with high verbal and day-to-day knowledge (what is measured on the Slosson) are also likely to have parents who support children in these domains and to have high self and task beliefs themselves as well as high rates of participation in these domains. This is the strongest correlational design we can use to adjust for selection effects with non-experimental data. However, the inclusion of these controls at each wave, along with controlling for the stability of each focal parent and youth latent variable across the two waves, makes our analyses of the relative contribution to the change in parents and youth very conservative. The specific findings concerning the control variables (i.e., coefficients) are not presented in the text, but are available from the authors.

Gender Moderation

As noted earlier, one central goal of this study was to examine whether the relations among parents' and youths' beliefs and behaviors varied by child

gender. As we noted in the introduction, mean-level gender differences are a separate issue from gender moderation. The same is true for testing measurement invariance for child gender and child gender as a moderator of the relations among the constructs. Measurement invariance examines the extent to which the constructs have similar meaning across girls and boys. Even if the constructs have similar meaning (i.e., they are invariant), it is still possible that the constructs have different correlates. Thus, it is necessary to examine if gender moderates the relations among the constructs. In our cross-lagged models, we tested whether the relations within each time point (i.e., the covariances) and the predictive relations across time (i.e., the stability and cross-lagged paths) varied by child gender.

To test for this invariance in the structural model, we tested the difference between two nested models through a multi-group analysis: (a) a model in which the loadings were constrained across time and gender (based on the previous measurement invariance findings) and (b) a model in which the loadings were constrained across time and gender, and the focal paths were constrained to be equal across girls and boys. The six focal paths included the stability paths, the cross-lagged paths, and the within-wave covariances. All of these paths address the relations among the focal latent variables. Other paths or covariances (e.g., paths from the control variables to the focal latent variables or the covariances among the control variables) were not constrained across gender.

In order to determine if there may be gender differences in the structural portion of the model, we first examined whether the change in model chi-square (based on the change in *df*) was significant at $p < .001$ due to the effect of large sample sizes on the chi-square statistic (Little, 2013). If this overall test was statistically significant, we computed a series of follow-up tests in which we tested each individual path or covariance to identify the path(s) and covariance(s) that differed across girls and boys.

Presentation of the Results

Given the number of analyses, we present some of the findings in the text and some are available through the supplemental material online. The goodness-of-fit indicators and the standardized path estimates are presented in the text. The online material includes four pieces of information. First, the model fit for measurement invariance across time and gender are presented in the online material as these tests are necessary but not the central questions of this monograph. Second, the unstandardized and standardized path estimates are presented in the supplemental materials. Third, we present the gender moderation in the online material as only one test was statistically significant. Fourth, we also include in the supplemental material the loadings for the parental behaviors as some of the loadings for parents' reading

behaviors were not statistically significant (detailed information on this issue is presented in Chapter 5). The loadings for other latent variables are available from the first author.

SUPPORTING INFORMATION

Additional supporting information may be found in the online version of this article at the publisher's website.

IV. CHILD FACTORS AND PARENT BELIEF MODELS

Our goal in this chapter is to summarize the findings from a series of cross-lagged models between child factors (i.e., ability self-concepts, task value, participation, and teachers' rating of the child's natural abilities in each domain) and parent beliefs in each domain measured at Wave 2 (grades 1, 2, and 4) and one year later at Wave 3 (grades, 2, 3, and 5). These models were designed to compare the extent to which the sequence of processes described in the Eccles's expectancy-value model starts with parents or with children. In other words, do parents shape children as theorized in the model, do children influence parents (Bell, 1979), or both? For the most part, we predict that parents' beliefs, particularly their perceptions of their children's abilities, will influence changes in their children's ability self-concepts and task valuing over time more than vice versa because the children's self-concepts are still developing and children's capacity to draw inferences about their abilities from their own performance is limited during the early elementary school years (Parsons & Ruble, 1978; Stipek & MacIver, 1989). We make a similar prediction for the association between parents' beliefs and children's participation in each domain for two reasons: (1) Parents' beliefs should directly influence the extent to which they actively encourage and support their children's participation in each domain; and (2) Parents' beliefs should indirectly influence their children's participation through the impact of these beliefs on the children's ability self-concepts and task valuing.

We also predict that the relative size of these predictions from parents to their children will be stronger in the leisure domains than in math due to the greater likelihood that children have more of their socialization experiences with their parents in leisure domains than in math. Whether this will also be true for reading is not clear because reading is an activity that is often done with one's parents in some homes.

In contrast, we predict that the teachers' rating of each child's natural ability will be more likely to influence changes in the parents' ratings of their children's abilities over time to a greater extent than vice versa, particularly in

the areas of math and reading. Teachers provide parents with new information about their child's performance in school that should influence changes in the parents' views of their children's academic abilities over time. Such a pattern of results is consistent with the Eccles and her colleagues' model in which the young children's aptitudes influence the parents' perceptions of the associated abilities, which in turn influence children's developing domain-specific ability self-concepts through the interpretative messages parents provide to their children about their aptitudes and performances, particularly during the elementary school years when children's own ability to interpret their experiences is still developing. In other words, parents are assumed to influence their children's developing ability self-concepts at least in part through their role as interpreters of experience and reality, particularly during the elementary school years.

Data Analysis Plan

Sixty-four separate structural equation models were estimated to test the relations between child factors and parent beliefs across the four domains (i.e., sports, instrumental music, math, and reading), two parents (i.e., mothers and fathers), four child factors (i.e., ability self-concept, value, participation, and teachers' ratings of child natural ability), and the two parent beliefs (i.e., perceptions of their child's domain-specific abilities and the task value the parents attach to each domain). Parents' beliefs were included as latent variables in the models with one exception: Parents' value at Wave 2 was a single-item indicator and thus was included as a measured variable in all models.

A conceptual representation of the cross-lagged model with these constructs is shown in Figure 5 (p. 50). Each model included two stability coefficients, two cross-lagged paths, and two within-wave covariances among the two latent variables. In each model, we first tested whether the relations between the child factors and parents' beliefs varied by child gender with the three steps outlined in the overview of the plan of analysis in Chapter 3.

There was one difference between the models with teachers' rating of the child's natural ability and the models with three other child indicators (i.e., children's ability self-concept, value, and participation). In the models with children's ability self-concept, value, and participation, teachers' rating of children's natural ability averaged across Waves 1–3 was included as a control variable. In the models where teachers' rating of the child's natural ability was included as one of the two central indicators in the cross-lagged analyses, the indicators of teachers' rating of the child's natural ability were single indicators at Waves 2 and 3. Obviously, teachers' rating of the child's natural ability could not be included as a control variable in the models with the cross-lagged relations between teachers' rating of the child's natural ability and

parental beliefs. Thus, that one control variable was removed from all the models with teachers' rating of the child's natural ability as one of the two central indicators in the main cross-lagged relations. All of the other control variables were used in all models.

Results

Measurement Invariance

Before presenting the results of the specific paths and covariances, we present the results on measurement invariance across time and gender (model fit for the unconstrained models is presented in Tables S7–S10 in the online material). Fifty-eight of the 64 models evidenced full weak measurement invariance across time and gender when we tested time and gender simultaneously. In other words, in 90% of the models, the loadings for parents' beliefs and children's indicators were similar over time and were similar for girls and boys.

Six of the 64 models had a $\Delta CFI \geq .010$ across the two nested models, suggesting that each of these models included loading(s) that were different (i.e., were not invariant) across time, gender, or across both time and gender. The six models were (a) mothers' sport value and children's sport ability self-concept, (b) fathers' perception of their children's sport ability and children's sport ability self-concept, (c) fathers' sport value and children's sport ability self-concept, (d) mothers' music value and children's music ability self-concept, (e) fathers' reading value and teachers' rating of children's natural reading ability, and (f) fathers' reading value and children's participation.

In each of the three sport models, the loading for one indicator of children's sport ability self-concept was different for girls compared to boys. Therefore, in each of these three sport models, we freed the loading for this item across gender (but constrained it over time). All other loadings in these models were similar across gender and time, and constrained to be equal.

We want to take a moment here to point out that the model with fathers' perception of their children's sport ability and children's ability self-concept is the first model in this monograph where we freed a loading that did not meet our criterion of $\Delta CFI \geq .010$. We noted in the analysis plan presented in Chapter 3 that we used $\Delta CFI \geq .010$ as a marker indicating if the loading(s) were significantly different across gender or time. When we ran the omnibus test including multiple loadings and the $\Delta CFI \geq .010$, there were usually one or two loadings that were driving the differences found in the omnibus test. However, sometimes the omnibus test suggested the loadings were significantly different across gender/time (i.e., $\Delta CFI \geq .010$), but none of the tests for the individual loadings were significant (i.e., $\Delta CFIs < .010$). As shown in Table S7, in the model of fathers' perception of

their child's sport ability and children's ability self-concept, the omnibus test was significant suggesting that some loadings differed across child gender (i.e., ΔCFI = .013). However, none of the tests on the individual loadings were significant according to our ΔCFI criterion—suggesting that each individual loading was similar across child gender. We had to reconcile these conflicting findings before we could estimate our full cross-lagged model. Unless we freed at least one loading, the omnibus test would still suggest the loadings differed across girls and boys. Of the individual loadings, the item asking children to compare themselves to other students had the largest change in CFI (i.e., ΔCFI = .007). After we freed that loading to be estimated separately for girls and boys, the omnibus test suggested the remaining loadings were similar across girls and boys (i.e., ΔCFI = .005, which is less than .010). We constrained all other loadings to be equal across time and gender. We proceeded with estimating the full cross-lagged structural models and testing gender moderation as only one loading varied in each of these models.

As shown in Table S8, some of the loadings were not invariant over time in the model with mothers' music value and children's music ability self-concept. Follow-up tests suggested that two of the four loadings for children's music ability self-concept were different at Wave 2 compared to Wave 3. Music ability self-concept included four indicators. The loading for one of these indicators was set to 1.0 to identify the latent variable. Therefore, two of the remaining three indicators had different loadings over time. The lack of invariance suggests that the structure of children's music ability self-concept (i.e., the loadings) changed over time. As a result, any comparisons of children's music ability self-concepts in this model over time would be like comparing "apples and oranges" so to speak and is discouraged. Thus, our analysis of the model with mothers' music value and children's music ability self-concept stopped here. We did *not* continue and estimate the full cross-lagged model.

Two of the reading models with fathers' reading value (i.e., teachers' ratings of children's natural ability and participation) had loadings that were not invariant (i.e., different) across gender. Each of these models included only one freely estimated loading. Children's natural ability and participation were single-item indicators at both waves. Fathers' value was a single indicator at Wave 2 and had only two measured indicators at Wave 3. The only invariance test for these models was to examine if the one loading in each model was similar (i.e., invariant) across girls and boys (Table S10). It was not similar suggesting that the loading for fathers' value was different for fathers of girls compared to fathers of boys and should be estimated separately for each group. Because fathers' value had a different structure (i.e., loadings) across girls and boys, we could not make comparisons across girls and boys using fathers' value.

Thus, we could not test whether gender moderated the relations between fathers' value of reading and children's ability or participation. However, we could continue and estimate the full cross-lagged model (just not include the step on gender moderation).

Final Models

All of the 64 models fit the data well according to the RMSEA (i.e., RMSEA < .05; Table 12 and Tables S11–S14 in the online material). According to the CFI, 58 of the 64 models fit the data well (i.e., CFI = .950–1.000), and the remaining 6 models that fit the data adequately (i.e., CFI = .900 to .949). We summarize the general patterns across the four domains, the various child constructs (i.e., ability self-concept, value, participation, and natural ability), girls and boys, and mothers and fathers. We also note where differences occurred by domain, child gender, and parent. The standardized path estimates are presented in Tables 13 through 16 for sports, instrumental music, math, and reading (respectively). The estimates are organized by the model and then by the type of predictive path within each model: cross-lagged paths, stability paths, and within-wave covariances. The unstandardized estimates, standard errors, and standardized path estimates are in Tables S15–S18 in the online supplemental materials.

There were a few general patterns of findings for the cross-lagged paths that are worth highlighting (Tables 13–16). First, with the exception of instrumental music, parents' valuing of a domain was often not a significant predictor of their children's constructs nor were they often predicted by their children's constructs. In contrast, parents' beliefs about their child's abilities often predicted significant changes in children's beliefs, participation, and teachers' ratings of the child's natural ability over time. As predicted, children whose parents rated their ability the highest showed the largest gains in their own domain-specific ability self-concepts and free time participation in the domain. Interestingly, these same children also showed the highest gains in their teachers' ratings of their natural ability over time.

Second, as predicted, the children's ability self-concepts, subjective task value and participation at Wave 2 did not predict changes in their parents' beliefs from Wave 2 to Wave 3. For instance, as expected, children's participation and children's ability self-concepts rarely ever predicted their parents' beliefs in sports, math, or reading. In instrumental music, however, all five models tested with parental values of music and children's music ability self-concepts, value, and participation had significant child effects. Specifically, mothers' and fathers' valuing of music increased over time if their child had high scores for their music ability self-concept, their perceived value of instrumental music, and their participation in instrumental music. (Note: one of the models was not tested due to lack of measurement invariance). These paths were small to moderate in size ($\beta = .13$ to .36, $ps < .05$).

TABLE 12

MODEL FIT INDEXES FOR THE MODELS WITH CHILD FACTORS AND PARENTS' BELIEFS

	Mothers				Fathers			
Model	*df*	X^2	CFI	RMSEA	*df*	X^2	CFI	RMSEA
Sports								
Parent perception of their children's ability								
Child ability self-concept	265	443.34***	.962	.031	258	371.43***	.966	.029
Child value	273	340.29**	.984	.018	247	305.58**	.980	.021
Child participation	106	99.90	1.000	.000	94	112.68	.990	.020
Teacher rating of child natural ability	106	95.58	1.000	.000	84	94.67	.994	.016
Parent sport value								
Child ability self-concept	179	307.97***	.949	.032	171	240.53***	.963	.028
Child value	162	203.01*	.980	.019	124	163.95**	.971	.025
Child participation	41	52.85	.981	.020	53	68.80	.977	.024
Teacher rating of child natural ability	53	51.22	1.000	.000	39	36.23	1.000	.000
Music								
Parent perception of their children's ability								
Child ability self-concept	243	308.59**	.984	.019	229	383.89***	.938	.036
Child value	223	389.06***	.951	.032	219	290.59***	.975	.025
Child participation	104	131.49*	.988	.019	88	150.76***	.958	.037
Teacher rating of child natural ability	74	78.13	.998	.009	92	131.56**	.973	.029
Parent music value								
Child ability self-concept	n/a				144	279.86***	.913	.043
Child value	144	199.09**	.979	.023	138	183.88**	.976	.025
Child participation	45	32.11	1.000	.045	45	60.37	.973	.026
Teacher rating of child natural ability	29	25.58	1.000	.000	33	40.50	.981	.021
Math								
Parent perception of their children's ability								
Child ability self-concept	291	464.09***	.958	.029	285	374.61***	.968	.025
Child value	231	364.93***	.961	.028	255	331.76***	.970	.024
Child participation	110	129.67*	.992	.016	102	104.55	.999	.007
Teacher rating of child natural ability	58	87.75**	.987	.027	94	99.39	.997	.011
Parent math value								
Child ability self-concept	130	189.89***	.965	.025	160	218.53***	.958	.027
Child value	108	173.92***	.947	.029	100	121.21	.978	.020
Child participation	29	37.48	.976	.020	59	75.75	.973	.023
Teacher rating of child natural ability	35	40.01	.992	.014	37	36.99	1.000	.000
Reading								
Parent perception of their children's ability								
Child ability self-concept	265	421.78***	.966	.029	271	441.85***	.946	.035
Child value	199	232.86*	.991	.015	228	307.34***	.969	.026
Child participation	72	109.64**	.987	.027	110	181.53***	.965	.036
Teacher rating of child natural ability	86	121.47**	.988	.024	86	164.08***	.960	.042
Parent reading value								
Child ability self-concept	196	277.96***	.968	.024	182	274.99***	.947	.031
Child value	112	120.59	.993	.010	132	151.91	.982	.017
Child participation	41	45.68	.992	.013	40	42.57	.996	.011
Teacher rating of child natural ability	41	36.98	1.000	.000	39	45.76	.991	.018

Note. n/a = This model was not estimated as the measurement model was not invariant over time.
*$p < .05$.
**$p < .01$.
***$p < .001$.

TABLE 13

STANDARDIZED PATH ESTIMATES FOR THE MODELS WITH CHILD FACTORS AND PARENTS' BELIEFS IN SPORTS

	Models With Parent Perception of Their Child's Ability and				Models With Parent Value and			
	Mothers		Fathers		Mothers		Fathers	
Path	Girls	Boys	Girls	Boys	Girls	Boys	Girls	Boys
Child ability self-concept								
Cross-lagged paths								
W2 parent beliefs → W3 child self-c	.13**	.15**	.17***	.23***	.07	.08	.14**	.17**
W2 child self-c → W3 parent beliefs	.01	.01	.00	.00	.04	.03	−.06	−.04
Stability paths								
W2 parent beliefs → W3 parent beliefs	.76***	.76***	.73***	.68***	.51***	.48***	.59***	.55***
W2 child self-c → W3 child self-c	.43***	.41***	.42***	.38***	.45***	.43***	.44***	.40***
Within wave covariances								
W2 parent beliefs ↔ W2 child self-c	.20***	.24***	.10*	.19*	.04	.05	.08	.13
W3 parent beliefs ↔ W3 child self-c	.15*	.17*	.14*	.24*	.27***	.31***	.16*	.24*
Child value								
Cross-lagged paths								
W2 parent beliefs → W3 child value	.03	.07	.03	.07	.01	.02	.07	.11
W2 child value → W3 parent beliefs	.08	.06	.14**	.12**	.12	.10	.10	.08
Stability paths								
W2 parent beliefs → W3 parent beliefs	.71***	.67***	.71***	.66***	.56***	.49***	.67***	.64***
W2 child value → W3 child value	.24***	.40***	.28***	.55***	.27***	.45***	.48***	.66***
Within wave covariances								
W2 parent beliefs ↔ W2 child value	.26***	.27***	.21***	.30***	.06	.07	.18**	.27**
W3 parent beliefs ↔ W3 child value	.14**	.27**	.10*	.33*	.18***	.32***	.08	.16
Child participation								
Cross-lagged paths								

(*Continued*)

TABLE 13. (*Continued*)

	Models With Parent Perception of Their Child's Ability and				Models With Parent Value and			
	Mothers		Fathers		Mothers		Fathers	
Path	Girls	Boys	Girls	Boys	Girls	Boys	Girls	Boys
W2 parent beliefs → W3 child time	.21***	.22***	.13**	.13**	.09	.09	.10	.09
W2 child time → W3 parent beliefs	.00	.00	.08	.06	.06	.05	.10	.09
Stability paths								
W2 parent beliefs → W3 parent beliefs	.73***	.71***	.72***	.68***	.53***	.51***	.67***	.66***
W2 child time → W3 child time	.19***	.16***	.23***	.19***	.22***	.19***	.19***	.16***
Within wave covariances								
W2 parent beliefs ↔ W2 child time	.09*	.09*	.08	.11	.12**	.14**	.13*	.16*
W3 parent beliefs ↔ W3 child time	.17**	.17**	.19**	.23**	.16**	.16**	.12	.12
Teacher rating of child natural ability								
Cross-lagged paths								
W2 parent beliefs → W3 teacher rating	.22***	.23***	.23***	.21***	.10	.09	.07	.06
W2 teacher rating → W3 parent beliefs	.11*	.10*	.18***	.19***	.17**	.18**	.16*	.18*
Stability paths								
W2 parent beliefs → W3 parent beliefs	.72***	.72***	.72***	.69***	.52***	.49***	.65***	.62***
W2 teacher rating → W3 teacher rating	.22***	.21***	.25***	.24***	.31***	.31***	.27***	.27***
Within wave covariances								
W2 parent beliefs ↔ W2 teacher rating	.41***	.41***	.34***	.40***	.16***	.19***	.29***	.33***
W3 parent beliefs ↔ W3 teacher rating	.19**	.20**	.21*	.24*	.02	.02	.03	.04

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

TABLE 14

STANDARDIZED PATH ESTIMATES FOR THE MODELS WITH CHILD FACTORS AND PARENTS' BELIEFS IN MUSIC

	Models With Parent Perception of Their Child's and				Models With Parent Value and			
	Mothers		Fathers		Mothers		Fathers	
Path	Girls	Boys	Girls	Boys	Girls	Boys	Girls	Boys
Child ability self-concept								
Cross-lagged paths								
W2 parent beliefs → W3 child self-c	.18**	.17**	.32***	.22***	n/a	n/a	.24*	.16*
W2 child self-c → W3 parent beliefs	.03	.04	.06	.08	n/a	n/a	.15*	.20*
Stability paths								
W2 parent beliefs → W3 parent beliefs	63***	.64***	.59***	.54***	n/a	n/a	−.03	−.03
W2 child self-c → W3 child self-c	.33***	.34***	.36***	.33***	n/a	n/a	.48***	.44***
Within wave covariances								
W2 parent beliefs ↔ W2 child self-c	.20**	.15**	.27***	.23***	n/a	n/a	−.03	−.03
W3 parent beliefs ↔ W3 child self-c	.40***	.29***	.47***	.30***	n/a	n/a	.37***	.23***
Child value								
Cross-lagged paths								
W2 parent beliefs → W3 child value	.24***	.21***	.21**	.16**	.01	.01	.17	.13
W2 child value → W3 parent beliefs	.06	.07	.07	.09	.13*	.15*	.33***	.36***
Stability paths								
W2 parent beliefs → W3 parent beliefs	.63***	.63***	.56***	.51***	.38***	.29***	.14	.14
W2 child value → W3 child value	.35***	.32***	.28***	.33***	.34***	.35***	.15*	.20*
Within wave covariances								
W2 parent beliefs ↔ W2 child value	.23***	.18***	.22**	.16**	.05	.04	−.08	−.06
W3 parent beliefs ↔ W3 child value	.35***	.24***	.30**	.21**	.39***	.26***	.24**	.17**

(*Continued*)

TABLE 14. (*Continued*)

	Models With Parent Perception of Their Child's and				Models With Parent Value and			
	Mothers		Fathers		Mothers		Fathers	
Path	Girls	Boys	Girls	Boys	Girls	Boys	Girls	Boys
Child participation								
Cross-lagged paths								
W2 parent beliefs → W3 child time	.19***	.25***	.19***	.22***	.06	.06	.14*	.13*
W2 child time → W3 parent beliefs	.07	.05	−.03	−.03	.32***	.25***	.29***	.25***
Stability paths								
W2 parent beliefs → W3 parent beliefs	.63***	.65***	.61***	.62***	.41***	.31***	.10	.09
W2 child time → W3 child time	.21***	.21***	.18***	.18***	.29***	.27***	.26***	.23***
Within wave covariances								
W2 parent beliefs ↔ W2 child time	.32***	.29***	.37***	.37***	−.01	−.02	.09	.11
W3 parent beliefs ↔ W3 child time	.38***	.36***	.40***	.40***	.30***	.25***	.18**	.17**
Teacher rating of child natural ability								
Cross-lagged paths								
W2 parent beliefs → W3 teacher rating	.02	.02	.14	.14	.03	.03	.14	.14
W2 teacher rating → W3 parent beliefs	−.05	−.04	.05	.04	.01	.01	.15	.12
Stability paths								
W2 parent ability → W3 parent beliefs	.66***	.64***	.62***	.55***	.31***	.31***	.05	.04
W2 teacher rating → W3 teacher rating	.18**	.18**	.11	.10	.19**	.19**	.15	.13
Within wave covariances								
W2 parent beliefs ↔ W2 teacher rating	.19**	.17**	.20**	.23**	−.09	−.10	−.09	−.12
W3 parent beliefs ↔ W3 teacher rating	−.00	−.00	.07	.06	.05	.05	.12	.12

Note. n/a = This model was not estimated as the measurement model was not invariant over time.
*$p < .05$.
**$p < .01$.
***$p < .001$.

TABLE 15

STANDARDIZED PATH ESTIMATES FOR THE MODELS WITH CHILD FACTORS AND PARENTS' BELIEFS IN MATH

	Models With Parent Perception of Their Child's and				Models With Parent Value and			
	Mothers		Fathers		Mothers		Fathers	
Path	Girls	Boys	Girls	Boys	Girls	Boys	Girls	Boys
Child ability self-concept								
Cross-lagged paths								
W2 parent beliefs → W3 child self-c	.07	.08	−.03	−.03	.06	.06	.01	.01
W2 child self-c → W3 parent beliefs	.08	.08	−.03	−.04	−.12	−.12	.04	.04
Stability paths								
W2 parent beliefs → W3 parent beliefs	.52***	.62***	.62***	.65***	.62***	.58***	.63***	.65***
W2 child self-c → W3 child self-c	.42***	.40***	.45***	.45***	.42***	.44***	.43***	.44***
Within wave covariances								
W2 parent beliefs ↔ W2 child self-c	.28***	.27***	.33***	.36***	.07	.06	.04	.04
W3 parent beliefs ↔ W3 child self-c	.22***	.28***	.26***	.35***	.10	.09	.07	.07
Child value								
Cross-lagged paths								
W2 parent beliefs → W3 child value	.12*	.12*	.08	.08	.00	.00	.04	.04
W2 child value → W3 parent beliefs	.09*	.10*	−.08	−.09	−.02	−.02	.04	.04
Stability paths								
W2 parent beliefs → W3 parent beliefs	.53***	.63***	.64***	.69***	.61***	.57***	.63***	.64***
W2 child value → W3 child value	.37***	.38***	.45***	.46***	.41***	.39***	.47***	.48***
Within wave covariances								
W2 parent beliefs ↔ W2 child value	.17**	.14**	.29***	.28***	.12*	.14*	.02	.02
W3 parent beliefs ↔ W3 child value	.24***	.27***	.12	.16	.17*	.16*	.26*	.25*

(*Continued*)

TABLE 15. (*Continued*)

	Models With Parent Perception of Their Child's and				Models With Parent Value and			
	Mothers		Fathers		Mothers		Fathers	
Path	Girls	Boys	Girls	Boys	Girls	Boys	Girls	Boys
Child participation								
Cross-lagged paths								
W2 parent beliefs → W3 child time	.04	.03	.01	.01	−.01	−.01	.09	.09
W2 child time → W3 parent beliefs	.03	.04	−.05	−.05	.09	.08	.03	.03
Stability paths								
W2 parent beliefs → W3 parent beliefs	.54***	.64***	.61***	.65***	.58***	.54***	.63***	.67***
W2 child time → W3 child time	.06	.05	.08	.08	.05	.06	.11*	.10*
Within wave covariances								
W2 parent beliefs ↔ W2 child time	−.04	−.03	−.05	−.05	−.02	−.02	−.14*	−.12*
W3 parent beliefs ↔ W3 child time	.08	.09	−.03	−.05	.16*	.16*	.16	.16
Teacher rating of child natural ability								
Cross-lagged paths								
W2 parent beliefs → W3 teacher rating	.19***	.19***	.22***	.18***	.01	.01	.03	.02
W2 teacher rating → W3 parent beliefs	.18***	.21***	.16***	.21***	.07	.06	.08	.09
Stability paths								
W2 parent beliefs → W3 parent beliefs	.56***	.64***	.64***	.67***	.58***	.56***	.61***	.64***
W2 teacher rating → W3 teacher rating	.42***	.46***	.38***	.42***	.54***	.49***	.45***	.50***
Within wave covariances								
W2 parent beliefs ↔ W2 teacher rating	.40***	.35***	.42***	.44***	−.02	−.02	.16*	.13*
W3 parent beliefs ↔ W3 teacher rating	.26***	.32***	.28***	.34***	.01	.01	.08	.08

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

TABLE 16

STANDARDIZED PATH ESTIMATES FOR THE MODELS WITH CHILD FACTORS AND PARENTS' BELIEFS IN READING

	Models With Parent Perception of Their Child's and				Models With Parent Value and			
	Mothers		Fathers		Mothers		Fathers	
Path	Girls	Boys	Girls	Boys	Girls	Boys	Girls	Boys
Child ability self-concept								
Cross-lagged paths								
W2 parent beliefs → W3 child self-c	.20***	.20***	.25***	.24***	−.08	−.06	.07	.08
W2 child self-c → W3 parent beliefs	−.08*	−.07*	−.08	−.08	.05	.06	.06	.08
Stability paths								
W2 parent beliefs → W3 parent beliefs	.70***	.77***	.83***	.87***	.59***	.58***	.33***	.56***
W2 child self-c → W3 child self-c	.40***	.34***	.42***	.37***	.42***	.37***	.45***	.43***
Within wave covariances								
W2 parent beliefs ↔ W2 child self-c	.22***	.20***	.25***	.24***	.06	.07	−.02	−.01
W3 parent beliefs ↔ W3 child self-c	.23**	.18**	.27**	.23**	.17	.17	.17*	.22*
Child value								
Cross-lagged paths								
W2 parent beliefs → W3 child value	.18**	.17**	.06	.06	−.02	−.01	.06	.07
W2 child value → W3 parent beliefs	−.01	−.02	.06	.07	.00	−.01	.04	.06
Stability paths								
W2 parent beliefs → W3 parent beliefs	.68***	.76***	.70***	.75***	.57***	.57***	.34***	.56***
W2 child value → W3 child value	.39***	.41***	.46***	.50***	.41***	.43***	.47***	.52***
Within wave covariances								
W2 parent beliefs ↔ W2 child value	.18**	.13**	.17*	.14*	.10	.09	.09	.05
W3 parent beliefs ↔ W3 child value	.04	.03	.25**	.22**	.10	.10	−.10	−.12

(*Continued*)

TABLE 16. (*Continued*)

	Models With Parent Perception of Their Child's and				Models With Parent Value and			
	Mothers		Fathers		Mothers		Fathers	
Path	Girls	Boys	Girls	Boys	Girls	Boys	Girls	Boys
Child participation								
Cross-lagged paths								
W2 parent beliefs → W3 child time	−.01	−.01	.22***	.22***	−.06	−.04	−.05[a]	.17[a,*]
W2 child time → W3 parent beliefs	.03	.03	.01	.01	.04	.05	−.03[a]	−.02[a]
Stability paths								
W2 parent beliefs → W3 parent beliefs	.67***	.76***	.72***	.78***	.57***	.58***	.48[a,***]	.44[a,*]
W2 child time → W3 child time	.24***	.24***	.32***	.30***	.24***	.23***	.34[a,***]	.23[a,***]
Within wave covariances								
W2 parent beliefs ↔ W2 child time	.07	.06	.05	.05	−.01	−.01	−.17[a,*]	−.05[a]
W3 parent beliefs ↔ W3 child time	.18*	.14*	.10	.09	.04	.04	−.11[a]	.02[a]
Teacher rating of child natural ability								
Cross-lagged paths								
W2 parent beliefs → W3 teacher rating	.18***	.19***	.27***	.27***	−.05	−.04	.11[a]	−.03[a]
W2 teacher rating → W3 parent beliefs	.20***	.18***	.09	.09	.01	.01	.12[a]	.08[a]
Stability paths								
W2 parent beliefs → W3 parent beliefs	.71***	.72***	.77***	.77***	.56***	.56***	.51[a,***]	.48[a,***]
W2 teacher rating → W3 teacher rating	.51***	.50***	.46***	.45***	.58***	.60***	.49[a,***]	.56[a,***]
Within wave covariances								
W2 parent beliefs ↔ W2 teacher rating	.52***	.47***	.45***	.41***	.04	.04	.06[a]	.14[a]
W3 parent beliefs ↔ W3 teacher rating	.20**	.16**	.20*	.18*	−.05	−.06	.22[a]	−.18[a]

*$p < .05$.
**$p < .01$.
***$p < .001$.
[a]These paths were not tested for gender differences because the loadings were not invariant across gender.

Third, as predicted, teachers' ratings of children's natural ability predicted changes in both parents' confidence in their children's sport and math ability as well as mothers' confidence in their child's reading abilities. Teacher's rating of each child's natural ability also predicted changes in both parents' valuing of sports. Interestingly, and contrary to our prediction, parents' confidence in their children's ability also predicted increases in teachers' ratings of children's natural ability in sports, math, and reading. There is consistent support for reciprocal influence between teachers' ratings of children's natural ability and parents' estimates of children's domain-specific abilities in sports, math, and reading.

Fourth, most of the support for parent to child pathways involved the association of parents' estimates of their children's abilities with increases over time in their children's domain-specific self-concepts and activity participation. Only fathers' valuing of an activity had any significant paths and, contrary to what we had expected, none of these were to their children's valuing of a domain. Also contrary to what we had predicted, the only parent beliefs that predicted increases in the children's valuing of a domain were parents' estimates of their child's ability in instrumental music and mothers' ratings of their child's ability in reading. Thus, children's valuing of activities was not predicted by their parents' valuing of similar activities for them.

Fifth, as predicted, there were more significant cross-lagged paths from parent to child in the leisure domains than in the math domain. For example, parents' confidence in their children's sport and instrumental music ability consistently predicted small to moderate changes in children's sport and music beliefs and participation ($\beta = .12$ to $.32$, $ps < .05$). Within the academic domains, there were more significant paths from parent to child in reading as compared to math, most of which involved the parents' estimates of their children's reading ability and the children's own perceptions of their reading ability. In contrast, the only significant path from child to parent in the math domain was that children's valuing of math at Wave 2 predicted small increases in their mothers' estimates of their children's math ability at Wave 3. There was also a significant relation between parents' confidence in their children's math ability and their children's valuing of math.

In the majority of models across the four domains, the parent and child constructs were moderately to highly stable from Wave 2 (grades 1, 2, and 4) to Wave 3. That included parents' value, parents' perception of their child's ability, children's ability self-concept, task valuing, and participation, as well as the teachers' ratings of the child's natural ability. There were two consistent exceptions to this pattern: Neither fathers' music valuing nor children's participation in math were stable over time. Furthermore, in all domains, parents' beliefs showed greater cross-time stability than their children's beliefs. This is particularly true for sports and reading. Parents' ratings of their children's abilities were more stable in all domains than were teachers'

ratings of each child's natural ability. This is particularly true for sports and instrumental music. The lower stability for teachers' ratings is not surprising, because children changed teachers each year. Finally, the stability of children's out-of-school participation is much lower than the stability of the other three child indicators, particularly in the math domain. Interestingly, children's participation in reading showed the highest stability across time.

Gender Moderation

As shown in Tables S11 through S14 in the online material, none of the 62 tests for gender moderation in the structural portion of the model were statistically significant at the $p < .001$ level. In other words, the six paths and covariances tested in each model were similar across boys and girls. These paths and covariances in each model were constrained across gender. The paths presented in Tables 13 through 16 in the text and in Tables S15 through S18 in the online material include these constraints.

Please note that we only tested gender moderation in 62 of the 64 models as the loadings were not invariant over time (i.e., were different at Wave 2 and Wave 3) in one of the instrumental music models and the loadings were not invariant over gender in one of the reading models. It is important to note that the standardized paths may be different for boys and girls even when the path was constrained to be equal across groups. Different standardized paths can arise if the variance within boys is different than the variance within girls.

Exogenous Control Variables

Before we conclude the overview of the results for this chapter, we would like to provide information on the relations between the exogenous control variables and the other parent and child variables ($ps < .05$). Teachers' ratings of children's natural abilities consistently and positively predicted youths' ability self-concept at Waves 2 and 3 ($\beta = .12$ to $.47$), mothers' perceptions of their children's abilities at Waves 2 and 3 ($\beta = .16$ to $.57$), and fathers' value at Wave 2 ($\beta = .17$ to $.32$). One exception to this pattern was instrumental music. Teachers' ratings of children's natural music ability often did not predict any of the music indicators at hand. Children's IQ positively predicted teachers' ratings of children's natural ability at Wave 2 ($\beta = .11$ to $.49$), and mother's perception of their children's ability in instrumental music, math, and reading ($\beta = .16$ to $.45$). In addition, IQ also predicted higher participation in math and reading ($\beta = .14$ to $.18$), as well as higher parental value at Wave 2 ($\beta = .25$–$.40$). One exception to this pattern was sports, in which children's IQ negatively predicted teachers' ratings of children's natural sport ability at Wave 2 ($\beta = -.21$ to $-.17$), and parents' perception of their children's sport ability at Wave 2 ($\beta = -.24$ to $-.14$). The cohort differences typically suggested that children in the youngest and middle cohorts had higher values ($\beta = .15$ to $.37$) and ability self-concepts ($\beta = .14$ to $.37$), but lower participation than children in the oldest cohort ($\beta = -.36$ to $-.12$). There

were not many differences by cohort in parents' beliefs although, in some models, mothers' beliefs were lower for the youngest and middle cohorts compared to the oldest cohort ($\beta = -.34$ to $-.14$). Parent education and family income were not strong predictors of parents' beliefs or the child indicators.

Discussion

In sports, instrumental music, and reading, we found consistent evidence supporting the hypothesis that parents act as expectancy socializers for their children (Eccles, 1993). Consistent with social constructivist perspectives, the Eccles's expectancy-value model assumes that individual differences in self- and task-perceptions come from individuals' interpretation of reality, and parents play a critical role in this interpretative process (Eccles, 1993; Frome & Eccles, 1998). The strongest evidence for the positive association between parents' beliefs and children's beliefs and participation emerged in the leisure domains. Because organized sports and instrumental music opportunities often occur outside of school during the elementary school years, parents need to provide such opportunities for their child in these activity domains. These findings are consistent with prior studies linking parents' beliefs to children's motivation in the sport domain (Bois et al., 2002; Fredricks & Eccles, 2002, 2005) and contribute to a very limited research base in instrumental music (Klinedinst, 1991).

Interestingly, and contrary to our predictions, we found much less support for the role of parents in the socialization of children's beliefs and behaviors in math than in the other three domains. One possible explanation for this discrepancy is that math largely occurs in school and there was little math homework during the elementary school years for this population. In this sample, the children reported very low rates of involvement in math in the after-school hours. As a result, there may have been fewer opportunities for parents to have an influence in this domain. In contrast, although reading is also covered in school, parents and children often read at home together during the preschool and early elementary school years. However, it is important to note that our math findings contrast with prior research linking mothers' ratings of children's ability to older children's perceptions of their ability in math (Fredricks & Eccles, 2002; Frome & Eccles, 1998). Thus, parents may play a more important role in supporting their children's ability self-concepts and interest in math when math becomes more salient and difficult in the secondary school years.

It is also important to note that the strength of the pathways from parents' beliefs to their children's participation was weaker in the reading domain than in the two leisure domains. In fact, contrary to our predictions, mothers' confidence in their children's reading abilities did not predict changes in out-

of-school reading over time (it does, however, for fathers). Why might this be true? Perhaps mothers engage their children in out-of-school reading for two quite different reasons: to enhance already good reading skills or to remediate reading problems. In the first case, we would expect a positive association between mothers' estimates of their children's reading ability and the amount of out-of-school time the children spend reading. In the second case, we would expect a negative association between mothers' estimates of their children's reading abilities and the time the children spend reading at home. These two cases could cancel each other out at the population level.

The majority of developmental researchers assume there is a reciprocal feedback process between parent and child, with parents shaping children as well as parents being shaped by children. According to the results of our cross-lagged models and consistent with our predictions, during the elementary school years, the direction of influence regarding children's developing ability self-concepts and activity participation largely flows from parents to children rather than vice versa in instrumental music and reading. This is also true for children's valuing of instrumental music and reading.

However, also as we had predicted, we found consistent evidence that children's characteristics (in this case the teacher's estimates of each child's natural ability) predicted changes in parents' estimates of their children's abilities in sports, math, and reading. Either one or both parents' confidence in their child's domain-specific abilities in these three domains increased over time if their child's teachers rated their child's natural abilities high. These findings are consistent with the idea that teachers give parents' messages about their children's ability through grades and other types of feedback that parents likely use to help them form their own perceptions of their children's competencies in different domains. This was not true in the domain of instrumental music perhaps because teachers have little opportunity to either observe the children's instrumental music skills or communicate their perceptions to the parents.

What is equally interesting is that parents' confidence in their children's abilities also predicted, in a reciprocal fashion, changes over time in the teachers' ratings of each child's natural ability in sports and reading. Why might this be true? We know that parents' (either one or both) confidence in their children's abilities predicts increases in participation in sports and reading. It seems likely that increases in participation in these domains will lead to increases in their children's skill levels, which, in turn, could lead the Wave 3 teacher to perceive these children as having more natural ability than the children whose parents see them as less able in sport and reading. If so, this would be a good example of parent expectancy effects leading to a self-fulfilling prophecy in these two domains. But why would not this also be true for math? Neither parents' confidence in the children's math ability nor the value they place on math for their child predicted increases in their child's

participation in math. The most likely explanation for this discrepancy is that parents in this sample had much less opportunity to do math with their children at home than sports or reading. If so, then we expect to find stronger evidence of a parental self-fulfilling prophecy effect for math today given that there are more opportunities and more pressure on parents to engage their children in math activities out of school.

Setting aside the analyses involving the teacher perceptions of the children's natural ability, the strongest evidence for reciprocal influences and child to parent effects is in the domain of instrumental music. In this case, parents' estimates of their children's instrumental music abilities predicted increases over time in children's instrumental music ability self-concepts and value, and the children's Wave 2 instrumental music value and participation also predicted increases in the value their parents attached to instrumental music for them. This suggests that children's interests may have a greater influence on their parents' provision of opportunities for them to engage in instrumental music than they have in the other three domains studied. We have three pieces of evidence that suggest this might be true for fathers. First, the amount of time children spent doing instrumental music at Wave 2 predicted increases in the value their fathers placed on instrumental music at Wave 3. Second, the value that the children placed on instrumental music at Wave 2 predicted increases in their parents', especially their fathers', valuing of instrumental music for them. Third, the value fathers placed on instrumental music at Wave 2 predicted increases in their children's participation in instrumental music at Wave 3.

We see some evidence of indirect reciprocal influences in the sport domain, though the strength of these associations was smaller than music. In this case, parents' confidence in their children's abilities at Wave 2 predicted increases in their children's participation in sports at Wave 3. Furthermore, both children's valuing of sports and their confidence in their sport ability at Wave 2 predicted increases in their fathers' confidence in the child's sport ability at Wave 3. This pattern suggests that children's interest in sports may influence their opportunities to participate in sports through its impact on their parents' confidence in their child's sport ability. Why might this pattern be true for both sports and instrumental music but not for either math or reading and why is the pattern stronger for instrumental music than for sports? We suspect it reflects differences in when parents in this country think it is most appropriate to begin to provide opportunities for their children to engage in these different domains. Middle-class parents are eager to engage with their children in reading from very early in their children's lives. Similarly, although somewhat later, middle-class communities in the United States offer many opportunities for 5-year-olds to get involved in organized sport activities. In contrast, the opportunities for instrumental music are fewer and more likely to be offered to children after they have begun elementary

school. Parents of elementary school-aged children in the United States may also be waiting for more evidence that their children will enjoy instrumental music classes before trying to get them involved. We expect that these domain differences are culturally grounded and likely to vary across nations and cultural subgroups within each nation.

The final pattern that needs discussion is the fact that parents' confidence in their children's abilities were more predictive of changes in their children's beliefs and participation than were parents' valuing of each domain for their child. Because we included teachers' ratings of the each child's natural ability in each domain as a covariate (with the exception of the models with teachers' rating of children's natural ability as a focal indicator in the cross-lagged models), we know this pattern is not an artifact of the relatively high association between parents' estimates of their children's abilities and an independently assessed indicator of their child's ability in each domain. Why then might parents' perceptions of their children's abilities have stronger predictive effects on changes in children's beliefs and participation than the value parents attach to each domain? It might reflect differences in the psychometrics of these two beliefs. Inspection of Table 4 (p. 28) suggests this might be true for math and reading given that the means are higher and the standard deviations are lower for the valuing items than for the perceived ability items and there are fewer items on the valuing scale than on the perceived ability scales leading to lower internal consistency reliabilities for the valuing scales. It could also be that parents have more stable beliefs about their children's abilities than about the value of particular domains for their child. If so, these beliefs could exert a stronger effect over time because they remain more stable. Inspection of Tables 13 to 16 provides some support for this suggestion in that the stability coefficients were usually larger for the perceived ability scales than for the task valuing scales. Finally, it could be that parents' perceptions of their children's abilities are a stronger predictor of their parenting practices than are the values they attach to each domain for their child. We address this hypothesis in Chapter 5.

SUPPORTING INFORMATION

Additional supporting information may be found in the online version of this article at the publisher's website.

V. PARENT BELIEF AND BEHAVIOR MODELS

In this chapter, we summarize our findings for the link between parents' beliefs and parents' behaviors. As in most social cognitive theories of behavior, Eccles and her colleagues (1983) assume that individuals' beliefs drive their behaviors. However, there is a long tradition within the social psychology of the link between attitudes and behaviors in which scholars question this assumption. Thus, we test for both of these possibilities.

It is important to note that Eccles and her colleagues hypothesize that two types of beliefs can influence parents' behaviors: general beliefs and child-specific beliefs. In this monograph, we focus on the link between child-specific beliefs and a composite indicator of different ways that parents try to influence their children's achievement-related task- and self-beliefs as well as participation. We chose this focus for two reasons: (1) The social psychological literature on attitudes and behaviors suggests that the belief to behavior link will be strongest the more similar the beliefs and behaviors are to each other, and (2) we needed to reduce the length and complexity of this monograph to what we consider to be its most important, new contributions. As reviewed in Chapter 1, others have investigated the link between such general beliefs as gender-role beliefs and parents' valuing of different types of competencies and activities for sons versus daughters. Far fewer researchers have looked at the link between child-specific beliefs and patterns of domain-specific parenting behaviors.

In general, we predict that parents' child-specific beliefs will predict changes in their behaviors over time. Second, given the more consistent relations between parents' beliefs and the child outcomes in the leisure domains reviewed in Chapter 4, we predict a more consistent pattern of associations between parents' beliefs and parents' behaviors in the leisure domains.

Data Analysis Plan

To test these hypotheses and to more generally investigate these associations, we tested the cross-lagged relations between parents' beliefs

and parents' behaviors measured at Wave 2 (i.e., grades, 1, 2, and 4) and one year later at Wave 3 (i.e., grades 2, 3, and 5). Sixteen separate structural equation models were estimated to test the relations between parents' beliefs and behaviors across the four domains (i.e., sports, instrumental music, math, and reading), two parents (i.e., mothers and fathers), and the two parent beliefs (i.e., beliefs about children's domain-specific abilities and the value of each domain). For example, in the sport domain, models were run to examine: (1) maternal beliefs about her child's sport ability and maternal sport support-related behaviors, (2) maternal valuing of sport and maternal sport support-related behaviors, (3) paternal beliefs about his child's sport ability and paternal sport support-related behaviors, and (4) paternal valuing of sport and paternal sport support-related behaviors. A conceptual version of the cross-lagged model is shown in Figure 6 (p. 61). Figure 6 differs from Figure 3 in that Figure 6 is a predictive model with controls and includes predictive paths whereas Figure 3 is simply the measurement model.

Parents' beliefs and behaviors were included as latent variables with one exception. Parents' value of each domain at Wave 2 was measured with a single item and included as a measured indicator in the models. The specific indicators of parents' beliefs and behaviors measured at each wave and for each domain varied slightly (see Tables 3 and 5 in Chapter 2 for the specific items). Each model included the basic cross-lagged model with two stability coefficients, two cross-lagged paths, and two within-wave covariances among parents' beliefs and behaviors.

Before we discuss the results for the models, we need to discuss parents' behavior in the domain of reading. Parents' reading behaviors operated differently than the parenting behaviors in the three other domains. In sports, math, and instrumental music, all parent behaviors significantly loaded onto a single latent variable suggesting that they were related indicators of an overall construct. In reading, however, some of the parenting behaviors did not significantly load onto the latent variable (see Tables S19 and S20 in the online material for the loadings of parents' behaviors). Some of the parenting behaviors, such as parental encouragement of reading, were highly skewed with nearly all parents rating their encouragement of reading above the midpoint of the scale. In addition, the bivariate relations among parents' reading behaviors evidenced only low to modest relations, with some of these associations not reaching statistical significance (correlations ranged from .01 to .27). Experts have noted that such low correlations can impact the extent to which indicators load on a single latent variable (Millsap & Olivera-Aguilar, 2012). Thus, we were not empirically justified in creating a latent parenting variable in reading.

Although these behaviors did not load onto a single latent variable, theoretical and empirical evidence suggests each behavior supports

children's reading motivation and participation. Items that have these properties are called cause indicators (Bradley, 2004). Cause indicators may not be highly associated with each other, but comprise a single scale because they theoretically all cause or predict the same outcome. One of the most widely used cause indicators is the HOME scale (Bradley, 2004).

We used an approach similar to that used with the HOME subscales as well as by risk and resiliency researchers to create a parenting variable for reading (Rutter, 1988; Sameroff et al., 1998). Using the same set of parental indicators, we created an index of the number of promotive reading factors in the home. For each variable, parents were given a score of 1 or 0, depending on whether they were above or below a certain cutoff point on the variable. As shown in Table 17, the cutoff point was at a value that corresponded to the top 25% or the lower 75% of the distribution for that variable. Researchers have used similar coding methods in previous work with this data (Fredricks & Eccles, 2005; Fredricks et al., 2005; Simpkins, Fredricks, et al., 2006). A higher

TABLE 17

CUTOFFS FOR READING PROMOTIVE VARIABLES AT WAVES 2, 3, and 4

Parent Variable	0	1
Wave 2		
Mother modeling	0–5	6–8
Mother coactivity	1–5	5.50–6
Mother encouragement	4–6	7
Mother provision of opportunities	0 or 1	2
Father modeling	0–4	5–7
Father coactivity	0	1
Father encouragement	1–5	6–7
Wave 3		
Mother modeling	0–4	5–7
Mother coactivity	0–4.5	5–7
Mother encouragement	2–6	7
Mother provision of opportunities	0–1	2
Father modeling	0–3	4–7
Father coactivity	1–3.5	4–7
Father encouragement	2–6	7
Father provision of opportunities	0–1	2
Wave 4		
Mother modeling	0–3	4–7
Mother coactivity	1–3.5	4–7
Mother events	2–6	7
Father modeling	0–3	4–7
Father coactivity	0	1
Father events	1–4	5–7

Note. Father provision of opportunities was not measured at Wave 2.

score signified that parents engaged in more behaviors to support children's reading.

The number of reading promotive factors was used as a measured indicator of parents' behaviors at each wave. For the other three domains, latent variables of parents' behaviors at both waves were used. Other than this difference, all of the models were the same across domains.

Results

Measurement Invariance

Before presenting results of the cross-lagged models, we describe the findings from the tests of measurement invariance. All of the unconditional models fit the data well (i.e., CFI $\geq$ .95, RMSEA $\leq$ .05) or adequately (i.e., CFI $\geq$ .90, RMSEA $\leq$ .08) with the exception of the model with fathers' sport value, which did not fit the data well according to the criterion for evaluating CFI (i.e., .877), but fit the data well according to the RMSEA (i.e., .043). The significance tests of measurement invariance are shown in Table S21 in the online material.

All models evidenced full or partial weak measurement invariant across time and gender. Full weak measurement invariance is when all loadings in

TABLE 18

Model Fit Indexes for the Models With Parents' Beliefs and Behaviors

	Mothers				Fathers			
Model	*df*	X^2	CFI	RMSEA	*df*	X^2	CFI	RMSEA
Sports								
Perception of their child's ability	344	440.00***	.971	.020	493	674.57***	.940	.027
Value	219	317.48***	.922	.025	316	510.50***	.870	.035
Music								
Perception of their child's ability	339	598.13***	.924	.033	289	432.09***	.932	.031
Value	235	446.02***	.901	.025	193	280.79***	.922	.030
Math								
Perception of their child's ability	241	457.12***	.928	.036	287	327.40*	.980	.017
Value	153	218.78***	.935	.024	158	181.64	.964	.017
Reading								
Perception of their child's ability	116	151.87	.988	.021	116	214.58***	.952	.041
Value	45	34.56	1.000	.000	33	32.48	1.000	.000

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

the model were similar across time and child gender. Partial weak measurement invariance is when some but not all loadings are similar across time and child gender. Ten of the sixteen models evidenced full weak invariance across time and gender when tested simultaneously. This means that in those 10 models, the loadings were similar across Waves 2 and 3 as well as across parents of girls and parents of boys. Thus, we constrained these loadings to be the same across time and gender in the subsequent full cross-lagged models.

The remaining six models evidenced partial weak measurement invariance. Five of these six models emerged in the leisure domains; only one of these models was in an academic domain. Most of the differences in the loadings emerged for one or two parental behaviors. The loadings for parents' beliefs were typically invariant (i.e., similar) across Waves 2 and 3 as well as across parents of girls and parents of boys. Furthermore, the differences largely emerged across gender for fathers, but across time for mothers. Below we discuss the details of these tests organized by parent gender given these different patterns.

The loadings for mothers' modeling and coactivity were different across Waves 2 and 3 (i.e., not invariant across time) in some of the instrumental music and math models. The loadings for mothers' modeling of music, coactivity with her child in music, and coactivity with her child in math were significantly different at Waves 2 and 3. Thus, we freed these loadings in the respective model so that they were estimated separately at each time point.

Three of the four models with fathers' data in sports and instrumental music had loadings that varied. In all cases except one, the findings suggested that a behavior loaded differently depending on whether it was a father of a girl or a father of a boy. In the father sport models, the loadings for fathers' coaching, modeling, and expectations for child's success next year (i.e., item 1c in Table 3) were different for fathers of girls compared to fathers of boys in one or both sport models. In all cases, we freed the loading so that the loading was estimated separately for fathers of girls versus fathers of boys.

The model with fathers' valuing of instrumental music is one of the two models in the entire monograph that had loadings that varied across *both* time and gender. In this case, we ran separate follow-up tests for gender and time. These tests suggested that the loadings for provision and coactivity varied across child gender, and the loading for coactivity also varied over time (as shown in Table S21). It should be noted that two of these three loadings met our criterion for measurement invariance, namely the $\Delta CFI < .010$, as discussed in Chapter 3. However, we had to free a third additional loading with the highest ΔCFI so that the new final model had a $\Delta CFI < .010$ compared to the original unconstrained model (see Figure 4 [p. 58] for invariance steps).

Despite a handful of differences, the majority of our latent variables had a similar structure across time and across parents of girls and parents of boys. Thus, it is possible and makes sense to examine the relations among these constructs over time and across parents of girls and parents of boys. We, therefore, continued with our cross-lagged models and tested gender moderation in the structural portion of the model. In the models moving forward, we freed the loadings noted in Table S21 and in the text above, but constrained all other loadings to be equal across time and gender.

Final Models

As shown in Table 18 (and Table S22 in the online material), the models fit the data well (i.e., CFI $\geq$ .95, RMSEA $\leq$ .05) or adequately (i.e., CFI $\geq$ .90, RMSEA $\leq$ .08), with the exception of the father sport value model where the CFI was below adequate (i.e., CFI = .870) but the RMSEA suggested the model fit the data well (i.e., RMSEA = .035). Table 19 includes the standardized path estimates and Table S23 in the online material includes the unstandardized estimates. Unless noted, the findings were similar across the ability self-concept and value models, child gender, and mothers and fathers.

Some of the patterns differed across the academic and leisure domains. In math and reading, parents' behavior never predicted changes in parents' beliefs. In contrast, this same relation was statistically significant in seven of the eight sport and instrumental music models. Parents who exhibited higher sport or music behaviors at Wave 2 showed increases in both their perception of their children's competence and the value the parents' attached to that domain one year later. These paths were generally moderate to strong in size (β = .17–.73, *p*s < .05).

The other cross-lagged path in these models tested the extent to which parents' beliefs predicted changes in parents' behaviors over time. Parents' beliefs predicted small to moderate changes in parents' behaviors in 6 of the 16 models (β = .07–.25, *p*s < .05). Specifically, parents' perceptions of their children's ability predicted small increases in mothers' reading and sport behavior, and fathers' math behavior (β = .07–.24, *p*s < .05). Parents' valuing of a domain predicted small increases in mothers' and fathers' sport behavior and fathers' reading behavior (β = .15–.22, *p*s < .05).

There were a few consistent differences in this path from parents' beliefs to their behaviors across domains. First, three of the six significant cross-lagged paths from parents' beliefs to behaviors emerged in sports. Second, none of these cross-lagged paths were significant in instrumental music. Finally, we had only very limited evidence of parents' beliefs predicting changes in their behavior in math (1 path) and reading (2 paths).

In the majority of models, parents' beliefs and behaviors were moderately to highly stable across the two waves. These estimates are presented in the

TABLE 19

STANDARDIZED PATH ESTIMATES FOR THE MODELS WITH PARENTS' BELIEFS AND BEHAVIORS

	Mothers		Fathers		Mothers		Fathers	
	Girls	Boys	Girls	Boys	Girls	Boys	Girls	Boys
Path	Sports				Music			
Perception of their child's ability								
Cross-lagged paths								
W2 parent percept. → W3 parent behaviors	.24**	.23**	.15	.13	.03	.04	.12	.13
W2 parent behaviors → W3 parent percept.	.21**	.20**	.11	.13	.20*	.17*	.39**	.40**
Stability paths								
W2 parent percept. → W3 parent percept.	.64***	.62***	.64***	.62***	.53***	.53***	.36**	.34**
W2 parent behaviors → W3 parent behaviors	.65***	.55***	.81***	.84***	.72***	.72***	.48**	.55**
Within wave covariances								
W2 parent percept. ↔ W2 parent behaviors	.38***	.40***	.63***	.51***	.69***	.71***	.76***	.64***
W3 parent percept. ↔ W3 parent behaviors	.47***	.42***	.50**	.64**	.80***	.70***	.63***	.60***
Value								
Cross-lagged paths								
W2 parent value → W3 parent behaviors	.22*	.19*	.18*	.13*	.11	.10	−.09	−.09
W2 parent behaviors → W3 parent value	.31***	.38***	.37***	.50***	.64***	.62***	.71***	.73***
Stability paths								
W2 parent value → W3 parent value	.38***	.37***	.45***	.43***	.26**	.22**	−.09	−.08
W2 parent behaviors → W3 parent behaviors	.59***	.62***	.81***	.87***	.77***	.80***	.71***	.72***
Within wave covariances								
W2 parent value ↔ W2 parent behaviors	.42***	.45***	.67***	.52***	.05	.05	.10	.10
W3 parent value ↔ W3 parent behaviors	.68***	.74***	.61**	.63**	.62***	.51***	.43*	.39*

(Continued)

TABLE 19

(Continued)

	Mothers		Fathers		Mothers		Fathers	
	Girls	Boys	Girls	Boys	Girls	Boys	Girls	Boys
Path	Math				Reading			
Perception of their child's ability								
Cross-lagged paths								
W2 parent percept. → W3 parent behaviors	.04	.05	.25*	.22*	.07*	.09*	.12	.15
W2 parent behaviors → W3 parent percept.	.05	.05	−.09	−.11	.02	.02	.03	.03
Stability paths								
W2 parent percept. → W3 parent percept.	.70***	.81***	.66***	.70***	.66***	.73***	.72***	.77***
W2 parent behaviors → W3 parent behaviors	.89***	.85***	.75***	.79***	.48***	.49***	.41***	.40***
Within wave covariances								
W2 parent percept. ↔ W2 parent behaviors	.11	.10	.37***	.37***	.15**	.14**	.27***	.30***
W3 parent percept. ↔ W3 parent behaviors	−.25	−.24	.46*	.56*	.10	.09	.07	.08
Value								
Cross-lagged paths								
W2 parent value → W3 parent behaviors	−.01	−.01	.09	.08	.11	.04	.15*	.15*
W2 parent behaviors → W3 parent value	.03	.03	.04	.05	.04	.13	.12	.12
Stability paths								
W2 parent value → W3 parent value	.57***	.61***	.63***	.64***	.58***	.56***	.51***	.56***
W2 parent behaviors → W3 parent behaviors	.88***	.84***	.83***	.90***	.48***	.49***	.41***	.40***
Within wave covariances								
W2 parent value ↔ W2 parent behaviors	.10	.11	.19*	.16*	.16***	.20***	.25***	.29***
W3 parent value ↔ W3 parent behaviors	.18	.17	.24	.22	.08	.10	.01	.01

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

middle two rows listed under each model in Table 19. The stability of parents' perception of their children's ability and parents' valuing of each domain were typically moderate to strong across the four domains ($\beta = .22–.81$, $ps < .001$) with just one exception. Furthermore, parenting behavior showed strong stability from Waves 2 to 3 in all four domains ($\beta = .40–.90$, $ps < .001$), making it difficult for our analyses to reveal significant cross-lagged predictive relations from parents' beliefs to changing parents' behavior.

Perhaps even more interesting, the within-wave associations of parents' beliefs and their parenting behaviors varied considerably across wave and domain. Contrary to the Eccles and her colleagues' model, these associations were not significant for mothers' estimates of their child's ability in math at Wave 2, for fathers' estimates of their child's ability in reading at Wave 3, and for both parents' valuing of reading at Wave 3. In addition, the relation between mothers' estimates of their child's math ability was negatively related to their behaviors in math at Wave 3 suggesting a compensatory relation in the upper elementary and early middle school grades.

These within-wave patterns were different in the leisure domains. All of these associations were statistically significant and very strong with one exception: Parents' valuing of instrumental music was not significantly related to supportive parents at Wave 2. Interestingly, in the instrumental music domain, the Wave 2 parent valuing to Wave 3 parenting behaviors path was not statistically significant. Furthermore, the stability of parents' valuing across time was small but significant only for mothers, whereas the stability of parents' instrumental music supportive behaviors was very high. Taken together, this pattern of coefficients suggests that the parents' valuing of instrumental music is coming into line with their behavior over this time period—when their children are in the middle to late childhood/very early adolescent period.

Gender Moderation

All tests for gender moderation were not statistically significant at $p < .001$ level (Table S22 online). These findings suggest that the relations among parents' beliefs and behaviors were similar across parents of girls and parents of boys in all domains. The paths presented in Table 19 and Table S23 includes these gender equality constraints.

Exogenous Control Variables

Before we discuss the findings of this chapter, we want to briefly present the findings between the exogenous control variables and parents' beliefs and behaviors ($ps < .05$). These findings are not presented in a table, but are available from the authors. Teachers' ratings of children's natural abilities positively predicted parents' beliefs about their children's abilities at Waves 2 and 3 ($\beta = .12–.55$). Teachers' ratings of children's natural abilities were not consistent predictors of parents' value of a domain or parents' behaviors.

Children's IQ typically only predicted parents' beliefs about their children's abilities at Wave 2 ($\beta = .11$–$.22$). These relations were positive, except in sports where IQ predicted lower parental beliefs ($\beta = -.15$). There were not many consistent cohort differences. Two consistent patterns were that parents of children in the youngest and middle cohorts exhibited fewer behaviors at Wave 2 in instrumental music ($\beta = -.39$ to $-.23$), but exhibited more behaviors in math and reading than parents of children in the oldest cohort ($\beta = .19$–$.34$). Parents' education and family income were not strong, consistent predictors of the indicators in sports, and math, reading. In instrumental music, parents' education positively predicted parents' beliefs and behaviors ($\beta = .14$–$.29$).

Discussion

According to the Eccles's model of parent socialization, the direction of influence should largely flow from parents' beliefs to parents' behaviors (Eccles, 1993). The evidence for this prediction was quite mixed and not particularly strong even when the paths were significant. The most consistent support was in the domain of sports with six of the eight possible cross-lag coefficients reaching statistical significance. Only the path from fathers' estimates of their children's sport ability to parenting was not significant, which could reflect the very high stability of fathers' sport-related parenting over these two waves. Thus, our findings do support the hypothesized path from parents' child-specific beliefs to parenting behaviors in the sport domain when their children are in the elementary school age period. The same cannot be said for instrumental music, math, and reading.

For example, none of the belief to behavior paths was significant for instrumental music even though there was little difference in the stability of the beliefs and behaviors across the two leisure domains and those differences that emerged showed less stability in instrumental music than in sports. Thus, this domain difference does not reflect differences in the psychometric properties of the scales across these two domains. Interestingly, the strength of the within-time covariance of parents' valuing of instrumental music and parenting behavior was nonsignificant at Wave 2 but highly significant at Wave 3, suggesting that synchronous relations between parents' beliefs and behaviors are changing rather dramatically over this time period. This finding may reflect the fact that each of the school districts introduced instrumental music at the third grade. At Wave 3, children were in the second, third, and fifth grades, meaning that more parents at Wave 3 would have the opportunity to observe their children's growing competence and interest in instrumental music. This shift could lead to a stronger linkage between parents' beliefs and parents' behaviors at Wave 3 while at the same time reducing the likely cross-time association between beliefs and behaviors.

In fact, the cross-time stability for both parents' estimates of their children's abilities in and the valuing parents have for instrumental music was the lowest of the four domains.

Why would we find stronger associations from beliefs to behaviors in sports than in instrumental music, reading, and math? First, the nature of the link between parents' beliefs particularly about their children's abilities and the parents' behaviors might be more varied in the academic than in the leisure domains. Parents' behavioral responses to their perceptions of their children's abilities likely vary depending on the value they attach to competencies in various domains. In the Eccles et al. framework, we assume that parents will provide more behavioral support for their child in those domains in which they feel their children have the greatest aptitude because they would like to further enrich their children's growing competence in these domains. However, if the parents and/or the society highly value a particular competency, then parents might respond to an assessment of their children's low ability with increased efforts to help remediate a perceived deficit in a very important skill domain. Math and reading certainly fit this category for most middle-class American parents. Thus, both relatively high and relatively low estimates of one's child's ability in these two domains could lead to increased support. Although similar curvilinear relations might emerge in leisure domains, many parents might just give up in these domains and find a different leisure pursuit at which their child might be more competent. The option of shifting focus is not as viable in reading and math during the elementary school years. Alternatively, parents' beliefs may have weaker links to their behaviors in academic versus leisure because some parents may assume that schools are addressing their children's academic needs. When the onus lies more squarely on parents, as in the case of leisure, there might be a stronger correspondence between parental beliefs and behaviors. Either case still supports the expectancy-value model. However, the linear approach we used to test the data would not detect such nonlinear relations. Pattern centered approaches with quantitative data or qualitative data may be more optimal to reveal such patterns.

In contrast to the mixed evidence supporting the hypothesis that parents' beliefs lead to changes in parents' behaviors, there was quite strong support for the association of parenting behaviors with changes in both parents' estimates of their children's sport ability and with the value both parents attached to both sports and instrumental music. The strength of these paths was often twice as large as the path from parents' beliefs to behaviors. Interestingly there was no such evidence of parents' behaviors leading to change in parents' beliefs over time in neither math nor reading. Why might the processes underlying the substantial cross-lag predictive association from parents' socialization behaviors to parents' beliefs manifest themselves more strongly in the leisure domains than in the academic domains?

One explanation is that the sources of information influencing parents' beliefs differ across these four domains. For example, parents likely have more sources of information to inform their beliefs in the academic domains than the leisure domains because they get substantial information in the early elementary years about their children's performance in math and reading from the school and their children's teachers. In academics, parents' beliefs about their child's abilities may be less strongly related to their personal assessment of their children at home precisely because they are likely to integrate (and perhaps heavily weigh) the information they receive from schools in reading and math into their perceptions of their children's ability in these domains.

In contrast, because instrumental music and sports are not taught in school, parents need to do more to support their children's skill acquisition. As a result, they have more opportunities to watch their skills develop over time in these domains than they do in math or reading. It is also possible that those parents who are putting a great deal of effort into helping their child in sports and instrumental music could be justifying the amount of effort they are putting in by raising both their estimates of their children's competencies and the value they attach to these competences.

Finally, it is also likely that measurement issues influenced domain differences in the parent behavior to parent beliefs cross-lag links. The lack of evidence could reflect, at least in part, the fact that these scores are positively skewed in the academic domains compared to the leisure domains (e.g., mean value was 6.4 in math, 7.0 in reading, 3.2 in instrumental music, and 4.5 in sports). The stabilities across time in parents' ratings of their children's math and reading ability are also quite high, as well as being more stable than the parents' ratings of their children's abilities in sports and instrumental music. Given both the ceiling effect and the high rate of stability leaves little room for behavior at Wave 2 to predict changes in these beliefs from Wave 2 to Wave 3.

Finally, it is also likely that the timing of the data collection influences the nature of the cross-lagged associations between parents' beliefs and behaviors. The time frame of data collection is critical to understanding the directionality of belief–behavior links. It is quite possible that the parents' beliefs at time one predicted their parenting at that time or shortly thereafter. If, as we show in Chapter 6, these behaviors lead to gradual increases in their children's competence or interest in a particular domain between Wave 2 and Wave 3, then it would appear that Wave 2 behaviors led to changes in Wave 3 beliefs, but the mechanism would not be through the parents inferring their beliefs from their behaviors as proposed by Bem (1970). Rather, the mechanism would be consistent with that proposed by Eccles et al. in Figure 1a, namely, that parents' beliefs influence their behaviors which, in turn, influence the children's developing ability and interest, which, in turn,

influence the parents' subsequent perceptions of their children's competencies and values. This is a true example of reciprocal influences playing out over time in a quite logical fashion. Distinguishing between these possible mechanisms requires much more frequent measurement of parents' and children's relevant achievement-related beliefs along with their behaviors and activity engagement than our yearly assessments of these constructs.

SUPPORTING INFORMATION

Additional supporting information may be found in the online version of this article at the publisher's website.

VI. PARENT BEHAVIOR AND CHILD BELIEF MODELS

In this chapter, we move on to the next step in the cascade of influences outlined in Figure 1b, namely, the cross-lagged relations between parents' behaviors and children's beliefs over time. A conceptual model with the loadings and predictive paths is shown in Figure 7 (p. 61).

Eccles and her colleagues assume that parents' behaviors would influence their children's achievement-related behaviors, at least in part, through their influence on their children's achievement-related ability self-concepts and perceived value of the various domains. Thus, we predict positive associations between parents' behaviors in all domains with changes in their children's beliefs from Wave 3 (i.e., grades, 2, 3, and 5) to Wave 4 (i.e., grades 3, 4, and 6).

It is of course also possible that children's achievement-related beliefs can influence their parents' behaviors. Parents are likely to be sensitive to the value their children place on developing their skills and participating in various activities, particularly in the leisure domains in which parents have considerable leeway in their socialization behaviors. To the extent that this is true, their children's valuing of both sports and instrumental music should predict changes over time in parenting behaviors in these two domains. In addition, to the extent that children's valuing is influenced by their own ability self-concepts as shown by Jacobs et al. (2002), it is likely that children's confidence in sports and instrumental music will influence their parents' behaviors over time as well.

Whether this is also true for reading and math is a more open question. As we noted in Chapter 5, parents can quite reasonably respond in two ways to their perceptions of their children's abilities in these two domains precisely because these two domains are so highly valued by the society at large and their children have to participate in these two domains in school even if they do not like and/or are not particularly skilled at reading and math. More specifically, parents can engage in increased socialization efforts in reading and math either because they want to further enrich and encourage their high performing children's competencies and interests in math and reading or

because they want to support their struggling children's skill acquisition in these domains.

Data Analysis Plan

To test the cross-lagged relations between parents' behaviors and children's beliefs over time, we examined full cross-lagged models that included parents' behaviors and children's beliefs at Waves 3 and 4. We used Wave 3 and Wave 4 because this represents the next phase in the cascading flow of processes from exogenous influences on parents' beliefs to the influence of parents' behaviors on their children's beliefs. A total of 16 structural equation models were estimated to test the relations between parents' behaviors and their children's beliefs across the four domains, mothers and fathers, and children's domain-specific ability self-concept and task values. As in Chapter 5, parents' reading behavior was not included as a latent variable in these models. The number of reading promotive factors was used as a measured variable for parents' behaviors at both waves (see Table 17 for the cutoff scores, Chapter 5 for a detailed description, and Tables S24 and S25 in the online material for the factor loadings). Also as in Chapter 5, latent variables of parents' behaviors were used in math, sports, and instrumental music. Other than this difference, all of the models were comparable across the four domains. As in the previous chapters, we first tested for weak measurement invariance across time and gender. Following the tests of measurement invariance, we present the findings for the final models, gender moderation of the relations among the latent variables, and the relations with the exogenous control variables.

Results

Measurement Invariance

The model-level statistics testing weak measurement invariance across gender and time are presented in Table S26 in the online material. All of the models for instrumental music, math, and reading evidenced full weak measurement invariance simultaneously across time and gender, which suggests that the structure of the latent variables for parents' behaviors and children's beliefs was similar across Waves 3 and 4 as well as across girls and boys. Because the loadings for the latent variables were similar in each of these models, all of the loadings were set to be equal across time and gender in the full cross-lagged models.

In contrast, all of the sport models evidenced partial weak measurement invariance, suggesting that some of the loadings for the latent variables differed across time or child gender. There were two consistent findings across the sport models. First, the child ability self-concept item about

learning something new in sports had a significantly different loading across girls and boys in both the mother and the father models (i.e., item 1d in Table 7 [p. 61]). Second, fathers' participation in community sporting events with their children had a different loading at Wave 3 compared to Wave 4 in the two father sport models (i.e., it was not invariant over time). In each of the sport models, only one or two of the individual loadings on a latent variable varied across child gender or across time. Furthermore, in each of these cases, the individual loading varied across only one aspect, namely, time or child gender, and not both aspects. Therefore, we estimated the loading separately across the one aspect that was significantly different, but at the same time set the other aspect to be equal. For example, fathers' co-participation in sporting events was similar for fathers of girls and fathers of boys, but varied across Wave 3 and Wave 4. Therefore, we set the loading to be equal for fathers of girls and fathers of boys, but to be estimated separately for Waves 3 and 4. All other loadings were constrained across time and gender simultaneously in the full cross-lagged models. In the next paragraph, we provide specifics on the tests for each of the four sport models.

The measurement invariance findings of the sport models require further discussion. In many cases, the omnibus or overall test examining invariance in all of the loadings across time and gender simultaneously suggested that the loadings were not the same over time and/or gender. However, our follow-up tests that were used to isolate which individual loadings varied often suggested that each individual loading was similar over time and/or gender. In other words, the omnibus tests suggested that there were significant differences in the loadings (i.e., ΔCFIs $\geq .010$), but the individual follow-up tests suggested those differences were not significant (i.e., ΔCFIs $< .010$). Unless we freed some of the individual loadings in these models or allowed them to be estimated separately by child gender or time, the omnibus test would still say that the loadings were significantly different. As noted in Figure 4 (p. 58), in these cases, we freed the individual loading with the largest ΔCFI because that loading is likely to have the largest differences over time and/or gender compared to the other individual loadings. We continued to free one loading at a time until the comparison between the final model with some freed loadings and the original unconstrained model met our criterion of ΔCFI $< .010$.

In both of the models with mothers' sport data, the majority of loadings were similar across child gender and time (i.e., invariant). However, there were 1 to 2 individual loadings in each model that significantly varied. For example, in the model with mothers' behavior and children's sport value, the loading for mothers' coactivity was different for mothers of girls compared to mothers of boys.

Parallel to the models with mother data, the majority of loadings in the models with father sport data were similar across child gender and time

(i.e., they were invariant). In both of the father sport models, attending community sporting events with their children had a significantly different loading across time. Therefore, we freed this loading and estimated it separately at Wave 3 and Wave 4. This was the only change we needed to make in the model with children's value to meet our criterion for invariance (i.e., ΔCFI $< .010$). However, the results suggested that more loadings significantly differed in the model with children's self-concept of sport ability. The child-reported item on learning something new in sports was different across girls and boys, which was the same finding in the model with mothers' data. By freely estimating this loading for girls and for boys, we met our criterion for our omnibus test suggesting the remaining loadings were similar across child gender and time. In moving to our full cross-lagged models, we freely estimated the loadings across gender or time noted above. All other loadings in the sport models were constrained to be equal across child gender and time.

Final Models

Most of the math and reading models fit the data well according to both the CFI and RMSEA (Tables 20 and S27). All other models fit the data adequately with one exception: The model with fathers' behaviors and children's music value had mixed fit. The CFI = .869, which was not adequate, but the RMSEA (.043) suggested the data fit the model well. In general, the findings were similar across domain, children's ability self-concept and value, girls and boys, and mothers and fathers (Tables 21 and S28 in the online material). Thus, we summarize the general patterns unless a difference emerged.

There were three patterns worth highlighting in the cross-lagged paths (Table 21). First, in all models, children's ability self-concepts and value at Wave 3 never significantly predicted changes in parents' behavior over time, and the majority of these paths did not meet the criterion for even a small effect size (i.e., the $\beta \leq .10$). In contrast, in 9 out of 16 models, parents' behavior predicted changes in children's motivational beliefs over time.

Second, the paths from parents' behaviors at Wave 3 to the changes in their children's beliefs from Waves 3 to 4 were moderate in instrumental music ($\beta = .19$–$.58$, $ps < .05$), but small to moderate in the other domains ($\beta = .13$–$.29$, $ps < .05$). In fact, the paths for instrumental music were often more than twice the size of the equivalent paths in the other domains for fathers.

Third, all of the significant paths from parents' behavior to children's beliefs in the academic domains emerged for fathers but not for mothers even though the main direction of influence was the same for mothers and fathers. Fathers' behavior predicted small changes in their children's math ability self-concept, math task value, and reading task value.

TABLE 20

Model Fit Indexes for the Models With Parents' Behavior and Children's Beliefs

	Mothers				Fathers			
Model	*df*	X^2	CFI	RMSEA	*df*	X^2	CFI	RMSEA
Sports								
Self-concept of ability	457	687.15***	.940	.026	554	751.52***	.941	.026
Value	428	686.63***	.927	.029	553	730.22***	.944	.024
Music								
Self-concept of ability	417	853.60***	.904	.038	372	610.39***	.924	.035
Value	451	735.72***	.941	.030	273	537.54***	.869	.043
Math								
Self-concept of ability	305	422.58***	.958	.023	258	325.27**	.959	.023
Value	262	346.38***	.964	.021	381	662.66***	.916	.038
Reading								
Self-concept of ability	140	227.85***	.968	.030	135	175.35*	.979	.024
Value	151	200.26**	.975	.021	137	173.51*	.973	.023

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

Across the four domains, children's beliefs and their parents' behaviors were moderately to highly stable from Waves 3 to 4 (see Table 21 in the text and Table S28 of the online material). Two standardized stability paths were over 1.00: the stability of mothers' sport behavior in the model with boys' value, and the stability of fathers' music behavior in the model with girls' value. Jöreskog (1999) noted that it is possible to obtain standardized path estimates close to and over 1. In fact, he stated that "a standardized coefficient of 1.04, 1.40, or even 2.80 does not necessarily imply that something is wrong, although, as will be seen, it might suggest that there is a high degree of multicollinearity in the data" (p. 1).

Gender Moderation

The tests for gender moderation in the relations among parents' behaviors and children's beliefs (shown in Figure 7 [p. 61]) are presented in Table S27 online. The overall tests suggested that 1 of the 16 models included a path that varied across gender. Specifically, the covariance between mothers' behavior and children's reading ability self-concept within Wave 4 was negative for boys, but positive for girls. Because this was true in only 1 out of 16 tests, we conclude that it likely reflects a chance finding.

Exogenous Control Variables

We conclude our summary of the results with a brief discussion of the relations between the exogenous control variables and parents' behaviors and children's beliefs (*p*s $< .05$). Child physical abilities, family income, and

TABLE 21

STANDARDIZED PATH ESTIMATES FOR THE MODELS WITH PARENTS' BEHAVIOR AND CHILDREN'S BELIEFS

	Mothers		Fathers		Mothers		Fathers	
	Girls	Boys	Girls	Boys	Girls	Boys	Girls	Boys
Path	Sports				Music			
Self-concept of ability								
Cross-lagged paths								
W3 parent behaviors → W4 child beliefs	.08	.11	.13**	.19**	.30***	.35***	.58***	.48***
W3 child beliefs → W4 parent behaviors	.10	.08	−.03	−.02	.01	.01	.08	.10
Stability paths								
W3 parent behaviors → W4 parent behaviors	.75***	.90***	.70***	.87***	.87***	.90***	.93***	.79***
W3 child beliefs → W4 child beliefs	.57***	.56***	.49***	.46***	.41***	.36***	.29***	.37***
Within wave covariances								
W3 child beliefs ↔ W3 parent behaviors	.09	.10	.26***	.29***	.51***	.35***	.48***	.31***
W4 child beliefs ↔ W4 parent behaviors	−.01	−.01	.07	.12	.45***	.40***	.73**	.33**
Value								
Cross-lagged paths								
W3 parent behaviors → W4 child beliefs	−.17**	−.19**	.08	.14	.22***	.19***	.47***	.40***
W3 child beliefs → W4 parent behaviors	−.09	−.09	.14	.08	.04	.05	−.02	−.03
Stability paths								
W3 parent behaviors → W4 parent behaviors	.85***	1.01***	.66***	.83***	.87***	.89***	1.02***	.90***
W3 child beliefs → W4 child beliefs	.66***	.58***	.62***	.44***	.52***	.59***	.42***	.48***
Within wave covariances								
W3 child beliefs ↔ W3 parent behaviors	.18***	.35***	.31***	.45***	.43***	.32***	.46***	.35***
W4 child beliefs ↔ W4 parent behaviors	.11	.65	.05	.07	.48***	.49***	.53*	.36*

	Mothers		Fathers		Mothers		Fathers	
	Girls	Boys	Girls	Boys	Girls	Boys	Girls	Boys
Path	Math				Reading			
Self-concept of ability								
Cross-lagged paths								
W3 parent behaviors → W4 child beliefs	−.03	−.03	.18*	.20*	.01	.01	−.04	−.04
W3 child beliefs → W4 parent behaviors	−.06	−.06	.02	.02	−.02	−.02	.05	.05
Stability paths								
W3 parent behaviors → W4 parent behaviors	.91***	.90***	.65***	.83***	.34***	.33***	.29***	.26***
W3 child beliefs → W4 child beliefs	.44***	.43***	.43***	.45***	.50***	.54***	.51***	.57***
Within wave covariances								
W3 child beliefs ↔ W3 parent behaviors	.04	.04	.05	.05	.07	.06	.06	.05
W4 child beliefs ↔ W4 parent behaviors	n/a	n/a	−.07	−.14	**.19**[*a]	**−.29**[***a]	−.09	−.07
Value								
Cross-lagged paths								
W3 parent behaviors → W4 child beliefs	.02	.12	.18*	.20*	.08	.07	.20**	.15**
W3 child beliefs → W4 parent behaviors	−.10	−.10	.03	.04	.02	.02	.04	.04
Stability paths								
W3 parent behaviors → W4 parent behaviors	.85***	.83***	.49***	.69***	.34***	.34***	.29***	.26***
W3 child beliefs → W4 child beliefs	.48***	.50***	.51***	.53***	.52***	.54***	.62***	.55***
Within wave covariances								
W3 child beliefs ↔ W3 parent behaviors	.28***	.26***	.12	.11	.05	.05	.07	.07
W4 child beliefs ↔ W4 parent behaviors	−.22	−.16	.01	.01	.04	.04	−.07	−.05

Note. n/a = This covariance was not included because the error variance of one of the Wave 4 latent variables was set to a nonsignificant, positive value. Paths that significantly varied by child gender are bolded. The level of significance of the difference is noted with [a]$p < .05$.

*$p < .05$.

**$p < .01$.

***$p < .001$.

parent education were not consistent predictors. Child IQ positively predicted child self-concepts of music ($\beta = .21$–$.26$) and reading abilities ($\beta = .13$–$.16$). In contrast, child IQ negatively predicted child self-concept of sport ability at Wave 3 ($\beta = -.18$ to $-.13$). Teachers' ratings of children's natural abilities consistently predicted children having more confidence in their abilities at Waves 3 and 4 ($\beta = .16$–$.47$). Teachers' ratings of children's natural abilities also positively predicted children's value of math and sports at Waves 3 and 4 ($\beta = .17$–$.37$), but only predicted parents' behaviors in sports ($\beta = .30$–$.41$; and not in the three other domains). Finally, there were several consistent cohort differences. Generally, children in the oldest cohort had lower confidence in their abilities in all four domains compared to children in the youngest and middle cohorts ($\beta = .13$–$.30$). Consistent cohort differences in children's values were only evident in sports and math ($\beta = .14$–$.21$), in which older children placed lower value on sports and math than children in the two younger cohorts. Parents' behavior was higher for the two younger cohorts in math compared to the older cohort ($\beta = .19$–$.40$), but the opposite pattern emerged in instrumental music ($\beta = -.56$ to $-.18$).

Discussion

The majority of hypotheses outlined in the Eccles's model were supported in this set of analyses, although the strength of these findings differed by domain and gender of the parent. As predicted in the Eccles's models, parents' behaviors were associated with changes in children's ability self-concepts and task value beliefs over time across several models in math, sports, and instrumental music. These findings were consistent and strong in instrumental music (effect sizes ranged from moderate to strong). In general, these findings support and extend research specific to each dimension of parenting, including prior research on modeling in sports and music (Davidson et al., 1996; Kahn et al., 2008), studies relating parental encouragement to children's motivational beliefs in math and sports (Bauer et al., 2008; Ferry et al., 2000; Fredricks & Eccles, 2005), and studies linking sports equipment purchases to sport motivational beliefs (Fredricks & Eccles, 2005). Additionally, our findings are consistent with the literature on the impact of parents' involvement on motivational beliefs and participation in sports, instrumental music, and math (Babkes & Weiss, 1999; Davidson et al., 1996; Fredricks & Eccles, 2005; Simpkins et al., 2012).

Interestingly, we found that fathers' behaviors were a more consistent predictor of children's beliefs in math and reading than were mothers. Fathers' behaviors predicted small to moderate increases in their children's math and reading beliefs in three of the four analyses. The parallel analyses for mothers were all nonsignificant. This finding demonstrates the role that fathers play in academic socialization and underscores the importance of

including fathers in future research on parenting. This finding may reflect the fact that mothers' involvement in children's school work is more normative than is fathers' involvement (Yeung, Sanberg, Davis-Kean, & Hofferth, 2001). Because fathers tend to be less involved in that aspect of development, those fathers who do support their child in math and reading are likely to have a larger impact on motivation than mothers. It is also possible that fathers support their children in math and reading in qualitatively different ways than do mothers that are particularly helpful during these developmental years. Qualitative research would help test this hypothesis.

We found no evidence of reciprocal influences between parents' behaviors and their children's beliefs during the late elementary and early middle school years in any these domains. It is certainly possible at this developmental point in children's lives that they could be trying to elicit parents' supportive to help them build their competencies and interest in these activity domains, particularly in their leisure activities for which they might request equipment, lessons, parent involvement in transporting them to lessons, and parent attendance at events in which they are playing or performing. We suspect that these nonsignificant paths reflect the very high stability in the parents' behaviors. With cross-time stabilities from .66 to 1.02 in sports and music there was little unexplained variance to predict. The cross-time stability of the parents' behaviors were somewhat low in math, particularly for fathers, and for both parents in reading but even in these models there was no evidence of the children's beliefs predicting changes across time in their parents' behaviors.

Finally, we were particularly interested in the fact that the associations of parents' behaviors with their children's beliefs were the strongest and most consistent in the instrumental music domain. This result could reflect differential timing of parents' most effective engagement in their children's skill development across different domains. There was some emerging evidence of this possibility in Chapter 5 in which the association between parents' beliefs and behaviors increased dramatically between Wave 2 and Wave 3. If this increase reflects an emerging consolidation between parents' beliefs and behaviors in this domain, then it seems very logical that the impact of the parents' behaviors in instrumental music might be particularly strong between Wave 3 and Wave 4 because the children would be benefiting from this consolidation between their parents' beliefs and behaviors.

It also seems quite likely that the period of maximally effective parent socialization processes might come earlier for the other domains, when these competencies are first emerging in their children and the role of parents in the acquisition of these competencies is most supported by larger social forces. For example, interest in reading and books is strongly encouraged during the preschool years by the availability of picture and simple-word

books for parent child co-reading, by strong societal norms about the importance of co-reading during the preschool and early school years, and by the wide availability of children's television shows focused on early pre-reading activities. This confluence of opportunities and norms, coupled with this being the time when these skills can develop most rapidly, could lead the preschool and early elementary school years to be a time of maximal impact of parents on children's confidence and interest in reading. The early elementary school years may also be an important period for parent socialization in sports. This is the time period when many parents sign up children for their first sporting experience, coach their child's sport team, and work with their child on learning sport skills. Finally, one might begin to see an analogous situation emerging with early math as efforts are being made to encourage greater parent involvement in early math learning. Focused research across different age periods is needed to test these hypotheses.

SUPPORTING INFORMATION

Additional supporting information may be found in the online version of this article at the publisher's website

VII. YOUTH BELIEF AND PARTICIPATION MODELS

In this chapter, we focus on the question: Do youths' beliefs predict changes in their participation in the activities and courses in each of these domains during their late childhood and adolescent years? According to the Eccles's expectancy-value models, adolescents' choices should be influenced by their prior ability self-concepts and subjective task value. Empirical evidence is growing to support this general hypothesis in mathematics and sports over relatively short periods of time. Much less work has been done in the domains of reading/English and instrumental music and over the longer periods of time encompassing the entire high school period of development. In the CAB dataset, the lag between Wave 4 and Wave 5 was four years and the lag between Wave 5 and the end of high school varies from 2 to 5 years depending on the cohort. Having these longer time lags provides an opportunity to fill these gaps in the literature. We added the link of beliefs at Wave 5 to adolescents' high school history of participation in order to provide the most comprehensive picture possible of links proposed in the Eccles's models. Thus, the time lags in this chapter are larger than the time lags in the previous chapters.

Given the nature of the feedback loop from current participation and performance to subsequent self- and task-related beliefs within the Eccles's model (see Figure 1a), we also expected to find evidence of reciprocal influences between beliefs and behaviors. Engaging in any task provides the actors with new information about how well they are doing at the activity and how much they like doing the activity. Thus, we also test for these reciprocal associations.

We suspect that both directions of possible influence may differ across the four domains we are studying, because the nature of the experiences in each domain changes in different ways across these four domains. For example, the content of instruction in both reading/English and mathematics changes substantially as youth move from elementary into middle and secondary school. These changes may weaken the associations between beliefs and behaviors in these two domains compared to the associations in instrumental

music and sport. However, although the content may not change dramatically in leisure domains, the opportunities to participate may change due to increasing competitiveness of team sport participation. We do include participation in school team sports as one of the youth behavioral choices, even though factors other than individual choice will influence this indicator due to the increasing competition for slots on school-based teams. For that reason, we also included indicators of participation in noncompetitive sport activities. One might expect that the evidence for beliefs influencing changes in participation over time will be larger for these more voluntary sport activities than for participation on competitive high school teams. However, it might take higher levels of confidence in one's sport abilities and higher levels of valuing of sports to seek out slots on competitive teams than voluntary sport activities. We also differentiate within instrumental music between participating in high school bands and playing an instrument on one's own. The same predictive dilemma holds for instrumental music as in sports. Thus, in neither case do we make firm predictions about variations in the strength of the predictions across different measures of participation in the leisure domains.

The same is not true for the two academic domains because of different requirements for and availability of various high schools courses. Some form of English, literature, or writing was required each year in the districts we studied. Furthermore, it is impossible to reliably code the difficulty level of the various literature and writing courses offered in the schools we studied; AP courses in English or literature were rare. Thus, the variance in our indicators of high school English/literature/writing courses was constrained and the amount of reading for leisure is not necessarily going to increase over these age periods. In contrast, only 2 years of math was required and AP math courses were much more commonly available in our schools. Thus, we had a strong indicator of variation in math participation during the high school years. Because of the greater variability in math participation we expect to be able to document stronger associations between beliefs and behavior in this domain than reading.

Data Analysis Plan

As in the earlier chapters, we used cross-lagged structural equation models to test our hypotheses within each domain. We ran separate models for ability self-concept and value beliefs. We examined models that included youths' beliefs and participation at Wave 4 and 4 years later at Wave 5 as well as measures of activity participation and courses during the high school years. As shown in Figure 8 (p. 62), these models differ from those presented in the previous chapters as we have the typical cross-lagged model between Waves 4 and 5, but these models also included indicators of youths' activities and courses throughout high school. For example, in sports, the model included

youths' motivational beliefs at Waves 4 and 5, time spent in organized sports at Waves 4 and 5, and four indicators of youths' sport activities throughout high school. The high school indicators represent the average of each indicator across the high school years, which spanned Waves 6 to 9 depending on the specific cohort. It is important to note that a slightly different model was tested for math. Because math participation was not collected at Wave 5, these models included youths' math motivational beliefs at Waves 4 and 5, math participation at Wave 4, and the average number of math AP/honors courses per year in high school. As a result, fewer paths were tested in the math models than the other domains.

Eight structural equation models were estimated to test the relations between youths' beliefs and participation over time in each of the four domains and for ability self-concept and value. The high school indicators varied by domain. Sports included four high school outcomes: (a) the average number of school sports per year, (b) the average number of community sports per year, (c) the average time spent in organized sports per year, and (d) the average time spent in other sports per year. Instrumental music included two high school outcomes: (a) the average time spent practicing per year, and (b) whether adolescents ever participated in band. Math included one high school outcome: the average number of AP/honors math courses per year. Reading included three high school outcomes: (a) the average time spent reading per year, (b) whether adolescents ever participated in a literature-related club, and (c) the average number of English/literature courses per year. First, we tested for weak measurement invariance in the models as outlined in the general data analysis plan. Following the tests of measurement invariance, we present the findings for the final models, gender moderation of the relations among youths' beliefs and participation, and the relations including the exogenous control variables.

Results

Measurement Invariance

The model-level statistics testing weak measurement invariance across time and gender are presented in Table S29 in the online material. The unconstrained models fit the data well (i.e., CFI = .980–.998, RMSEA = .009–.034). Five of the eight models evidenced full weak measurement invariance across time and gender when tested simultaneously. These five models were sport ability self-concept, sport value, instrumental music value, math ability self-concept, and reading ability self-concept. The findings suggest that the structure of all the latent variables in each of these five models were similar across Waves 4 and 5 as well as across girls and boys. Thus, we constrained loadings in each of these models to be equal across time and gender.

Three of the eight models evidenced partial weak measurement invariance. These three models were instrumental music ability self-concept, math value, and reading value. In each of the three models, the loadings were similar across girls and boys (i.e., invariant across gender), but one individual loading in each model varied across Waves 4 and 5. The specific item differed across the three models. In the instrumental music ability self-concept model, the item that had a different loading over time was the item asking children to compare their ability in music to other subjects (i.e., item 1c in Table 7). In the reading task value model, the loading for the importance of reading changed over time (i.e., item 2b in Table 7). In the math model, the loading for the interest item varied over time (i.e., item 3a in Table 7). Because only one loading differed over time in these models, we freed that one loading across time in each model (i.e., it was estimated separately at Waves 4 and 5), but constrained these loadings to be equal across girls and boys. All other loadings in these three models were constrained to be equal across Waves 4 and 5 and across girls and boys.

Final Models

As shown in Tables 22 and S30, across all four domains, the final models fit the data well. The standardized paths are shown in Table 23; the standardized and unstandardized estimates are presented in Table S30 in the online material.

The pattern of significant cross-lagged paths varied across domain (Table 23). There was consistent evidence of the predicted associations from Wave 4 beliefs to Wave 5 participation across all domains (except math which was not tested) and for both the youths' ability self-concepts and perceived task value, despite the 4-year lag in time between these two waves. Wave 4 motivational beliefs always predicted small to moderate increases in participation across the 4-year span in sports, instrumental music, and reading ($\beta = .16$–$.32$, $p < .001$). In addition, Wave 5 motivational beliefs (both ability self-concepts and perceived task value) predicted small to moderate increases in adolescents' overall high school participation in sports, instrumental music, and math ($\beta = .14$–$.41$, $p < .05$). Because indicators of both Wave 4 participation and an independent indicator of adolescents' ability in each domain were included as covariates, these relations are net of a substantial portion of the variance in actual competencies and prior patterns of participation. In contrast, these cross-lagged paths were much weaker and often insignificant for reading.

Interestingly, the relative predictive associations of both youths' ability self-concepts and their valuing of each domain with increases in participation across time varied somewhat across domains. They were slightly higher for perceived task value than for ability self-concepts in all domains except math. This is particularly true for the analyses spanning Waves 4–5 in sports and

TABLE 22

MODEL FIT INDEXES FOR THE MODELS WITH YOUTHS' BELIEFS AND ADOLESCENTS' PARTICIPATION

Model	*df*	X^2	CFI	RMSEA
Sports				
Self-concept of ability	297	424.15***	.973	.024
Value	289	323.88	.992	.013
Music				
Self-concept of ability	185	287.02***	.981	.028
Value	176	234.64**	.989	.021
Math				
Self-concept of ability	156	270.07***	.964	.032
Value	139	169.21*	.986	.017
Reading				
Self-concept of ability	246	352.85***	.969	.025
Value	219	265.63*	.980	.017

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

spanning Wave 5 to overall high school participation in instrumental music. In contrast, for math, Wave 5 ability self-concept was a stronger predictor of high school AP course participation than Wave 5 valuing of math.

There was also weak but significant support for the power of Wave 4 participation in predicting changes in youths' beliefs from Wave 4 to Wave 5 in sports and instrumental music. In these two leisure domains, youths' participation at Wave 4 predicted small changes in youths' sport ability self-concept, music ability self-concept, and music value over the 4-year gap between Waves 4 and 5 ($\beta = .09$–$.18$, $ps < .05$), supporting the hypothesized reciprocal influences in these two leisure domains. There was no support for the significance of the link between participation and beliefs in either math or reading.

The stability of youths' beliefs and behaviors over time ranged from small to large. Across the 4-year period from Waves 4 to 5, the stability of youths' beliefs in all four domains was typically small to moderate ($\beta = .29$–$.56$, $ps < .001$), whereas the stability in youths' participation was small over the same 4-year period ($\beta = .07$–$.21$). The models also included paths for the stability of adolescents' participation from Wave 5 to overall high school indicators. In sports, the stability was small to moderate for time in organized sports and the number of school sports ($\beta = .21$–$.39$, $ps < .001$) compared to small stability for informal high school sport activities ($\beta = .09$–$.15$, $ps < .05$). The stability in instrumental music ($\beta = .37$–$.58$, $ps < .001$) and reading participation ($\beta = .54$–$.64$, $ps < .001$) were particularly strong across these periods and often stronger than the predictive power of youths' motivational

TABLE 23

STANDARDIZED PATH ESTIMATES FOR THE MODELS WITH YOUTHS' BELIEFS AND ADOLESCENTS' PARTICIPATION

	Models With Youth Ability Self-Concept		Models With Youth Value	
Path	Girls	Boys	Girls	Boys
Sports				
Cross-lagged relations between beliefs and behaviors				
W4 beliefs → W5 time	.20***	.17***	.32***	.24***
W4 time → W5 beliefs	.09*	.10*	.12*	.13*
W5 beliefs → HS time organized sports	.27***	.26***	.24***	.24***
W5 beliefs → HS time other sports	.36***	.30***	.37***	.32***
W5 beliefs → HS # school sports	.31***	.22***	.32***	.24***
W5 beliefs → HS # community sports	.27***	.22***	.31***	.27***
Stability				
W4 beliefs → W5 beliefs	.53***	.50***	.56***	.44***
W4 time → W5 time	.14**	.14**	.07	.07
W5 time → HS time organized sports	.37***	.38***	.37***	.39***
W5 time → HS time other sports	.15**	.14**	.12*	.11*
W5 time → HS # school sports	.30***	.23***	.28***	.21***
W5 time → HS # community sports	.14*	.13*	.10*	.09*
Within wave covariances				
W4 beliefs ↔ W4 time	.38***	.44***	.41***	.52***
W5 beliefs ↔ W5 time	.41***	.37***	.50***	.42***
HS time organized sports ↔ HS time other sports	.25***	.21***	.26***	.22***
HS time organized sports ↔ HS # school sports	.47***	.33***	.48***	.33***
HS time organized sports ↔ HS # community sports	.14**	.12**	.14**	.12**
HS # school sports ↔ HS time other sports	.21***	.12***	.21***	.12***
HS # school sports ↔ HS # community sports	.31***	.18***	.30***	.18***
HS # community sports ↔ HS time other sports	.50***	.35***	.49***	.34***
Music				
Cross-lagged relations between beliefs and behaviors				
W4 beliefs → W5 time	.17***	.20***	.20***	.24***
W4 time → W5 beliefs	.18**	.16**	.11*	.10*
W5 beliefs → HS band participation	.17**	.17**	.17*	.18*
W5 beliefs → HS time	.23***	.21***	.41***	.37***
Stability				
W4 beliefs → W5 beliefs	.32***	.35***	.34***	.40***
W4 time → W5 time	.21***	.19***	.18***	.17***
W5 time → HS band participation	.51***	.49***	.49***	.48***
W5 time → HS time	.58***	.51***	.43***	.37***
Within wave covariances				
W4 beliefs ↔ W4 time	.59***	.57***	.57***	.51***
W5 beliefs ↔ W5 time	.67***	.69***	.76***	.74***
HS time ↔ HS band participation	.50***	.42***	.50***	.41***
Math				

(*Continued*)

TABLE 23
(Continued)

Path	Models With Youth Ability Self-Concept		Models With Youth Value	
	Girls	Boys	Girls	Boys
Cross-lagged relations between beliefs and behaviors				
W4 time → W5 beliefs	.04	.04	.04	.05
W5 beliefs → HS math AP courses	.26***	.25***	.16***	.14***
Stability				
W4 beliefs → W5 beliefs	.31***	.29***	.37***	.37***
W4 time → HS math AP courses	.08	.08	.07	.07
Within wave covariances				
W4 beliefs ↔ W4 time	.25***	.26***	.35***	.34***
Reading				
Cross-lagged relations between beliefs and behaviors				
W4 beliefs → W5 time	.16***	.16***	.19***	.22***
W4 time → W5 beliefs	.09	.08	.05	.05
W5 beliefs → HS English class	.09	.07	.07	.05
W5 beliefs → HS literature club	.11*	.15*	.02	.02
W5 beliefs → HS time	.02	.02	.05	.05
Stability				
W4 beliefs → W5 beliefs	.32***	.29***	.33***	.36***
W4 time → W5 time	.18***	.18***	.17***	.17***
W5 time → HS English class	.07	.06	.08	.06
W5 time → HS literature club	.08	.10	.09*	.11*
W5 time → HS time	.64***	.54***	.63***	.54***
Within wave covariances				
W4 beliefs ↔ W4 time	.26***	.26***	.25***	.23***
W5 beliefs ↔ W5 time	.16**	.15**	.15**	.15**
HS English class ↔ HS literature club	.07	.08	.09	.10
HS English class ↔ HS time	.05	.04	.05	.03
HS literature club ↔ HS time	−.10*	−.11*	−.09*	−.10*

Note. HS, High school.
*$p < .05$.
**$p < .01$.
***$p < .001$.

beliefs. In math, there was not an indicator of Wave 5 participation. Thus, Wave 4 was used to predict high school courses. There was not a significant relation across waves in math ($\beta = .07$–$.08$, *ns*).

Gender Moderation

The tests for gender moderation in the relations among youths' beliefs and participation (shown in Figure 8 [p. 62]) are presented in Table S30 online. The overall tests suggested that these relations were similar across gender in every model.

Exogenous Control Variables

As in the previous chapters, we provide a summary of the relations between the exogenous control variables and youths' beliefs and participation from the final models ($ps < .05$). These statistics are not presented in tables, but are available from the authors. Several of the relations between the control variables and youths' beliefs and participation were statistically significant. Teachers' ratings of children's natural ability in a domain often positively predicted adolescents' high school classes ($\beta = .21$–$.44$) and motivational beliefs ($\beta = .11$–$.55$); however, the relations were more consistent in predicting ability self-concept compared to value, and in predicting beliefs in math, reading, and sports compared to instrumental music. Youths' IQ was not a consistent predictor. Generally, the oldest cohort had taken more math and reading classes each year in high school ($\beta = -.33$ to $-.10$) as well as spent more time in instrumental music at Waves 4 and 5 ($\beta = -.25$ to $-.22$) than the youngest and middle cohorts. When there were differences in youths' motivational beliefs by cohort, the patterns generally replicated what other studies have found where younger youth have higher self-concepts of abilities ($\beta = .13$–$.29$) and values ($\beta = .19$–$.24$) of these domains than older youth (Fredricks & Eccles, 2002; Jacobs et al., 2002). Parents' education positively predicted sports and instrumental music participation at multiple waves for girls ($\beta = .12$–$.30$), and advanced high school math courses for both boys and girls ($\beta = .11$–$.16$). Parents' education also predicted higher ability self-concepts in music and math ($\beta = .14$–$.30$). Parent education did not predict any of the reading indicators. Youths' sport ability and family income rarely predicted the indicators at hand.

Discussion

As we predicted and consistent with prior research, by and large both ability self-concepts and task value predicted participation choices across the four domains and across both time periods, including the number of AP math courses (Simpkins et al., 2006, 2012; Updegraff et al., 1996), participation in sport activities at both Wave 5 and across the high school years (Fredricks & Eccles, 2005; Marsh et al., 2007), and instrumental music participation at both Wave 5 and across high school (Austin, 1990; Klinedinst, 1991; Simpkins et al., 2012). These findings align with theories emphasizing competence beliefs as a predictor of achievement choices, including self-efficacy, self-concept, and self-determination theories (Bandura, 1997; Ryan & Deci, 2000; Marsh & Craven, 2006). Furthermore, these findings support motivational theories that focus on the value construct as the key determinant of choice behavior, including expectancy-value, interest, and intrinsic motivational theories (Deci & Ryan, 1985; Eccles, 1993; Schiefele, 1991).

Interestingly, in some previous work by Eccles and her colleagues using other data sets, subjective task value was a strong predictor of activity choices, whereas ability self-concepts were the strongest predictors of changes in actual performance (see Wigfield et al., 2006, for review). Clearly in this study, both beliefs were significant predictors of participation, though their relative influence varied across different analyses. It is not surprising that youths' math ability self-concepts might be a particularly strong predictor of enrollment in AP math courses because these courses require both very high levels of ability and great confidence in one's ability to master the difficult material. Furthermore, because taking AP math courses is very useful for getting into the best college possible after high school, there may be a great deal of external pressure on those students who have high abilities in math to take these courses, leaving less variance to be explained by the value youth place on these courses. The same pattern emerged for participation in high school literature-related clubs, but the coefficients were much weaker and not even significant for the perceived value of English. These same dynamics would be less true in sports and instrumental music, domains in which perceived valuing is often a stronger predictor than ability self-concepts.

The findings on the direction of influence suggest that there is more support for the reciprocal influence between beliefs and participation in the leisure domains than in the academic domains. In math and reading, participation at Wave 4 did not predict changes in these youths' ability self-concepts or perceived value of these domains 4 years later. These same relations evidenced small effect sizes in sports and instrumental music. Why might participation predict changes in youths' beliefs in leisure and not in academics? It is not because there are consistent differences in the stabilities of either beliefs or participation across the domains. But it could be that the types of activities these youth can participate in each domain change more dramatically in the academic than in the leisure domains. For example, the types of math courses taken during the late elementary and early middle school years were quite different from the types of math courses taken in eighth grade and beyond in these cohorts. Late elementary school and early middle school math consisted primarily of arithmetic; later middle school and high school math courses consisted of algebra and geometry, which are more abstract forms of mathematics. As a result, it seems less likely that the experiences one was having at Wave 4 could influence later math ability self-concepts and the perceived value of the kinds of math they were learning in late middle school and early high school than might be true in sports in which the nature of the experiences are likely to be more similar across these time frames. The same argument could be made for reading/English where the high school course material is much more focused on literature than the reading and writing courses they took in fifth through seventh grades.

In addition, the nature of the grading in the academic subjects also changed across this time frame from more mastery based feedback to more relative performance based feedback (i.e., marks that relate to improvement versus marks based on how well one performed relative to other students in one's class). These arguments suggest that assessing beliefs and behaviors more closely in time during the middle school and early high school years might yield a different pattern of results in the academic domains.

In addition, as noted in Chapter 4, youths' free time participation in both math and reading can reflect their enjoyment of the activity or their need to spend time improving their competencies. In the latter case, this could be because they want to excel in this area or because they need to overcome deficits in their current competencies. If participation is for remedial purposes, high rates of participation might not be associated with gains in either one's ability self-concepts or one's interest in the subject area due to frustration and failure experiences associated with remediation efforts. Thus, in order to fully understand the relations between time spent in academic domains and their beliefs, one might also need to understand the goals for their participation (e.g., enjoyment vs. improvement). In leisure, the relation between participation and subsequent beliefs should be more positive than in academic domains (albeit small) because youth who are not skilled in sports and instrumental music can quit. Thus, the heterogeneity in the reasons why one is participating might be larger in academics than in leisure particularly in the late childhood and early adolescent periods of development.

Generally the findings supported the expectancy-value model in all domains except reading. Consistent with prior research (Baker & Wigfield, 1999; Wigfield & Guthrie, 1997), self-concept of reading ability and value predicted reading participation 4 years later from Waves 4 to 5. In addition, self-concept of reading ability at Wave 5 predicted high school participation in literature-related clubs. However, neither English belief predicted high school English coursework or time spent reading. Why might this be so? First some form of English-related coursework was required each year in the high schools sampled in this study. Thus, there was very little variance to explain. Second, the cross-time stability of reading was quite high, the highest of the four domains sampled in this study; leaving little variance to be predicted.

This nonsignificant association between Wave 5 beliefs and high school English-related course work is inconsistent with the work of Durik et al. (2006). Using the same dataset, they found a small, positive relation between value beliefs at tenth grade and language arts course taking throughout high school. In the current study, we examined the relations between Wave 5, which included seventh, eighth, and tenth grade data depending on the cohort, and indicators of high school coursework. In the Durik et al. study (2006), the indicators for values and courses were both measured in high school for everyone. It is possible that a small relation between tenth graders'

perceived value of English and their decision to taking extra English- or writing-related coursework during their last 2 years of high school emerged because adolescents' beliefs were measured very close in time to the coursework decisions. Examining the same relation over longer time frames may decrease the likelihood of finding a significant association.

SUPPORTING INFORMATION

Additional supporting information may be found in the online version of this article at the publisher's website.

VIII. DISCUSSION

We had two major goals for this project: (1) To test the predicted socialization pathways from parents to children as summarized in Figure 1b; and (2) to test the pathways from children's motivational beliefs to their behavioral engagement as predicted in Figure 1a in four different achievement domains. Related to these goals, we had three major subgoals: (1) To rigorously test the direction of effects at each step in the developmental sequence inherent in the Eccles's expectancy-value models of the ontogeny of achievement-related behavioral choices; (2) to explore the variations in the strength of support for the Eccles's models across different activity domains; and (3) to determine whether children's gender predicts mean-level differences and moderates the patterns of associations predicted in Figures 1a and 1b. In this chapter, we summarize and discuss the major findings associated with each of these six goals while avoiding repetition of our discussions in each of the four results chapters.

Major Findings

At the most general level, we found the most consistent support for pathways in the expectancy-value model concerning adolescent's motivational beliefs to their subsequent high school behavioral engagement in sports, instrumental music, and math, even with indicators of elementary school competence and participation in each domain and family social class controlled as noted in Figure 1a. We found a more mixed pattern of support for the predicted socialization pathways from parents' beliefs to their elementary school-aged children's beliefs as noted in Figure 1b. For the most part, we found strong and consistent links from parents' perceptions of children's abilities to the changes in children's beliefs 1 year later. The strength of these associations was highest in the two leisure domains and was not significant for math. We also found little consistent evidence that parents' valuing of these four domains predicts changes in their children's motivational beliefs. Additionally, in only three cases did parents' beliefs

predict changes in children's valuing of any domain. However, parents' estimates of their children's ability in instrumental music predicted increases in the value the children attached to instrumental music and mothers' ratings of their children's reading ability predicted increases in the children's valuing of reading. Although parents' beliefs predicted changes in youths' beliefs, we found very limited support for the predicted cross-lagged links between parents' beliefs and their behavior. In contrast, we found stronger and more consistent evidence of a cross-lagged link from parents' behaviors to changes in their beliefs across time.

With regard to our first sub-goal on direction of influence, as predicted, we found consistent evidence that Wave 2 (grades 1, 2, and 4) indicators of children's domain-specific competence levels predicted changes in their parents' perceptions of their children's ability over time in sports and math. This was not true for instrumental music and it was only true for mothers in reading. In contrast, we found little evidence that Wave 2 children's motivational beliefs and participation predict changes in either their parents' estimates of their children's abilities or the value the parents' attached to competence in sports, math, or reading. Thus, although parents beliefs and behaviors were responsive to information about their elementary-school-aged children's competencies, their beliefs and values were not responsive to their elementary school-aged children's beliefs and interests over time except in the domain of instrumental music.

In regard to our third sub-goal, we found fairly consistent evidence that children's gender predicts their parents' concurrent perceptions of their children's ability, the importance of the domain for their child, and parents' supportive behaviors in our two leisure activity domains. The association of children's gender with either the parents' beliefs or supportive behaviors in math and reading was much less consistent, varying by wave and by gender of the parent. When present, however, the differences were in the gender stereotypic direction even when independent indicators of current competence levels were controlled. However, we found no evidence that the patterns of associations among the constructs varied by children's gender. Thus, despite consistent evidence of gender-stereotypic differences in the mean levels of both children's and their parents' beliefs and behaviors, the socialization processes appear to work the same for both girls and boys.

We organize our general discussion of these results around three general themes: (a) direction of influence or the reciprocal relations between parents and children in the ontogeny of achievement-related beliefs and behaviors, (b) the robustness of the findings across different activity domains, and (c) the role of gender in the ontogeny of parents' and children's achievement-related beliefs and behaviors.

Direction and Reciprocity of Influence

We looked at two types of possible reciprocal influences. First, and most importantly for the developmental sciences, we examined the direction of predictive influences between parents and children. Second, and most importantly for social cognitive perspectives on motivation, we looked at the reciprocal influences between beliefs and behaviors for both parents and children.

Directions of Influence Between Parents and Children

In many studies of socialization, researchers assume that parents influence children and design their methods and analyses accordingly (e.g., Eccles et al., 1983; Furstenberg et al., 1999; McGillicuddy-DeLisi, 1982; McLoyd, 1990; Simpkins et al., 2012). In contrast, Bell (1979) and others argued that parents adjust their beliefs and behaviors according to their children's beliefs, performance, and participation. Through a stringent test of cross-lagged models with several control variables, we found evidence for both the responsiveness of parents' beliefs about their children based on characteristics of their children and the more unidirectional impact of parents' beliefs on changes in their children's motivational beliefs and behaviors (see Chapter 4). With regard to the first pattern, as predicted, teachers' estimates of a child's natural talents did predict changes in parents' views of their child's domain-specific abilities.

In contrast, during the elementary school years, there was almost no evidence that children's motivational beliefs and participation influence changes in their parents' perceptions of their child's abilities over 1 year (see Chapter 4). There was also no evidence that older elementary school-aged children's motivational beliefs predict changes in their parents' supportive behaviors over 1 year (see Chapter 6). The predominate direction of influence flowed from parents to children during both Waves 2–3 and Waves 3–4, which spanned grades 1 through 6.

We found consistent evidence that parents play an important role in shaping the ontogeny of their children's ability self-concepts during the early elementary school years in sports, instrumental music, and reading (Eccles, 1993; Eccles et al., 2000; Fredricks, 1999; Simpkins et al., 2012; Yoon et al., 1993). The predictive power of parents' beliefs was significant even when the association of the teachers' ratings of each child's natural talent with both the parents' and the children's ability perceptions were controlled. These findings suggest that parents' perceptions of their children's abilities are receptive to information from their children's teachers. In turn, parents' perceptions of their children's abilities influence their children's own developing sense of their abilities particularly in sports and reading.

Why do children's ability self-concepts have so little predictive influence on changes in their parents' beliefs and behaviors? By the early elementary

school years, children do have reliable opinions about their abilities in different domains (Wigfield et al., 1997). One might expect that a child would make comments while engaged in different activities that would both reflect his/her developing ability self-concept and inform their parents' developing view of their child's relative abilities across different domains. For example, they might make comments such as "I can't do this" or "It's easy" or "It's too hard for me." If so, we found no evidence that such comments influence parents' estimates of their children's abilities in various domains during the early elementary school years.

This set of findings also could reflect the relative across-time stabilities of parents' versus children's estimates of the child's abilities; parents' ratings were much more stable than children's. As a result, there was little room for change in the parents' ratings by the time their children were in elementary school, particularly in sports and reading. The same argument is true for the link between parents' supportive behaviors and their children's beliefs in all domains except reading because parents' supportive behaviors in math, sports, and instrumental music were very stable across time.

It seems likely that the predominant predictive direction between parents' and children's estimates of children's abilities across different domains will vary across chronological age and in different social or cultural contexts. First, the developmental course associated with the increasing stability of these ability perceptions likely differs for parents and children; parents' greater cognitive maturity and interest in forming these judgments likely leads to greater stability in parents' beliefs during the early elementary school years. However, as children mature, they gain more performance experience in different domains, as well as greater cognitive ability to integrate this information into stable concepts about their relative abilities and interests, and they become more interested in assessing their own competencies in different activity domains. As a result, their ability self-concepts should, and, in fact do, become increasingly stable (e.g., Stipek & MacIver, 1989; Wigfield et al., 2007). At some point, the stabilities of parents' and children's estimates of the children's abilities should become more equivalent.

Second, relative access to performance information should change as children mature. When children are young, parents have more opportunities to observe their children's performance in those activities that are prevalent in the children's life (Furstenberg et al., 1999; Parke et al., 2003). As children get older and begin doing more of these activities away from their parents, children's access to information about their performance will increase and likely surpass that of their parents by the time the children move into and through secondary school. At that point, the predominant direction of influence may change as adolescents interpret their performance histories for their parents rather than the reverse. Unfortunately, our research design does

not allow us to test either of these predictions because we did not have the funding to gather parent data during the middle and high school years.

Directions of Influence Between Individual's Beliefs and Behaviors

The second type of reciprocal effects that we investigated was the relation between people's beliefs and their behaviors over time. We tested these relations within both parents and adolescents. Although most social cognitive theorists of motivation, particularly those focused on the self as a causal agent have focused their empirical work on the belief to behavior link (Deci & Ryan, 1985; Dweck, 2006; Eccles et al., 1983; Lerner, 1996; Weiner, 1979), most motivational theorists posit a reciprocal relation over time between self-beliefs and behaviors, performance, or choices (Bandura, 1997; Eccles et al., 1983; Harter, 1999; Marsh, 1990; Marsh & Craven, 2006; Skaalvik, 1997; Weiner, 1979). For example, as outlined in Figure 1a, to the extent that behavior yields performance information that is then interpreted by the actor, behaviors should lead to changes in ability self-concepts and values over time. Similarly, within social psychology, there is a long history of interest in the causal ordering of the relations between attitudes and behavior (e.g., Bem, 1970, Eagly & Chaiken, 1993). Nonetheless, within the area of motivated behavior, few studies have directly tested the possible reciprocal links between self-beliefs and behavioral engagement over time in either parents or children (see Marsh & Craven, 2006, for a recent exception).

We found evidence of both reciprocal patterns and unidirectional patterns of influence at several points. The strongest support for reciprocal influences was in sports for parents' beliefs and behaviors (Chapter 5) and for youths' beliefs and behaviors (Chapter 7), as well as in instrumental music for youths' beliefs and behaviors (Chapter 7). For mothers and fathers, parents' supportive behaviors and perceptions of both their children's sport competence and the value of sports were reciprocally related over time. For youth, their beliefs and their participation in sports and in instrumental music were reciprocally related. With regard to evidence consistent with a unidirectional pattern of influence, the most consistent and strongest findings suggest a predominant flow of influence from beliefs to behaviors among youth in math and from behavior to beliefs among parents in instrumental music.

Variations by Domain

One of our major goals was to investigate domain differences in the applicability of the Eccles's models for explaining achievement-related choices across mandatory academic domains and voluntary achievement-related leisure pursuits. Our findings suggest that the predicted associations are stronger in sports and instrumental music than in math and reading.

There are several possible explanations for this pattern. One is that math and reading are required aspects of the school curriculum, whereas sports and music are more likely to occur outside of the traditional curriculum in voluntary school- and community-based after-school contexts. As a result, motivation and participation in math and reading are more likely to be influenced by school factors, especially in the elementary schools years, whereas sports and instrumental music are more likely to be influenced by experiences provided by families or determined by adolescents' own interests, identities, and self-perceptions as the children get older.

Similarly, these domains differ in the number of ways in which parents can and need to be involved if their children are to acquire strong interests and competencies. For both instrumental music and sports, parents are called upon to play many roles in helping their children acquire skills and interests in these (and other) achievement-related leisure activities, such as driving children to practices and lessons; cheering at games and recitals; paying for lessons, equipment, uniforms, and camps; and watching sports and music together (Fredricks & Eccles, 2004; Simpkins et al., 2015). Thus, if their children are to acquire these skills and interests, parents need to organize and implement the relevant experiences, likely leading to a stronger correspondence between parents' beliefs, parents' behaviors, and children's engagement in these domains than in the domain of academic subjects.

Reading and math, however, differ from sports and instrumental music in the United States as both domains are viewed as key components of academic and, therefore, life-long success. The importance the typical middle class American parents attach to math and reading skills is likely quite high and not particularly diverse. For example, in this sample parents' mean ratings of the importance of reading averaged above 6.4 on a 7-point scale and the standard deviations were much smaller for reading than for either sports or instrumental music. Because of the lower variability, it was not surprising that we found weaker relations between parents' beliefs, parents' behaviors, and their children's ability self-concepts and value in reading and math than in sports and instrumental music.

We also documented interesting differences between math and reading. First, parents' beliefs had a stronger predictive influence on children's beliefs in reading than in math. The stronger relations for reading may reflect the fact that reading is emphasized in the early elementary school grades to a greater extent that is math and the type of reading activities that parents and children do at home may be better aligned with the skills the children are learning in reading in early elementary school. If so, these characteristics could help explain why parents' Wave 2 (grades 1, 2, and 4) beliefs predicted increases in their children's beliefs and leisure activities over the next year in reading, but not in math (Chapter 4). By Wave 3 (grades 2, 3, and 5), the majority of the students in this study were in third or fifth grade. By this time,

math is becoming both a more important component of the curriculum and more difficult. At the same time, the kinds of basic reading skills that children need to read with their parents are becoming more routine. To the extent that this is true, then parents may be called upon to provide more substantive academic support in math than in reading, leading to stronger evidence of parent to child influence in math during the Wave 3 to Wave 4 transition (grades 2, 3, and 5 to grades 2, 4, and 6) than during the transition 1 year earlier (Chapter 6).

Interestingly, fathers' Wave 3 (grades 2, 3, and 5) behaviors predicted increases in their children's math ability self-concepts and value, as well as reading value over the next year, but mothers' behaviors did not. The fact that fathers have greater predictive influence than mothers in math could reflect cultural stereotypes about who is better in math as well as likely differences between mothers and fathers in both their confidence and their valuing of math (Eccles [Parsons] et al., 1984).

Additionally, we found that early adolescents' Wave 5 (grades 7, 8, and 10) beliefs were more predictive of high school math course taking than English course taking. We believe this difference reflects culturally grounded differences in the choices students have over course enrolment in math versus English. For this sample, English was required for all four high school years whereas math was only required for 3 of the 4 years. Furthermore, the level of difficulty of the courses selected was easier to code in math than in English. Finally, AP courses were more readily available in math than in English in all of the high schools attended by our participants. Thus, students had more choice in math about how much math to take and the difficulty of the math courses they selected. Consistent with this argument, the students' reading beliefs did predict their participation in high school literature clubs, an area in literature/English domain where students may have more choice.

The final domain difference we want to point out is the uniqueness of the instrumental music. This was the domain in which parents' beliefs and behaviors were most consistently responsive to their children's expressed interests and behavioral engagement. Why? One possibility is that instrumental music is the least universally valued skill of the four we studied in this culture with the least easily available organized opportunities to learn during the first 8–9 years of life. During the early elementary school years, the parents in this sample were much less likely to enroll their children in organized programs, to do the activity with their child, and to model related behaviors in instrumental music compared to sports. Parents of boys also placed less value on instrumental music than on sports. Finally, the rate of provision of opportunities to learn instrumental music went up from Wave 2 to Wave 3 (i.e., grades 1, 2, and 4 to grades 2, 3, and 5) and then declined in later waves. Together, this pattern suggests that most of these parents were not motivated to provide their children with opportunities to learn to play a musical

instrument before the middle of their elementary school years. Children may have been key to initiating this opportunity to a greater extent in music than in sport and then perhaps were more key to stopping their instruction if they did not enjoy it and feel competent at it. We know of no other research to evaluate the role of youth in initiating or halting the pursuit of instrumental music. It seems likely that the relative parental valuing of instrumental music versus sport will vary by culture and subculture. Understanding the association of the relative valuing, as well as parents' beliefs about the origins of interest and individual differences in aptitude across different domains for various activities is an important topic for future research.

Gender

We examined both mean differences between boys and girls and differences in the relations among constructs by child gender. Consistent with prior research, we documented stereotypic mean-level gender differences among children, with boys typically having higher scores than girls on sports and math ability self-concepts, value (only for sports), participation, and coursework (Eccles, Wigfield, et al., 1993; Fredricks & Eccles, 2005; Simpkins, Davis-Kean, et al., 2005). In contrast, boys had lower ability self-concepts, value beliefs, participation, and course taking in reading and music than girls (Baker & Wigfield, 1999; Eccles et al., 1993; Jacobs et al., 2005). The mean-level differences were generally stronger in the two leisure domains than in the two academic domains. This may reflect the fact that participation in sports and music tends to be voluntary, whereas math and reading are the two subjects that form the backbone of children's education from kindergarten through the high school years. Mastery of math and reading are important precursors to college achievements and economic success in adulthood.

Although the youth findings were fairly consistent, the evidence of an association of children's gender with parents' beliefs and behaviors was mixed. Just as was true for the youth, both mothers and fathers tended to be gender-stereotyped in their beliefs about their children and their behavioral supports in sports and instrumental music. Consistent with previous studies, parents of sons held more positive beliefs and did more to support their children's engagement in sports than did parents' of daughters (Eccles et al., 2000; Fredricks & Eccles, 2005; Welk et al., 2003). These gender differences likely reflect the internalization of cultural expectations about gender competencies and interest in these domains. In contrast, there were significantly fewer gender differences in parents' beliefs and practices in math and reading.

This study is one of the first to examine gender differences in children's and parents' beliefs and behaviors in instrumental music (see Simpkins et al.,

2012; Wigfield et al., 1997; for exceptions) and our findings run counter to the differential prevalence of males versus females in the professional world of instrumental musicians. By and large, gender-related stereotypes about both ability and interests reflect the gendered differential participation patterns in the adult world (Ruble et al., 2006). By a substantial margin, the majority of professional instrumental musicians are male (Ammer, 2001). Why then do both parents and children see instrumental music as female-typed during the childhood years? We suspect that parents' beliefs and behaviors reflect two cultural phenomena: (a) lay person's assumptions about the patience it takes to study instrumental music coupled with stereotypes regarding gender differences in children's patience and self-control, and (b) the greater emphasis placed on sports for boys. We know of no studies assessing these two predictions.

Despite the fact that girls and boys rated themselves and were rated by parents as being different in several domains, the patterns of associations among the predictors over time were quite similar for girls and boys. Take sports as an example. Girls had less confidence in their sport abilities, spent less time in sports, and experienced fewer supportive sport-related behaviors from parents than boys. However, the predictors of children's sport ability self-concepts or participation were similar for girls and boys. The lack of gender moderation is consistent with the limited number of studies that have investigated gender as a moderator (Marsh et al., 2007; Sabiston & Crocker, 2008; Simpkins et al., 2005, 2006, 2012; Valentine et al., 2004). The relative lack of gender moderation in light of the mean-level differences based on gender is important for interventions aiming to change motivation and participation. On the one hand, these findings indicate that socialization processes operate similarly across gender, suggesting that similar interventions can be used to support both girls' and boys' participation in these domains. On the other hand, these findings suggest that one will need to provide more of these service to girls than to boys if one wants to reduce the mean level gender differences in beliefs and behaviors.

Broader Implications for Research

Researchers make many decisions in designing, implementing, and then analyzing data for large scale, longitudinal datasets like CAB. In this section, we discuss what we learned about the impact of such decisions on the findings from the approach we took in this manuscript.

Developmental Design

Development takes place over time and can be studied using quite different time frames ranging from moment to moment developmental

processes to the more distal accumulation of developmental pathways over longer time frames. Developmental scientists make decisions about the time frame they wish to study both when they design their data collection plan and when they design their data analytic strategies. These decisions have several implications for what can be learned from any given data analytic project.

First, Eccles and her colleagues have analyzed the CAB data using various time frames, giving us the opportunity to compare the results of applying different types of statistical analyses on the same data. In 2012, we published a study using the CAB data to test the general Eccles's model of the socialization of achievement-related beliefs and behaviors summarized in Figure 1b. In this study, we used a widely accepted method to analyze longitudinal data to assess a singular set of theoretical predictions. Specifically, using structural equation modeling techniques, we estimated a linear model that captured the central theorized sequences of events that unfold over time. The findings in that paper provided strong evidence that the data fit well with what would be predicted over the long term from the Eccles's models. Although useful, that particular statistical approach does not allow one to rigorously evaluate possible rival hypotheses concerning the direction of influence, examine and predict changes in these phenomena over time, or address the multi-determined origins of parents' beliefs. The detailed, cross-lagged modeling approach used in this monograph is better suited to examine these types of issues and questions.

Additionally, the results of this monograph point to the need to plan carefully for when in the life course these developmentally defined sequences of data should be collected. We found different patterns of relations across the four activity domains we studied. These differences could reflect different developmental time courses for the processes in each domain. We argued that differences in the developmental time course for acquiring skills in instrumental music versus sports might explain the different patterns of relations across these two domains. The same could be true for reading versus math. If this is true, then we would have needed to gather the data when the children were younger in order to capture the power of parental socialization for reading. This issue is directly related to previous research on parents' beliefs about development (Goodnow & Collins, 1990; Sigel, McGillicuddy-De Lisi, & Goodnow, 1992). These scholars argued that parents' beliefs about when various skills should be cultivated should influence the timing of their related socialization behaviors. Our patterns of domain differences could reflect this phenomenon. The timing of various socialization practices should also vary cross-culturally because cultures will vary in their theories about optimal developmental timing (Harkness & Super, 1996; Willemsen & Van de Vijver, 1997).

Effect Size

Our findings also relate to concerns about effect sizes. Many of our effects sizes from the cross-lagged models fall within the range of .10 to .25—a range that would be considered small according to Cohen (1992). Small is often considered to be bad or not significant in the practical sense. We disagree with this assessment. In order to provide as stringent a test as possible of our hypotheses regarding the possible impact of parents on children and the possible impact of motivationally related beliefs on behaviors, we used longitudinal data to test for lagged effects and included several important controls for selection effects. This is a very conservative approach, which coupled with the fact that the "outcomes" we tested at each point are complex and likely to be multi-determined, is very likely to yield small effect sizes. However, as has been shown in the literature on teacher effects (Jussim & Eccles, 1992), such effects can accumulate over time to yield quite marked differences in developmental trajectories (see Rosenthal, Rosnow, & Ruben, 2000, for a similar discussion of the accumulation of small effect sizes).

Second, our study provides just one snapshot of a developmental process that begins at conception. We looked only at the parental socialization processes occurring during the elementary school years and the within-individual selection processes during secondary school. Because our method relies on predicting change over a 1-year gap (Chapters 4 to 6) or 4-year gap (Chapter 7), our effect sizes will be limited in the extent to which we captured the point of maximal change in the predicted variables. The high stability in some of our predicted "outcomes" inevitably leads to lower cross-lagged effect sizes because there is less unexplained variance to predict. Studying both parents and children simultaneously makes this issue particularly problematic because beliefs like those we are studying are likely to stabilize at different developmental points for parents and children due to cognitive and experiential differences between these two groups of people.

Finally, the "outcomes" we are studying at each step in our analyses can be influenced by many forces and experiences. The developmental processes underlying the trajectories of change in these "outcomes" are complex and multifaceted. Consistent with thinking about ecologically embedded developmental systems (e.g., Bronfenbrenner & Morris, 2006; Sameroff, 2000), these processes represent patterns of adaptation of both parents and children to each other over time and across various contexts. Furthermore, these processes include the principles of both multifinality and equifinality (Cicchetti & Rogosch, 1996) with the same precursors leading to multiple developmental outcomes and different precursors leading to similar developmental outcomes. Given these complexities, we should not expect that any one model will yield particularly high effect sizes.

Studying and Conceptualizing Parenting Effects

In this monograph, we took a holistic view of parenting in which we tried to capture the more general environment parents create for socializing their children's skill acquisition and interest development. Considering a range of parental behaviors simultaneously supports theoretical perspectives that emphasize the multifaceted and systems nature of parental behaviors in relation to child outcomes (Eccles, 1993; Epstein, 1995; Furstenberg et al., 1999; Grolnick & Ryan, 1989; Sameroff, 2000). However, in general, the extant literature has tended to include a singular aspect of parenting, such as coactivity or encouragement, or to try to isolate the unique effects of specific behaviors or characteristics. Drawing on the work of Sameroff (2000) and our own previous studies (Fredricks & Eccles, 2005), we adopted a different strategy—one that tries to capture family level variations in the broader system of parenting, which includes parents' beliefs, parents' own role modeling behaviors, and parents' direct attempts to manage their children's experiences. More specifically, we included multiple indicators to reflect the multidimensionality of parenting behaviors and the diverse behaviors that parents exhibit to promote children's pursuit of a domain. We utilized two analytic approaches to addresses the multidimensionality of parental behavior: (a) latent variable approach, which was used in the sports, instrumental music, and math models, and (b) the cumulative promotive approach, which was used in the reading models. Both approaches were useful in understanding parents' behavior. We believe such approaches to the study of family influences fits better with natural ecology of family functioning that do statistical models based on unique, additive effects.

To design better family level interventions, it would be helpful for future studies to pinpoint whether there is an optimal fit between particular patterns of parenting behaviors with particular types of children and whether there are particular qualities of parent–child coactivity or encouragement that should be targeted. It is also important for future researchers to complement our type of inclusive analyses with more micro-level and person-centered analyses. Results on parenting behavior at these various levels will be necessary to develop the most effective parenting interventions. The current results provide insight into the breadth of parenting behaviors. Future research on the fit between parents' behaviors and children would provide insight on for whom certain behaviors would be most effective. Findings on the qualities of the interactions would provide the foundation for what skills to teach parents.

Controlling for Selection Factors Versus Studying Selection as Part of the Complex Socialization Process

Directly related to the issue of the best way to conceptualize and then study parenting and family processes is the issue of conceptualizing and then

studying complex systems over time. There is a major effort in current developmental studies to include increasing numbers of control variables presumably to isolate the "causal influence" of particular experiences or characteristics on particular developmental "outcomes." This effort is considered to be key to social policy recommendations because social policies usually target specific interventions and are usually aimed at universal interventions. Although this may true for social policy recommendations, such strategies may not be appropriate for modeling and understanding the complex course of human development. For example, studies on the role of extracurricular programs often try to control for selection into these programs in order to estimate their causal impact on the acquisition of particular skills or interests. It may be the case that those children most likely to benefit from any particular program are those with the highest levels of motivation to enter and then persist in the program or the highest level of aptitude for the skill being taught. Controlling for such "selection" factors as initial motivation or skill level is very likely to substantially reduce the effect size associated with participating in any specific program. Is this a good thing? Rather than simply controlling for selection factors to isolate program effects, researchers could address the complexity of development by understanding the extent to which the impact of the program might vary based on selection factors.

We certainly used this strategy to test the potential impact of parents' beliefs and behaviors on their children's beliefs and behaviors by controlling for teachers' estimates of the children's natural talent in each domain and for the children's scores on the Slosson intelligence test. We included these controls to better isolate the unique effect of parents' beliefs and behaviors. But this strategy did not allow us to investigate the dynamic nature of associations across time of children's abilities and motivation on their self-selection or parent mandated selection into particular learning contexts with their increasing abilities and changing interests and participation. Looking at the cross-lagged associations between teachers' ratings and parents' beliefs about their children's abilities provided an initial look at these complexities. We encourage future studies that focus less on controlling for selection effects and more on the dynamics or these complex developmental processes and reciprocal pathways.

Broader Implications for Applied Work

The findings of this study also have applied implications. With the exception of instrumental music, during elementary school, the results of our cross-lagged models show that parents are more likely to shape children's motivation than vice versa, and that parents' beliefs about their children are quite stable by early elementary school. These findings suggest that targeting

parents even prior to elementary school will be a more effective method for increasing children's long-term motivation than targeting parents later in the elementary school years. These interventions can educate parents about how they can shape children's beliefs and activity choices by acting as "interpreters of experiences" and providing their children with inputs about their emerging abilities and the value of different skills for their short and long term developmental goals. Interventions could also highlight the multitude of ways parents can influence children's pursuit of domains through opportunities both inside and outside of the home. Especially at younger ages, parents play a primary role in structuring experiences and exposing children to different domains (Furstenberg et al., 1999; Parke et al., 2003). Such an approach to parenting has been labeled family management.

Directly related to age patterns in the role of parents is the possibility that there are optimal times for parents to try to help their children acquire different skills. As we discussed earlier, parents have ideas about when their children should be learning particular skills and these ideas vary across cultures (Harkness & Super, 1996). It is not clear that these ideas are developmentally accurate and thus parents may not be implementing the best developmental strategies. For example, we now know that learning a second language is easiest during the preschool years (Lightbown & Spada, 2006), but many American parents continue to resist sending their children to multilingual preschools and until quite recently, second language learning was not introduced to American children until secondary school. The same may be true for instrumental music and if so then both parents and schools in the United States are missing the optimal learning period for children's engagement in instrumental music. More research is badly needed on determining if and when optimal periods for learning skills are, so that parents and schools can be better informed about when to introduce experiences to children related to acquiring different types of skills.

Our results also demonstrate the important role that early motivational beliefs play in shaping achievement-related choices in high school. Understanding the ontogeny of activity choices is important because of evidence of the long-term benefits of participation in these domains for educational attainment, choice of college majors, occupational status, and well-being (Eccles, 1994; Fredricks & Eccles, 2006). These results suggest that strengthening competence and value beliefs offer a promising means of intervening to encourage greater participation in these domains for both girls and boys. Such interventions might focus on altering youths' beliefs about their ability and educating both girls and boys about the value of participating for their well-being and for their future educational and occupational pursuits. The importance of such a perspective has recently gained recognition in educational and recreational efforts to increase participation of America's children in STEM.

Our findings also have implications for involvement in leisure domains. Many schools have experienced shrinking budgets. One way schools have addressed these budget concerns is to reduce their instruction in subjects that are not core academic subjects, such as music and sports. The lack of opportunities is particularly problematic in music. Few parents in this study reported spending time by themselves or with their children playing musical instruments. Furthermore, music activities often require purchase or rental of instruments. In contrast, families were more likely to participate in athletic activities together. Moreover, some types of physical activities require minimal equipment and skill (e.g., walking, playing Frisbee). These cuts in instrumental music instruction in the school will likely have more profound implications on youths' pursuit of music than of sports, as our data suggest families were less likely to promote music than they are to promote sports.

Finally, our findings also have implications for child health. We are in the midst of a health crisis related to increases in childhood obesity. Our data suggest that families are critical to youths' motivational beliefs and participation in sports. The Let's Move campaign spear-headed by Michelle Obama is an example of a recent campaign designed to promote healthy lifestyles. The advice directed at families to promote youths' physical activity center on several of the key components of our model, including parental encouragement, coactivity, coaching a child's team, and providing athletic opportunities in home (www.letsmove.gov).

Limitations and Future Directions

The results of this study need to be interpreted in light of several methodological decisions. This study was based on a sample of middle-class European American families, whose children were in the early elementary grades in 1987. This sample was explicitly selected to test the processes by which parents influence children's activity choices and motivational beliefs in families where income and neighborhood resources were not obstacles to supporting activity participation. This decision has implications for the generalizability of our findings. It will be important to test whether these findings replicate across families of different socioeconomic, ethnic, cultural, and national groups. We expect that the associations will hold, though the strength in various domains may vary across these groups. For example, the associations between adolescents' beliefs and participation in sports and instrumental music may be weaker in contexts where there are fewer opportunities for adolescents to engage in these activities.

Another concern is that the data were collected from 1987 to 1999. Although we expect that the basic relations would emerge in data today, cultural changes over time might shift the strength of some of the relations. For example, several prominent book series, including the Harry Potter,

Twilight, and Hunger Games, have increased many children's and adolescents' interest in reading. It will be important in the future for researchers to use multiple datasets collected during different historical periods to understand how such shifts in popular culture impact youth.

Over the last decade, there also have been shifts in the gender patterns in some careers and college majors. From 1996 to 2006, there have been increases in the number of women who have earned graduate degrees in almost all areas of STEM (science, technology, engineering, and mathematics; National Science Foundation, 2009). Some STEM areas that were historically dominated by males are experiencing shifts. For example, the percentage of women who earned a bachelor's degree in chemistry rose from 45% in 1997 to 51% in 2006. As noted in ecological theory (Bronfenbrenner & Morris, 2006), it will be important to understand how such societal and cultural shifts alter micro-processes within youth and families.

Similarly, we made decisions about the testing regimen and the cohorts selected. Because our previous work had focused on the adolescent years and the school context, we decided to move to the elementary school years in order to investigate the family influence on the development of children's self and task related beliefs. We also decided that we could only assess the families once per year due to financial and practical limitations. Finally, we could only get initial funding for 5 years. Although we were able to get funding to collect additional data during the high school years, we were unable to get funding to collect data during the middle school years for most of our sample. As we discussed previously, each of these decisions limited what we could model. Clearly given the importance of the middle school period, more research is needed on the role of families during this period of development.

Another limitation in our study is that all information on parenting behaviors and adolescents' achievement-related behavior was collected with self-report methodologies. Although these parental measures have been validated and used in several in other studies (e.g., Eccles, 1993; Eccles et al., 2000; Fredricks & Eccles, 2005; Simpkins et al., 2012), there are concerns about the accuracy of parents' report of behavior, the level of detail that can be collected with self-report methods, and the types of analyses that can be conducted with this type of data (Holden & Edwards, 1989). The items in this study focused on the frequency of behavior, either more generally or in the past year. No information was collected on the quality of parent-child relations or specific details of their interactions, which likely moderate this relation between parental behaviors and youths' beliefs (Grolnick, 2003). In future research, it will be important to use a range of methodological techniques to collect more nuanced data on other parental behaviors to complement these general measures. Observational data can be used to assess a vast array of behaviors, as well as allowing for sequential analysis between parents' behaviors and children's outcomes (Bakeman & Quera, 2012).

Another methodological decision we made that has implications for the generalizability of our findings was to study mothers and fathers in separate analyses so that we could use the full sample of mothers and fathers. This meant that we could not directly test for mother and father differences and that the samples of mothers and fathers are drawn from overlapping, but not equivalent families. In order to test the implications of these decisions on the comparability of our findings, we replicated 20% of our analyses with mother data on the smaller sample of 541 that matched the father sample. In Chapter 4, we had 24 mother models; we reran 6. In Chapters 5 and 6, we had 8 mother models; we reran 2 in each chapter. We stratified the selection of the models by domain, parent construct, and youth construct (e.g., a model predicting self-concept and a model predicting value). Essentially, there were no substantial differences in the findings, suggesting that limiting the mother sample to only those whose husbands had participated would yield similar results but then these results would only generalize to families in which both mothers and fathers agree to participate. We chose to maximize the sample we had for mothers and for fathers at the outset for several reasons. First, we wanted to include as many cases as possible to examine child gender as a moderator. It is harder to document interactions using longitudinal data because we controlled for prior levels of the outcome variable. In contrast, interactions are easier to finding in the lab because of experimental manipulations. Because it is hard to find significant interactions in non-experimental designs, we needed maximum statistical power. Second, the comparison of mothers versus fathers was not our question. We included fathers because one major weakness of the literature on parenting is the limited information on fathers. Thus, we wanted to present our father data as well as our mother data while maximizing the representativeness within each sample.

We also made the decision to run ability self-concepts and task values in separate models due to issues related to multicollinearity and our desire to present findings relevant to both the ability self-concept/efficacy literature and the interest/value literature. However, taking this strategy prevented us from looking at the interaction of ability self-concepts and values in predicting either parents' behaviors (Chapter 4) or the youths' participation in high school (Chapter 7). For example, Marsh and his coworkers have shown that value increases the predictive power of ability self-concepts on subsequent academic achievement (Marsh, Trautwein, Ludtke, Koller, & Baumert, 2005). Similarly, although this has never been tested, parents' valuing of domain might moderate the association of their socialization behaviors with their perceptions of their children's abilities. For example, if the parents place very high value on skills in particular area, they might be particularly likely to engage in remedial behaviors if their child is having difficulty mastering those skills. In contrast, under similar circumstances, they might be more willing to

let their child drop out of a specific skill-based activity domain if they placed low value on that particular skill.

The decision to run the value and ability self-concept models separately also prevented us from testing whether the value parents attach to a particular domain moderates their influence on the ontogeny of their children's beliefs and behaviors. For example, it is possible that children will pay either more or less attention to their parents' socializations attempts if they understand how important a particular skill is to their parents. They might be more compliant and willing to invest their own energies if they both think their parents place high value on a particular skill domain and they have a positive relationship with their parents. Alternative, if their parents become too pushy because they value a particular domain so much, their children's motivation might decline because they are feeling too controlled by their parents (Grolnick, 2003).

One goal of this monograph was to examine whether the relations varied across four domains. These domains varied in academic versus leisure focus and if they were traditionally considered masculine or feminine domains. Inclusion of these four domains provided interesting insights we discussed earlier. However, they do not include all academic and leisure domains. The two academic domains that were included are the two core subjects throughout elementary and secondary school. It is unclear at this point if the relations found with these core academic subjects will generalize to other academic domains that become electives in high school or are not taught throughout early schooling. Science, foreign language, or social studies are examples of these classes. Parent endorsement and support of these classes may differ from math and reading. Furthermore, certain domains, such as science, have been shown to vary by gender (National Science Foundation, 2009). Gender differences may be more pronounced in academic subjects parents view as electives.

Similarly, we only picked two skilled-based leisure activities: sport and instrumental music. We picked sport because it is so pervasive in the US culture. We picked music as a less gender-typed but still skill-based comparison leisure domain. Even within in music, we focused specifically on instrumental music in comparison to other types of music (e.g., choral) to keep the music domain as specific as possible and as similar to sports as possible in terms of the role of organized instruction during the childhood years. Future research is needed on other skill-based leisure activities.

Finally, future research needs to explain parent-child effects across different ages. We found that in elementary school the direction largely went from parent to child. However, it is possible that across development there may be a shift in the relative degree of influence between parent and child. When children are young, parents play a large role in structuring children's experiences by signing them up for activities, co-participating and attending events, and buying them equipment and books to support their involvement.

It is possible that one would find that the lagged effects of children on parents will increase as the children become older and are granted more opportunities to make decisions about how they spend their time (Parke et al., 2003; Savage & Gauvain, 1998). However, it is also possible that as children get older, one would find less child effects on parents because of the waning influence of parents on children and the increasing effects of peers in adolescence. More studies are needed to chart these developmental pathways.

Final Summary

Our goal in this study was to test the central processes theorized in the two Eccles's expectancy-value models (Eccles, 1993; Eccles, Schiefele, & Wigfield, 1998). Although we found that mixed evidence that parents' beliefs predicted changes in their behavior, parents' behaviors predicted changes in youths' beliefs. Finally, youths' beliefs predicted changes in youths' participation. This predictive chain was more prominent in sports and instrumental music than in math and reading. There was also some evidence that youth's beliefs, skills, and participation predicted parents' beliefs and behaviors, as well as that individuals' behaviors predicted their later beliefs. But, these relations also emerged primarily in sports and instrumental music. Our findings on child gender suggest that even though there are some differences between girls and boys, the predictors over time were similar for girls and boys.

MONOGRAPHS OF THE SOCIETY FOR RESEARCH IN CHILD DEVELOPMENT

COMMENTARY

ON "THE ROLE OF PARENTS IN THE ONTOGENY OF ACHIEVEMENT-RELATED MOTIVATION AND BEHAVIORAL CHOICES"

Aletha C. Huston

ABSTRACT This monograph offers a comprehensive test of an important theory of motivation. Because the theory is sufficiently precise to permit disconfirmation, the results that support and those that fail to support it are both informative. The finding that parents' influence appears primarily for peripheral subjects (sports and music), but not for reading and math raises many issues for further research. The study also informs our understanding of gender differences in motivation.

In this monograph, the authors offer a summative test of Eccles's theory of achievement motivation, which is a direct descendent of work by McClelland, Atkinson, and Crandall. McClelland originally proposed a general theory of motivation, which was most extensively applied to achievement (McClelland, Atkinson, & Clark, 1953). Atkinson's expectancy-value model systematized the theory, formulating mathematical propositions that could be tested in the laboratory or at least in controlled settings (Atkinson & Feather, 1966). Both theories received extensive empirical support, but their very simplicity was also a limitation. In particular, they were developed and tested on college men. Women were excluded from the populations sampled because the measure of achievement motivation was found not to be valid for college women.

Crandall and his associates were pioneers investigating the development and socialization of achievement motivation in children (Crandall, Katkovsky, & Preston, 1960). Among the many conclusions from their work, perhaps the

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most important was the recognition that achievement motivation is content-specific. That is, children's motivation for one content domain is relatively independent of their motivation for another.

Eccles's theory builds upon the basic expectancy-value model, extending and elaborating its components, and it also incorporates both content specificity and the possibility of variation by gender. Developmental and socialization processes are melded with the basic expectancy and value constructs providing a clear articulation of the roles of both parents and teachers. The result is more complexity, as evidenced by the models shown in Figures 1a and 1b, but happily, the theory retains the precision that allows strong empirical tests.

In recent years, much of developmental science has taken one of two paths. Along one path are tightly-constructed theories that limit the range of content and processes investigated in order to gain precision and control. The laboratory experiments favored in this approach generate useful knowledge, but their value for understanding social development came under attack in the 1980s and 1990s from people like Bronfenbrenner who once said that our science was the study of children's reactions to strange people in strange (contrived) situations. Along the second path are broadly "ecological" studies without clear predictions or hypotheses. Bronfenbrenner's ecological model, illustrated in his concentric circle model of development (Bronfenbrenner & Morris, 1998), has become a guide for an expanding empirical literature investigating processes of development in complex, real-world environments, but many of these studies lack a clear theoretical foundation. The concentric circles provide a framework, but a model is not a theory. It does not typically lead to hypotheses that can be disconfirmed—a basic requirement of science.

Eccles's theory and research integrate these two paths by retaining a broad ecological approach along with a precisely articulated theory. The work described in this monograph is a good example, demonstrating the value of a guiding theory as well as the limitations of testing it, even with a large-scale longitudinal investigation. As the authors note, their major contributions are testing the theory over a wide age span, including both mothers and fathers, covering four domains of activity, including both concepts of ability and values, testing reciprocal patterns, and assessing gender differences in means as well as moderation by gender. The fact that the results support some predictions, but fail to support others, is a strength allowing refinement of the theory and contributing new knowledge that generates new research questions.

PARENTAL INFLUENCES

The big question in this monograph concerns whether and how parents' beliefs and behaviors affect their children's beliefs and behaviors. According

to the theoretical model, although children may influence parents, the principal direction of effects will be from parent to child. The results for younger children (Waves 2 and 3) support that prediction—children are more apt to increase their own beliefs and participation when their parents think the children have ability and when parents value the activity. The link from parents' beliefs to child beliefs leaves open the question of how parents transmit those beliefs. It seems likely that they convey their beliefs through encouragement and other supportive behavior, which in turn predict children's beliefs (Wave 4). The authors make a plausible case for a reciprocal process running from parent beliefs to parent behavior to child beliefs to child participation. Strangely, however, there is no direct test of parent behavior as a predictor of children's or adolescents' participation, leaving open questions about how the complex processes involved actually operate.

Given the many theoretical and intuitive reasons to assume that parents influence children's achievement, it is striking and surprising that parents have so little influence on academic subjects, especially math. Why? Is it really the case that parents are unimportant influences on their children's beliefs and efforts in core academic subjects? In the case of reading, parents may have conveyed their expectancies and values during the preschool years, so that the child's beliefs in Wave 2 already reflect much of the variation in parents' beliefs. This argument seems less plausible for math. Moreover, some parents begin encouraging their children in sports at an early age, yet the associations of parent beliefs with children's beliefs and participation in sports are strong.

The authors suggest that children get more feedback in school about their skills in reading and math than they do in sports and music. Hence, they may base their expectancies and values on their performance and on feedback from teachers. Whatever the reasons for the discrepancy across content domains, it has important implications for understanding the socialization of achievement motivation and behavior in the academic realm. If not parents, then what are the important influences on children's motivation for reading and math?

The likely importance of parents' behavior (e.g., encouragement, participating in an activity with the child, providing equipment and materials, and coaching) may help to understand the differences in parental influence across content domains. Parents' major contributions to their children's motivation and participation occurred in the nonacademic domains of sports and music. Because these activities are voluntary, they require more active parental involvement than do math and reading. For children to participate in many sports and instrumental music activities, parents often have to find teams and coaches, transport their children to lessons and games, pay for equipment and instruction, and encourage practice at home. By contrast, almost all children go to school, which provides materials, instruction, and

opportunities for practice in reading and math well beyond those that may be supplied by parents.

GENDER DIFFERENCES

Eccles's early work was inspired by questions about the origins of gender differences in achievement, particularly in math (e.g., Eccles, Barber, & Jozefowicz, 1999). Funding for her research was part of a federal initiative to understand why females performed less well in math than males on average, and why they were less likely to take advanced math courses. Although gender differences in performance have diminished or disappeared in recent years (Hyde, 2014), the gender disparity in STEM-related occupations remains, suggesting that motivation rather than ability may be an important determinant of participation.

In the investigation described in this monograph, children manifested sex-stereotyped patterns of expectancy and value in all of the domains assessed. Boys had higher assessments of their abilities and they valued sports and math more than girls did. Conversely, girls' ability beliefs and values in reading and music were greater than those of boys. Parents' beliefs about sports and music differed in a similar pattern for their sons and daughters, but parents did not have differential beliefs about reading and math for their elementary-school-aged children. Because parents were not assessed once children reached adolescence, we do not know whether their beliefs became more differentiated by gender as children got older.

The important question in this investigation is whether parents' beliefs and behavior contributed to gender differences in children's beliefs and behavior. At the most basic level, the mean gender differences for both parents and children are consistent with the possibility of parental influence in sports and music; however, mean differences are a necessary but not sufficient condition for inferring parental influence. There are many other possible explanations, including the idea that both adults and children are influenced by broad sociocultural forces. In fact, children held stereotyped beliefs about math and reading even though their parents did not, suggesting that other socialization influences contributed to children's beliefs.

Going beyond mean differences, the findings show that parents' beliefs and behavior were related to children's beliefs and behavior, at least in sports and music for both boys and girls. That is, within each gender, when parents thought their children had high ability, valued an activity, and offered behavioral supports, children were more apt to believe in their own ability, value an activity, and participate in it. This pattern supports the idea that parental socialization processes operate similarly for boys and girls.

One might lose sight of the gender differences in the study because the primary question in the analyses was whether *processes*, not means, differed for males and females. For example, were parents' expectancies and values more important for one gender than for the other? Did parents' behavior matter more for one than for the other? The answer was a resounding "no." Although these questions are of interest, the fact that gender did not moderate the relations found does not mean that gender was unimportant. In fact, as the authors note, it suggests that changes in gender-stereotyped patterns can come about through similar socialization experiences for males and females.

One major strength of this work is inclusion of both fathers and mothers, particularly because some earlier research demonstrated that fathers may play a particularly important role in socializing achievement motivation. In fact, fathers' beliefs and behavior predicted those of their children more consistently and with higher coefficients than did mothers' beliefs and behavior. There was no evidence, however, that fathers mattered more for their sons than for their daughters, or the reverse.

EXPECTANCY AND VALUE

Eccles's theory, along with its forerunners, distinguishes perception of ability from task values for both parents and children. In previous research, there was some evidence that both constructs predicted children's achievement-related behavior, but some investigations indicated that subjective task value influenced participation choices more than ability perceptions did (Eccles et al., 1999). On the whole, in this study, parents' beliefs about children's ability were better predictors of children's beliefs than were parents' values. Why? The authors suggest that external pressures for advanced placement math and possibly literature clubs might operate because these activities are important for getting into college. The same point might be made about sports, but it seems unlikely that these pressures would be operating for elementary-school-age children. Moreover, students can value an activity as a means of achieving another goal. It seems equally likely that values are less well defined and more difficult to measure accurately, especially at early ages, than are perceptions of ability and estimates of likely success.

TO WHOM DO THESE RESULTS APPLY?

The population represented in this study was deliberately limited; it was predominantly White, middle- to upper-middle class, and lived in one area of the country. The data were collected in the 1980s and 1990s. These limitations

do not diminish the value of the research, but they do raise questions about the extent to which the results would apply to children born a generation later, to a wide range of ethnic and racial groups, and to families living in or near poverty. Given the core assumption that parent and child values and beliefs are culturally conditioned, it is likely that average levels might vary across groups. There might be cultural differences in children's involvement and in parents' expectancies or values for different content domains.

The more interesting question is whether the relations among parent and child beliefs and behavior would be different. For example, might parent expectancies and values matter more or less for children living in poverty or for immigrant families than for those in more affluent or native-born families? Do different kinds of parent behavior convey expectancies and values in different groups? Do parents' expectancies and values have different impacts in different social and cultural contexts (e.g., when children attend schools of different quality or with different populations)? Do parents' beliefs and behaviors matter more when they are in conflict with the surrounding social culture? What is the role of peers for children in different social-cultural contexts? These and many more questions need to be addressed. In short, like all good science, this investigation not only contributes new knowledge, but generates grist for the future research mill.

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CHILD DEVELOPMENT

Child Development, May/June 2015, Volume 86, Number 3, Pages 903–918

Rebels With a Cause? Adolescent Defiance From the Perspective of Reactance Theory and Self-Determination Theory

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The present investigation focused on adolescents' defiance against parents by drawing upon psychological reactance theory (Brehm, 1966) and self-determination theory (Ryan & Deci, 2000). Psychological reactance would be elicited when freedom is taken away, thereby motivating individuals to engage in oppositional behavior. Throughout four studies (total N = 1,472, age ranging between 12 and 21 years), it was examined whether a controlling parenting style related to adolescents' experiences of autonomy need frustration (i.e., pressure) and reactance. Reactance, in turn, would relate to more externalizing and internalizing problems. Support was obtained for these associations in community and clinical samples, making use of different informants, and controlling for responsiveness and rule setting. A vignette-based study provided further support. The discussion highlights theoretical and clinical implications.

Within popular and scientific literature, adolescence is often depicted as a turbulent developmental period for both adolescents and their parents (Steinberg, 2001). Whether we consider the popular troubled teenage character of James Dean in the 1955 movie *Rebel Without a Cause* or the Arctic Monkeys singing about the *Fluorescent Adolescent* years, rebellion and defiance against authority figures are recurrent themes. Also in scientific accounts, adolescents are considered to be at risk for emotional upheaval, engagement in rule-breaking behaviors, and resistance against parental authority (e.g., Arnett, 1999). Across four studies, we investigated why some adolescents defy parental rules and exhibit problem behaviors, thereby focusing on the role of controlling parenting.

Parental control is assumed to be a key aspect of childrearing and an important correlate of adjustment (Barber & Xia, 2013; Steinberg, 2001). However, parental control is a complex concept involving positive and constructive forms, such as behavioral control (Gray & Steinberg, 1999) or firm control (Chao, 1994) as well as negative and detrimental forms, such as psychological control (Barber, 1996) or coercive control (Rothbaum & Weisz, 1994). Hereinafter, the term *controlling* parenting refers to an intrusive, pressuring, and coercive parenting style (i.e., a detrimental form of control), which may involve guilt induction, threats with punishment, and conditional regard (e.g., Barber, 1996; Soenens & Vansteenkiste, 2010). Abundant cross-sectional and longitudinal research has documented the bidirectional associations between controlling parenting and internalizing and externalizing problems among children and adolescents (e.g., Joussemet et al., 2008). Herein, we applied psychological reactance theory (PRT; Brehm, 1966) and self-determination theory (SDT; Ryan & Deci, 2000) to investigate the mechanisms behind this association among middle and late adolescents.

Psychological Reactance Theory

Back in the 1960s, PRT was developed to explain why "forbidden fruits" are often more attractive (Brehm, 1966). According to PRT, prohibitions may elicit psychological reactance, that is, a "motivational state hypothesized to occur when a freedom is eliminated or threatened with elimination" (Brehm & Brehm, 1981, p. 37). Reactance is considered an aversive state, comprising both an emotional component (e.g., feelings of anger) and a cognitive component (e.g., a rejecting attitude toward authority; Rains, 2013). Reactance also entails the behavioral intention to reestablish the threatened freedom

This research was supported by Grant 3F009009 from the Fund for Scientific Research Flanders. We are grateful for the input of Geneviève Mageau, Loes Keijsers, Rachel Campbell, and Samantha Ferguson on earlier versions of the manuscript.

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 0009-3920/2015/8603-0017
DOI: 10.1111/cdev.12355

through the tendency to engage in the forbidden behavior (Brehm, 1966).

Previous research found reactance to be triggered when requests are framed in a pressuring way, such that people experience these requests as a threat to their freedom. For instance, dogmatic language was found to elicit reactance, whereas offering a choice did not (Dillard & Shen, 2005; Grandpre, Alvaro, Burgoon, Miller, & Hall, 2003). Such effects have been documented using explicit attempts to induce pressure, such as forceful language in health messages (e.g., Quick & Stephenson, 2008), but also when pressure was induced in a more subtle way, such as through attention modification tasks (DeWall, Deckman, Maner, & Rouby, 2011) and priming (Chartrand, Dalton, & Fitzsimons, 2007). Furthermore, past research showed that the most apparent consequence of reactance is a "boomerang effect" where people tend to do exactly the opposite of what is requested (e.g., Quick & Stephenson, 2008; Rains, 2013). Although such restorative reactions are meant to regain freedom, they may come at the expense of one's personal preferences (Brehm, 1966).

Although psychological reactance was described initially as a state phenomenon, Brehm and Brehm (1981) added that there are stable individual differences in *reactance proneness*, which represents the dispositional propensity to experience reactance across situations. People high in reactance proneness are more sensitive to threats to their freedom (Chartrand et al., 2007) and react more strongly to influence attempts (e.g., Dillard & Shen, 2005). Reactance proneness would peak in adolescence (Grandpre et al., 2003), which may be due to adolescents' changing beliefs about parents' legitimate authority to impose rules and restrictions (Smetana, 1995).

Given the presumed role of parents in the development of reactance, the question arises whether a specific type of parenting is associated with reactance proneness. An additional reason why reactance warrants study within parent–adolescent relationships is because, at first sight, some propositions derived from PRT seem in contrast with findings from the parenting literature. While within PRT, prohibitions and rules that restrict adolescents' freedom are said to increase the likelihood of engaging in the forbidden behavior, socialization scholars emphasize the importance of parental regulation of undesirable behaviors, as a lack of regulation would be associated with more behavioral problems in adolescence (e.g., Steinberg, 2001). To resolve this seeming paradox, we also relied on SDT (Ryan & Deci, 2000).

Self-Determination Theory

Central to SDT are the basic psychological needs for autonomy, relatedness, and competence. When satisfied, these needs foster growth and psychosocial adjustment. When frustrated, people would display maladjustment and psychopathology (Ryan & Deci, 2000; Vansteenkiste & Ryan, 2013). In the present study, we focus on the need for autonomy, which involves experiencing a sense of volition and psychological freedom in one's actions. When this need is frustrated, people feel pressured to behave, think, or feel in a nondesired way, which is typically accompanied with feelings of internal conflict and alienation from what people truly value (Deci & Ryan, 2000). As predicted by SDT, need frustration has been found to relate to maladjustment and psychopathology among adolescents and adults (e.g., Bartholomew, Ntoumanis, Ryan, Bosch, & Thogersen-Ntoumani, 2011).

Importantly, SDT assumes that the active obstruction of psychological needs would elicit defensive behavior to cope with the experienced need frustration (Deci & Ryan, 2000). Oppositional defiance is one potential coping response, which involves a blunt rejection of authority and a tendency to do the opposite of what is requested (Deci & Ryan, 1985; Skinner & Edge, 2002). Although the aim of oppositional defiance is to cope with need frustration, it typically increases subsequent need frustration (Vansteenkiste & Ryan, 2013). Indeed, oppositional defiance does not imply self-endorsed functioning, because people's actions are not grounded in genuinely valued interests and convictions; instead, their actions are determined by the external rules against which they react (Deci & Ryan, 1985; Skinner & Edge, 2002).

Furthermore, SDT specifies that perceived controlling parenting, in contrast to autonomy-supportive parenting, would be associated with more need frustration among adolescents (Grolnick, 2003; Soenens & Vansteenkiste, 2010). While controlling parents force children to think, act, or feel in prescribed ways, autonomy-supportive parents foster children's sense of volition and psychological freedom (e.g., by offering meaningful choice or by providing a rationale for a request; Grolnick, 2003; Soenens et al., 2007). As research increasingly supports the notion that controlling, relative to autonomy-supportive, parenting relates to need frustration among adolescents (e.g., Ahmad, Vansteenkiste, & Soenens, 2013), controlling parenting is particularly likely to predict oppositional defiance. Indeed, Vansteenkiste, Soenens, Van Petegem, and

Duriez (2014) found that a controlling communication of prohibitions predicted increases in middle adolescents' oppositional defiance against these prohibitions 1 year later.

Thus, SDT and PRT converge on the assumption that a sense of freedom (or autonomy) is important for predicting adaptive outcomes. Indeed, oppositional defiance shows a strong conceptual overlap with reactance, as both are triggered when a person experiences pressure, that is, when one's freedom is threatened (PRT) or when one's need for autonomy is thwarted (SDT). Controlling parenting was therefore hypothesized to relate to more reactance. Moreover, both theories emphasize that reactance manifests in a tendency to reject externally imposed rules. Adolescents high in reactance therefore were expected to engage in undesirable behavior (e.g., externalizing problems). Both theories also predict that reactance may have an emotional cost (as manifested in internalizing problems) because reactance would alienate people from their personal values and preferences (Brehm, 1966; Deci & Ryan, 1985).

Even though the two theoretical frameworks converge on various issues, they seem to diverge regarding the question of whether rules as such trigger reactance. In our view, PRT seems to assume that rule setting in and of itself may hinder autonomy and therefore may be associated with more reactance. In contrast, according to SDT, rule setting is an aspect of parental structure, which refers to parental behaviors and strategies that promote children's competence (Grolnick & Pomerantz, 2009; Soenens & Vansteenkiste, 2010). As structure is largely orthogonal to the degree to which parents are controlling or autonomy supportive, SDT would expect rule setting to be unrelated to need frustration and reactance.

Examining the Robustness and Generalizability of the Proposed Model

Our overall aim was to examine whether controlling parenting relates to more need frustration among adolescents, which would be associated with more reactance toward the parents. Reactance, in turn, would relate to more externalizing and internalizing problems. To examine the robustness of this model, we examined whether the model (a) holds after controlling for parental responsiveness, (b) can be generalized to a sample of referred youth, (c) applies to middle and late adolescents and to boys and girls, and (d) is valid at the trait and state levels.

First, in order to test for the unique role of a controlling parenting style, we controlled for parental responsiveness, which pertains to parents' expressions of warmth and acceptance as well as their responsiveness to children's distress (Davidov & Grusec, 2006). In previous research, parents' responsiveness predicted decreased defiance against parents (e.g., Kochanska, Barry, Aksan, & Boldt, 2008). Many studies have found that responsiveness and controlling parenting are correlated negatively (e.g., Ahmad et al., 2013). Therefore, any association between controlling parenting and defiance may be spurious and accounted for by the variance shared with responsiveness.

Second, we tested whether the model would generalize to a sample of youngsters that are referred for antisocial behavior. Some scholars argue that there are systematic and qualitative differences between clinically referred versus nonclinical youth, not only in the average level of internalizing and externalizing symptoms, but also in the type and strength of association with certain parenting practices (e.g., Deater-Deckard & Dodge, 1997). According to Mason, Cauce, Gonzales, and Hiraga (1996), for instance, the dynamics of parental control may work differently among youth at risk for behavioral problems. These adolescents may benefit from at least moderate levels of parental control, in the sense of both parental rule setting and controlling parenting. In other words, to deal effectively with at-risk youngsters, it is important to be "neither too sweet nor too sour" (Mason et al., 1996, p. 2115). Technically, this hypothesis involves examining curvilinear effects between controlling parenting and outcomes to examine whether moderate levels of controlling parenting are most beneficial (Deater-Deckard & Dodge, 1997).

A third supplementary goal was to explore whether the proposed associations held up for middle and late adolescents and for boys and girls. We expected to find mean-level differences for age and gender, consistent with previous research (e.g., Bongers, Koot, van der Ende, & Verhulst, 2003). However, in spite of these mean-level differences, we expected the structural relations to be similar across age groups and gender.

Fourth, the proposed model was tested not only at the trait level (i.e., at the level of general individual differences in controlling parenting and reactance) but also at the state level. Recent research on personality states has shown that although individuals' trait personality dispositions relate to their personality states in specific situations, the association is far from perfect (e.g., Fleeson, 2007). Also, associations

between certain constructs may differ depending on the level of analysis (i.e., trait vs. state; Beckman, Wood, & Minbashian, 2010). That is, associations obtained at the level of personality traits are not necessarily perfectly equivalent with associations obtained at the level of personality states.

The Present Research

In total, four studies were conducted. Study 1 was an initial test of the proposed associations, making use of adolescent reports only. In Study 2, we relied upon parent reports of parenting style and problem behavior. In Study 3, we tested these associations in a sample of referred youth. Study 4 was a scenario-based experimental investigation to examine whether the model generalized to the state level.

Study 1

Method

Participants and Procedure

Data were gathered in three secondary schools in the Dutch-speaking part of Belgium (Flanders), during a regular class period. Participation was voluntary and confidentiality was guaranteed in all studies. The sample comprised 544 high school students (42% boys) from 9th through 12th grades, ranging in age between 14 and 21 years (M = 16.6). In total, 82% of the participants came from two-parent families. The majority of the students (74%) followed an academic track, with the remaining students following a technical or vocational track. These descriptive statistics match closely with population statistics of Belgian adolescents at this age (Goossens & Luyckx, 2007). Most of the participants came from middle-class families. Missing data (5.97%) were likely missing at random, as Little's (1988) missing completely at random (MCAR) test was nonsignificant (normed χ^2 = 1.59). Hence, as in all subsequent studies, full information maximum likelihood was used.

Measures

Unless mentioned otherwise, participants rated items on a 5-point scale, ranging from 1 (*completely not true*) to 5 (*completely true*), throughout the studies. Reliabilities are presented in Table 1.

Parenting. Adolescents reported about their mothers' and fathers' controlling, relative to autonomy-supportive, parenting style using a combination of two measures. That is, we administered the eight-item Psychological Control Scale-Youth Self Report (YSR; Barber, 1996; e.g., "My mother/father is less friendly to me if I don't see things like she/he does") and the seven-item Autonomy Support subscale of the Perceptions of Parents Scale (Grolnick, Ryan, & Deci, 1991; e.g., "Whenever possible, my mother/father allows me to choose what to do"). As in previous research (Soenens et al., 2007), there was a strong negative correlation between the two scales (r = −.61 for mothers and r = −.69 for

Table 1
Means, Standard Deviations, Reliabilities, and Correlations Among the Variables of Study 1

	1	2	3	4	5	6	7	8	9	10	11
1. Controlling parenting M											
2. Parental rule setting M	.20***										
3. Responsiveness M	−.64***	−.03									
4. Controlling parenting F	.40***	.06	−.26***								
5. Parental rule setting F	.04	.55***	.00	.15**							
6. Responsiveness F	−.29***	−.01	.40***	−.63***	−.01						
7. Need frustration	.57***	.21***	−.48***	.50***	.08	−.41***					
8. Reactance proneness	.43***	.05	−.38***	.39***	.00	−.30***	.51***				
9. Deviant behavior	.13**	−.01	−.15***	.10*	−.10*	−.15**	.09*	.32***			
10. Behavioral misconduct	.31***	−.06	−.27***	.24***	−.15**	−.19***	.33***	.45***	.56***		
11. Age	−.05	−.01	−.05	.00	−.02	−.13**	−.15**	−.15**	−.01	−.11*	
M	2.24	3.84	3.81	2.30	3.79	3.42	2.40	2.57	0.37	2.32	16.56
SD	0.56	0.50	0.73	0.66	0.58	0.85	0.64	0.59	0.31	0.65	1.38
α	.84	.70	.89	.88	.76	.91	.88	.87	.69	.80	NA

Note. M = mother; F = father; NA = not applicable.
*p < .05. **p < .01. ***p < .001.

fathers, ps < .001). Therefore, autonomy-supportive items were reverse coded and averaged with the items tapping into psychological control to obtain a general index of controlling (vs. autonomy-supportive) parenting. In addition, the Parental Expectations for Behavior subscale of the Parental Regulation Scale–YSR (PRS–YSR; Barber, 2002) tapped into mothers' and fathers' rule setting regarding desirable behavior (eight items; e.g., "My mother/father has clear expectations for how I should behave in and outside the home."). We also assessed responsiveness using a seven-item version of Acceptance-Rejection subscale of the Child Report of Parenting Behavior Inventory (Schaefer, 1965). An example item is: "My mother/father gives me a lot of care and attention."

Need frustration. A recently developed questionnaire measured autonomy need frustration (vs. satisfaction), that is, adolescents' experiences of pressure (vs. volition), in the parent–adolescent relationship (Van Petegem, Vansteenkiste, & Beyers, 2013). The scale consists of 10 items (e.g., "When I'm with my parents, I rarely have the feeling I can be myself"). Extensive validity information has been provided by Van Petegem et al. (2013).

Reactance proneness. Adolescents' reactance proneness toward the parents was assessed through a slightly adapted version of the 14-item Hong Psychological Reactance Scale (Hong & Faedda, 1996). Given that the scale taps into people's global propensity to experience reactance, items were reformulated to the parent–adolescent context (e.g., "Regulations of my parents trigger a sense of resistance in me"; see Van Petegem et al., 2013).

Behavioral problems. Two different indicators of behavioral problems were assessed. First, the Deviant Behavior Scale (Weinmann, 1992) assessed adolescents' norm-breaking behavior (10 items; e.g., stealing, involved in fighting) during the past 6 months and is rated on a frequency scale, ranging from 0 (*never*) to 3 (*frequently*). Second, the Behavioral Conduct subscale of Harter's Self-Perception Profile for Adolescents (five items; Harter, 1988; Wichstrom, 1995) taps into adolescents' behavioral conduct. This scale was reverse scored, such that higher scores reflect behavioral misconduct.

Results and Discussion

Preliminary Analyses

Descriptive statistics and correlations are presented in Table 1. Age correlated negatively with perceived paternal responsiveness, need frustration, reactance, and behavioral conduct. Next, a multivariate analysis of variance (MANOVA), including gender and family structure as fixed factors, yielded significant multivariate results for gender, $F(10, 529) = 4.72$, $p < .001$, $\eta^2 = .08$, and family structure, $F(10, 529) = 2.91$, $p < .01$, $\eta^2 = .05$. Girls scored higher on maternal, $F(1, 538) = 5.13$, $p < .05$, $\eta^2 = .01$ ($M = 3.87$ vs. $M = 3.72$ for girls vs. boys), and paternal responsiveness, $F(1, 538) = 10.60$, $p < .01$, $\eta^2 = .02$ ($M = 3.43$ vs. $M = 3.20$), whereas boys scored higher on need frustration, $F(1, 538) = 8.84$, $p < .01$, $\eta^2 = .02$ ($M = 2.32$ vs. $M = 2.48$ for girls vs. boys); behavioral misconduct, $F(1, 538) = 8.14$, $p < .01$, $\eta^2 = .02$ ($M = 2.32$ vs. $M = 2.47$); and deviant behavior, $F(1, 538) = 27.12$, $p < .001$, $\eta^2 = .05$ ($M = .36$ vs. $M = .50$). Furthermore, adolescents from intact families scored higher on paternal responsiveness, $F(1, 538) = 6.71$, $p < .05$, $\eta^2 = .01$ ($M = 3.44$ vs. $M = 3.20$ for intact vs. nonintact families), and lower on behavioral misconduct, $F(1, 538) = 5.85$, $p < .05$, $\eta^2 = .01$ ($M = 2.31$ vs. $M = 2.48$), and deviant behavior, $F(1, 538) = 15.04$, $p < .001$, $\eta^2 = .03$ ($M = .36$ vs. $M = .50$).

Primary Analyses

We used structural equation modeling (SEM) to test our hypothesized model, using robust maximum likelihood estimation in Mplus 7.00 (Muthén & Muthén, 2012). Each study variable was modeled as a latent variable represented by three parcels, created through a random selection of items. Behavioral problems was modeled as a higher order factor indicated by behavioral misconduct and deviant behavior. Model fit was evaluated based on the combined cutoff of .06 for the root mean square error of approximation (RMSEA) and .08 for the standardized root mean square residual (SRMR). In addition, a comparative fit index (CFI) of .95 or higher indicates a good fit (Marsh, Hau, & Wen, 2004). Analyses were performed separately for maternal and paternal ratings.

The estimated measurement model yielded a good fit for the mother and father models, χ^2s(172) = 282.32 and 290.92, ps < .001, CFIs = .98 and .98, RMSEAs = .03 and .04, SRMRs = .04 and .04. The structural models are shown in Figure 1. Perceived maternal controlling parenting related to more need frustration after taking into account the role of maternal responsiveness and maternal rule settings, which yielded, respectively, a negative and a null relation with need frustration. In the father model, only perceived paternal controlling parenting related to more need frustration.

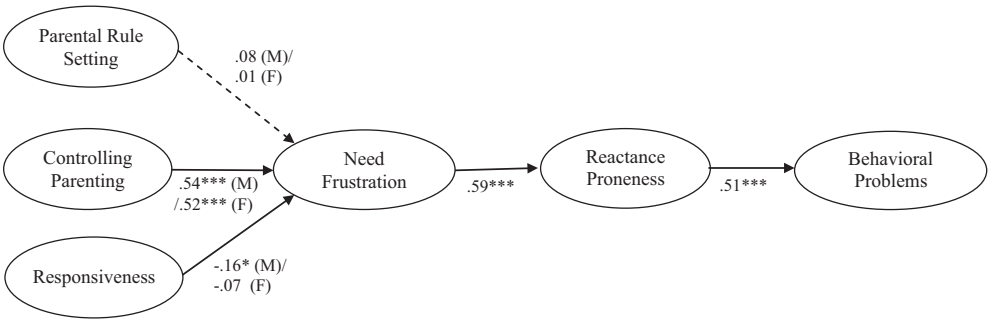

Figure 1. Structural equation model for Study 1, $\chi^2(179) = 310.67$, $p < .001$, comparative fit index (CFI) = .98, root mean square error of approximation (RMSEA) = .04, standardized root mean square residual (SRMR) = .05 for the mother model; $\chi^2(179) = 317.60$, $p < .001$, CFI = .98, RMSEA = .04, SRMR = .05 for the father model. M = mother, F = father. For clarity reasons, correlations between variables at the same level are not reported.
*$p < .05$. ***$p < .001$.

Furthermore, need frustration related to reactance proneness, which in turn related to more behavioral problems. Associations between perceived parenting and need frustration were not significantly different for mothers versus fathers (*z* values ranging between −1.93 and 1.72, *p*s > .05). Moreover, both paternal and maternal controlling parenting yielded significant indirect effects through the intervening variables (i.e., need frustration and reactance) on behavioral problems (*b*s = .16, $p < .001$ for both models).

Next, we tested the moderating roles of gender and age (i.e., middle vs. late adolescence) through multigroup comparison. As recommended (e.g., Dimitrov, 2010), we first tested for metric invariance across groups through multigroup confirmatory factor analysis by comparing the fit of a constrained model (where factor loadings are fixed across groups) with the fit of an unconstrained model (where factor loadings are allowed to vary across groups). Then, we tested for structural equivalence by comparing a constrained model (with all structural paths set equal across groups) with an unconstrained model (with all paths set free). As indicators of model invariance, we examined the chi-square difference ($\Delta\chi^2$), which should be nonsignificant, and the CFI difference (ΔCFI), which should be lower than .01 (e.g., Dimitrov, 2010).

After splitting the sample into a group of middle (14–16 years) and late (17–21 years) adolescents, metric invariance, $\Delta\chi^2(14) = 20.46$, *ns*, ΔCFI = .001 for the mother model, and $\Delta\chi^2(14) = 15.81$, *ns*, ΔCFI = .000 for the father model, and structural equivalence was obtained, $\Delta\chi^2(6) = 2.06$, *ns*, ΔCFI = .000 for the mother model, and $\Delta\chi^2(6) < 1$, *ns*, ΔCFI = .001 for the father model. Thus, the uncovered factor structure and structural associations were equivalent for middle and late adolescents. As for gender, both the measurement model, $\Delta\chi^2(14) = 15.48$, *ns*, ΔCFI = .001 for the maternal ratings and $\Delta\chi^2(14) = 11.08$, *ns*, ΔCFI = .000 for the paternal ratings, and the structural model, $\Delta\chi^2(6) = 3.39$, *ns*, ΔCFI = .000 for the mother model and $\Delta\chi^2(6) < 1$, *ns*, ΔCFI = .001 for the father model, were found to be equivalent as well.

Summary

Study 1 provided initial evidence for the validity of our proposed model, as adolescents who perceive their parents as controlling experienced more need frustration (i.e., pressure) in the parent–child relationship. Need frustration, in turn, related to more reactance proneness, which was related to adolescents' susceptibility for engaging in behavioral problems. The model held up across adolescents' ratings of both parents' rearing styles, across boys and girls and middle and late adolescents, as well as after controlling for perceived parental responsiveness and rule setting. Rule setting as such was unrelated to need frustration.

Study 2

Given the exclusive reliance on adolescent reports in Study 1, Study 2 made use of a multi-informant assessment, with adolescents reporting on need frustration and reactance, and mothers reporting on their parenting style and on children's maladjustment. We also examined whether reactance would come with an adjustment cost, as indexed by internalizing problems.

Method

Participants and Procedure

The sample comprised 596 adolescents and 591 mothers. Data were gathered in the context of a course on developmental psychology. Trained undergraduate students visited the families at home to administer the questionnaires. An informed consent was signed by the adolescent and the parents. Adolescents ranged in age between 12 and 19 years (M = 15.8; 57% girls). Participants followed either an academic (66%), technical (24%), vocational (6%), or arts (3%) track. Most participants were of Belgian nationality (97%) and 81% of the adolescents came from intact families. Mothers' age ranged between 32 and 59 years (M = 45.7). As for educational level, 34.5% of the mothers completed secondary education, 45.7% had a bachelor's degree, and 18.1% had a master's degree. Almost no data (0.8%) were missing; the MCAR test (normed χ^2 = 1.70) was nonsignificant.

Measures

The need frustration and reactance scales were filled out by the adolescents and were identical to Study 1. Table 2 contains reliability information.

Parenting. Mothers rated their own parenting style toward the participating adolescent. The same scales as in Study 1 were used to assess controlling parenting and responsiveness, but the items were adapted to parent report (e.g., "I give my son/daughter a lot of care and attention"). As indicators of parental rule setting, we used the Parental Expectations subscale of the PRS–YSR again, combined with the Parental Monitoring subscale (eight items; e.g., "I ask my son/daughter questions about how he/she behaves outside the home"; Barber, 2002), as both subscales correlated strongly (r = .60, p < .001).

Internalizing and externalizing problems. Through the Child Behavior Checklist (CBCL; Achenbach & Rescorla, 2001), mothers reported on their youngsters' internalizing (e.g., anxious/depressed symptoms; 31 items) and externalizing (e.g., rule-breaking behavior; 41 items) problems. Items were rated on a scale from 0 (*not at all*) to 2 (*very much*).

Results and Discussion

Preliminary Analyses

Table 2 presents descriptive statistics and correlations. Adolescents' age correlated negatively with responsiveness and positively with internalizing problems. A MANOVA with gender and family structure as independent variables provided evidence for multivariate effects of gender, $F(7, 575) = 4.35$, $p < .001$, $\eta^2 = .05$, and family structure, $F(7, 575) = 3.27$, $p < .01$, $\eta^2 = .04$. As for gender, boys scored higher on reactance proneness, $F(1, 581) = 19.58$, $p < .001$, $\eta^2 = .03$ (M = 2.37 vs. M = 2.60 for girls vs. boys); need frustration, $F(1, 581) = 14.45$, $p < .001$, $\eta^2 = .02$ (M = 2.18 vs. M = 2.36); and externalizing symptoms, $F(1, 581) = 9.45$, $p < .01$, $\eta^2 = .02$ (M = .20 vs. M = .25). As for family structure, nondivorced mothers reported more rule setting, $F(1, 581) = 5.31$, $p < .05$,

Table 2
Means, Standard Deviations, Reliabilities, and Correlations Among the Variables of Study 2 (Top Half) and Study 3 (Bottom Half)

	1	2	3	4	5	6	7	8
M	2.13	4.02	4.30	2.24	2.44	0.25	0.20	15.77
SD	0.43	0.44	0.48	0.58	0.65	0.20	0.20	1.22
α	.73	.78	.80	.86	.89	.86	.92	NA
1. Controlling parenting	—	−.01	−.36***	.33***	.24***	.16***	.32***	−.05
2. Parental rule setting	−.18	—	.25***	.08†	.09*	.01	.07	−.06
3. Responsiveness	−.44**	.62***	—	−.24***	−.23***	−.13**	−.24***	−.09*
4. Need frustration	.64***	−.22	−.46**	—	.49***	.11**	.26***	−.06
5. Reactance proneness	.52***	.03	−.30†	.51**	—	.18***	.39***	−.04
6. Internalizing symptoms	.27†	.15	−.03	.22	.38*	—	.45***	.09*
7. Externalizing symptoms	.35*	.26†	.15	.28†	.47**	.66***	—	−.03
8. Age	.13	−.18	−.16	.03	.17	−.01	.27†	—
M	2.55	3.57	3.81	2.40	2.38	0.53	0.74	16.28
SD	0.66	0.58	0.93	0.78	0.97	0.35	0.33	0.99
α	.81	.78	.88	.69	.81	.92	.90	NA

Note. NA = not applicable.
†p < .10. *p < .05. **p < .01. ***p < .001.

η^2 = .01 (M = 4.05 vs. M = 3.94), and adolescents from intact families reported less externalizing problems, $F(1, 581) = 11.13$, $p < .01$, $\eta^2 = .02$ (M = .19 vs. M = .26).

Primary Analyses

As in Study 1, main analyses were performed with SEM. The measurement model yielded a good fit, $\chi^2(168) = 424.72$, $p < .001$, CFI = .94, RMSEA = .05, SRMR = .05. The results of the structural model are presented in Figure 2. As in Study 1, mother-reported controlling parenting and responsiveness related, respectively, positively and negatively to adolescents' reports of need frustration. Different from Study 1, mother-reported rule setting related to more need frustration. Furthermore, need frustration related to reactance proneness, which in turn related positively to mother-reported ratings of externalizing and internalizing problems. Controlling parenting yielded a significant indirect effect via need frustration and reactance on internalizing (b = .04, $p < .01$) and externalizing (b = .09, $p < .001$) problems. Finally, we tested moderation by age group and gender using the same procedure as in Study 1. For age group, we contrasted early and middle adolescents (12–16 years) with late adolescents (17–19 years). As in Study 1, we found evidence for metric invariance, $\Delta\chi^2(14) = 5.10$, *ns*, ΔCFI = .002, and structural equivalence, $\Delta\chi^2(6) < 1$, *ns*, ΔCFI = .001, across age groups. As for gender, both metric, $\Delta\chi^2(14) = 9.86$, *ns*, ΔCFI = .001, and structural invariance, $\Delta\chi^2(6) = 4.11$, *ns*, ΔCFI = .001, were obtained as well. Thus, the model presented in Figure 2 held up for middle and late adolescents and for boys and girls.

Summary

The present results replicate the findings of Study 1, this time using mother reports of parenting and adjustment. If mothers reported relying on a more controlling parenting style, their adolescents reported experiencing more need frustration and reactance proneness, which in turn related to more adolescent externalizing and internalizing problems as reported by their mothers. Different from Study 1, mother-reported rule setting predicted more experienced need frustration, which may be due to the use of different informants in the two studies. A supplementary analysis confirmed this interpretation, as the inclusion of adolescent reports on parenting in Study 2 provided the opportunity to further explore this issue. The obtained results were very similar to the findings of Study 1, with adolescent-reported controlling parenting relating to more experienced need frustration (b = .70, $p < .001$). The degree of rule setting was unrelated (b = .02, *ns*) and responsiveness was associated slightly negatively to need frustration (b = −.15, $p < .05$). It seems, then, that differences between Studies 1 and 2 indeed were due to the different informant used to measure parenting (rather than specific sample characteristics).

Study 3

As the generalizability of Study 1 and 2 is limited to community families, the goal of Study 3 was to

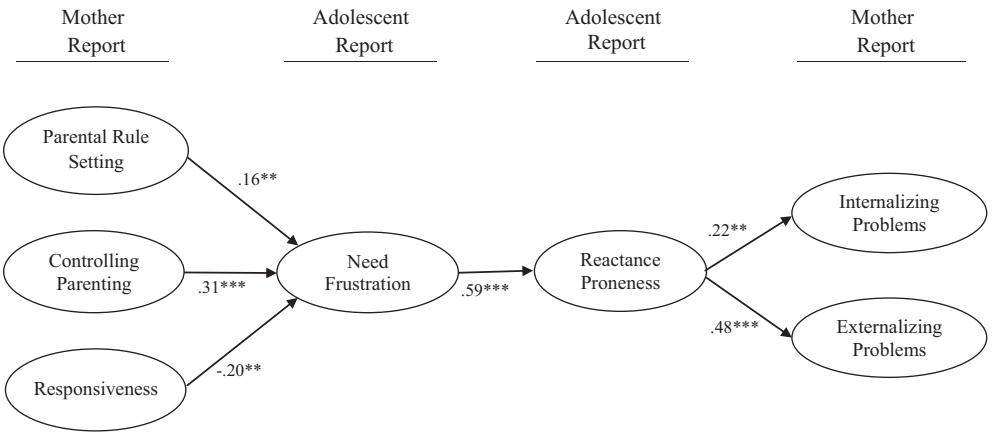

Figure 2. Structural equation model for Study 2, $\chi^2(179) = 479.97$, $p < .001$, comparative fit index = .93, root mean square error of approximation = .05, standardized root mean square residual = .07. For clarity reasons, correlations between variables at the same level are not reported.
**$p < .01$. ***$p < .001$.

test whether the proposed model would hold in a clinical sample of youngsters referred for antisocial behavior. Based on the work of Mason et al. (1996), one could expect that a moderate amount of perceived parental rule setting and controlling parenting would yield the most beneficial outcomes among at-risk youngsters. On the basis of SDT, however, one could expect the same direction and strength of associations as in Study 1 and 2 because perceived controlling parenting would be universally detrimental (Ryan & Deci, 2000). Therefore, we examined linear and curvilinear relations between parenting and need frustration and reactance. As in Studies 1 and 2, we controlled for responsiveness and rule setting.

Method

Participants and Procedure

Participants were recruited in two residential mental health care centers in the Dutch-speaking part of Belgium, to which male adolescents are referred for behavioral problems. Although 46 adolescent boys initially participated, 3 cases were dropped because of low-quality responses. In the final sample (N = 43; age range = 13–18 years, M = 16.3), 1 participant followed an academic track, 2 followed a technical track, and the other 40 youngsters followed a vocational track. Furthermore, 15 adolescents (34.9%) reported coming from intact two-parent families, 26 adolescents (60.5%) had divorced parents, and in 2 cases (4.7%) one of the parents had deceased. Questionnaires were administered individually in the presence of a research collaborator. Informed consent was obtained from adolescents and their parents. The few missing data (1.1%) were missing at random (normed χ^2 = 1.66, *ns*).

Measures

Reliability information is presented in Table 2. Perceived parenting was measured through the same questionnaires as in Study 2.

Psychological need frustration. Experienced need frustration in the mother–adolescent relationship was assessed using a five-item questionnaire (e.g., "When I'm with my mother, I feel free to be who I am," reverse coded), which was based upon a well-validated autonomy need satisfaction questionnaire for close relationships (La Guardia, Ryan, Couchman, & Deci, 2000).

Reactance proneness. Adolescents' reactance proneness was measured through a recently developed measure of Oppositional Defiance (Vansteenkiste et al., 2014). This four-item scale (e.g., "I do exactly the opposite of what my mother expects me to do") correlates highly with the reactance proneness measure of Studies 1 and 2 (rs > .70; Van Petegem et al., 2013).

Internalizing and externalizing problems. Participants filled out the YSR (Achenbach & Rescorla, 2001), which is the adolescent self-report version of the CBCL used in Study 2, to assess internalizing and externalizing problems. Adolescents answered items on a scale ranging from 0 (*not at all*) to 2 (*very much*).

Results and Discussion

Preliminary Analyses

Descriptive statistics and correlations are presented in Table 2. A MANOVA indicated no mean-level differences between intact versus nonintact families, $F(5, 35) < 1$, *ns*. Furthermore, age correlated only marginally positively with externalizing problems.

Primary Analyses

The small sample size precluded us from performing SEM with latent variables. Hence, we tested our integrated model through path analysis with manifest variables. The model fit the data well, $\chi^2(39) = 46.96$, *ns*, CFI = .96. The values of the RMSEA and SRMR fit indices were rather high (.07 and .10, respectively). However, these fit indices tend to be strongly biased when the sample size is small and therefore it is recommended not to take these into account (e.g., Kenny, Kaniskan, & McCoach, 2014). The path model is presented in Figure 3. As in Studies 1 and 2, perceived controlling parenting related uniquely to need frustration. Need frustration related to reactance proneness, which in turn related to both internalizing and externalizing problems. Additionally, controlling parenting was associated indirectly with internalizing (b = .12, $p < .01$) and externalizing (b = .15, $p < .05$) problems through the intervening variables. Finally, curvilinear associations between the parenting variables and each of the other variables were nonsignificant (t values ranging between −.07 and 1.81, *ns*).

Summary

The findings of Study 3 indicate that our obtained associations generalize to a sample of

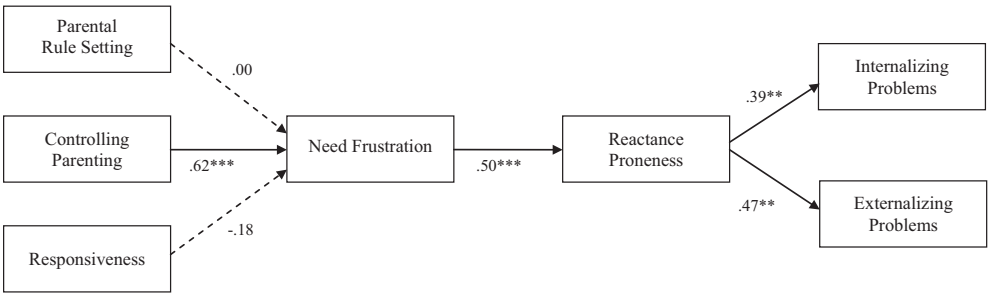

Figure 3. Path model for Study 3. For clarity reasons, correlations between variables at the same level are not reported. $^{**}p < .01$. $^{***}p < .001$.

clinically referred male youth. Clinically referred youth who perceive their parents as controlling reported more need frustration, which in turn was related to reactance proneness and subsequent externalizing and internalizing problems. Neither perceived responsiveness nor limit setting related to need frustration. Interestingly, there were no curvilinear associations between these parenting dimensions and any of the other variables, which contradicts the assumption that at-risk youth would benefit most from moderate levels of rule setting or controlling parenting (Mason et al., 1996).

Study 4

The first three studies focused on parenting and reactance at a general level. Yet, adolescents can also display reactance in more circumscribed situations in which they feel pressured by their parents. Therefore, in Study 4, we provided participants a hypothetical vignette in which parents formulated a specific request, using either a controlling, neutral, or autonomy-supportive style. We hypothesized that a controlling vignette would elicit more state reactance among adolescents, and that need frustration would explain why a controlling request elicits state reactance. State reactance, in turn, was expected to relate to adolescents' intention to engage in the undesirable behavior (i.e., studying less on a next occasion), which would be reflective of their tendency to oppose and reject the parental request.

In addition, we investigated the role of trait differences in reactance proneness in the parent–child relationship, thereby examining whether adolescents high on trait reactance proneness would display more need frustration and state reactance in the specific situation (i.e., a main effect of reactance proneness) and/or whether they would be more susceptible to the controlling induction. Specifically, adolescents high on trait reactance might display elevated levels of need frustration state reactance, particularly in response to the controlling vignette (i.e., an interaction effect; e.g., Dillard & Shen, 2005).

Method

Participants and Procedure

Participants were 289 adolescents, ranging in age between 13 and 19 years (M = 15.8 years; 51.2% girls). Almost all participants (96.8%) were of Belgian nationality. Most of the participants came from two-parent families (82.5%). Furthermore, 67.5%, 23.7%, 5.3%, and 2.5% of the participants followed, respectively, an academic, technical, vocational, and arts track. As in Study 2, trained undergraduate students visited adolescents at home. An informed consent was signed by the adolescents and the parents. During that meeting, participants provided background information and filled out a first set of questionnaires (including a measure of trait reactance proneness). A few days later, the students visited the same family again for the state questionnaires. Adolescents first read the description of a specific situation (i.e., coming home with bad grades) followed by a hypothetical maternal reaction to the situation, that is, the mother requesting the child to study more. The maternal reaction was either controlling, neutral, or autonomy supportive. After reading the vignette, participants filled out a number of state questionnaires. Appendix S1 in the online Supporting Information contains a description of the vignettes as well as information on the development and validity of the material. Participants were assigned randomly to the controlling (n = 97), autonomy-supportive (n = 93), or neutral (n = 99) condition.

Only 0.3% of the data were missing; the MCAR test was not significant (normed $\chi^2 < 1$).

Measures

Before filling out the vignette-based questionnaires, trait reactance proneness was assessed in the same way as in Studies 1 and 2. Reliabilities are presented in Table 3.

State need frustration. The degree of anticipated need frustration in the specific situation was assessed through a subscale of a recently developed need questionnaire (Chen et al., 2014). The subscale has eight items, tapping into the frustration (vs. satisfaction) of one's need for autonomy. We adapted the items such that they refer to the specific situation (e.g., "If my mother would react like this, I would feel forced to do things I wouldn't choose to do").

State reactance. We assessed state reactance toward the request, thereby making use of the previously described four-item measure of oppositional defiance (Vansteenkiste et al., 2014). The items were also adjusted such that they referred to the specific request (e.g., "I would rebel against the request of my mother").

Intention to study. We assessed adolescents' intention to study more on a next occasion with three items, that is, whether they would be inclined to study more, to study differently, and to study more thoroughly. The item tapping into adolescents' intention to study more correlated highly with the item about thoroughness ($r = .61$, $p < .001$). Hence, these items were averaged.

Results and Discussion

Preliminary Analyses

Descriptive statistics and correlations can be found in Table 3. A MANOVA yielded no significant effects for gender, $F(5, 273) = 2.04$, *ns*, or family structure, $F(5, 273) = 2.02$, *ns*. Correlations with age were not significant either.

Primary Analyses

A MANOVA indicated that condition yielded a multivariate effect on the study variables, $F(8, 564) = 20.99$, $p < .001$, $\eta^2 = .23$. Subsequent univariate analyses showed significant mean-level differences in need frustration and state reactance, with participants in the controlling condition scoring highest and those in the autonomy-supportive condition scoring lowest (see Table 3). No significant differences emerged for intention to study.

Next, SEM was used to test the proposed model, thereby also testing for the role of reactance proneness by adding paths of reactance proneness to each of the state variables. As for condition, two dummy variables were created, one comparing the controlling condition with the neutral condition and another one comparing the autonomy-supportive condition with the neutral condition. The measurement model fit the data well, $\chi^2(24) = 54.69$, $p < .001$, CFI = .97, RMSEA = .07, SRMR = .04. The structural model is presented in Figure 4. In line with the MANOVA findings, the dummies representing the controlling and autonomy-supportive

Table 3
Means, Standard Deviations, Condition Differences, Reliabilities, and Correlations Among the Manifest Variables of Study 4

	Overall *M*	*SD*	α	AS condition	Neutral condition	Controlling condition	*F*(2, 285)	η^2	1	2	3	4
1. Trait reactance proneness	2.50	0.64	.89	2.51	2.43	2.54	0.77	0.00				
2. State need frustration	3.00	0.82	.90	2.48_a	2.83_b	3.69_c	89.75***	0.39	0.12*			
3. State reactance	1.94	0.79	.84	1.87_a	1.73_a	2.22_b	10.95***	0.07	0.39***	0.35***		
4. Intention to study more	2.99	1.04	.76	3.04	3.00	2.90	0.50	0.00	−0.07	−0.16**	−0.20**	
5. Intention to study differently	3.76	0.70	NA	3.80	3.76	3.73	0.20	0.00	−0.12*	−0.11	−0.32***	0.37***

Note. Scores with a different subscript differ significantly, based on Tukey's post hoc test ($p < .05$). AS = autonomy-supportive; NA = not applicable.
*$p < .05$. **$p < .01$. ***$p < .001$.

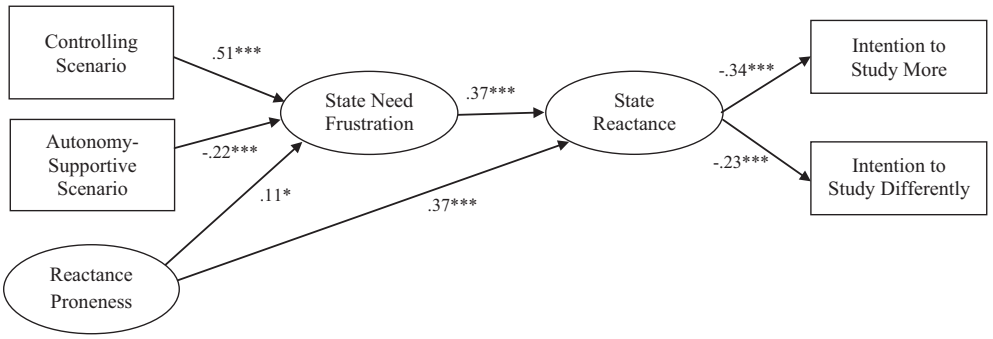

Figure 4. Structural equation model for Study 4, $\chi^2(58) = 106.62$, $p < .001$, comparative fit index = .97, root mean square error of approximation = .05, standardized root mean square residual = .04. For clarity reasons, correlations between variables at the same level are not reported.
*$p < .05$. ***$p < .001$.

vignettes were associated positively and negatively, respectively, with state need frustration. Need frustration predicted more state reactance, which in turn related negatively to the study intention variables. Furthermore, trait reactance proneness related to more state need frustration and more state reactance. Indirect effects were found for the controlling condition on intention to study more ($b = -.06$, $p < .01$) and differently ($b = -.04$, $p < .01$) through the intervening variables. This was also the case for the effects of the autonomy-supportive condition ($b = .03$, $p < .01$ for studying more; $b = .02$, $p < .01$ for studying differently). Adolescents' reactance proneness also had an indirect effect on study intention ($b = -.14$, $p < .001$ for studying more; $b = -.10$, $p < .01$ for studying differently).

Then, we performed a number of supplementary analyses. First, we examined the moderating role of reactance proneness by examining the interactions with each of the predictors in the structural paths. None of the interactions were significant (t values ranging between -1.73 and 1.83, all *ns*). Also, multigroup comparisons indicated that findings were similar for middle (13–16 years) and late (17–19 years) adolescents and for boys and girls, as we found metric invariance, $\Delta\chi^2(6) = 4.52$, *ns*, ΔCFI = .001 for age group, and $\Delta\chi^2(6) = 9.70$, *ns*, ΔCFI = .002 for gender; and structural equivalence, $\Delta\chi^2(7) = 3.93$, *ns*, ΔCFI = .002 for age group, and $\Delta\chi^2(7) = 12.03$, *ns*, ΔCFI = .003 for gender, across groups.

Summary

Study 4 replicated our obtained findings using a vignette-based manipulation. Specifically, when adolescents were confronted with a hypothetical controlling request, they anticipated more experienced need frustration and state reactance. As expected, state reactance was related to an inclination to do the opposite of what was requested in the scenario, that is, a lower intention to invest in studying. Furthermore, we found main effects of trait reactance proneness on state need frustration and reactance, supporting the idea that adolescents with a reactant orientation are sensitive to pressure and more easily interpret any kind of parental request (irrespective of how it is communicated) as a threat to their autonomy, and are more quickly inclined to defy to any request (e.g., Grandpre et al., 2003).

General Discussion

The goal of the present set of studies was to gain a better understanding of the relation between controlling parenting and reactance in adolescents. We found that children of parents who use a controlling style were more likely to experience autonomy need frustration and reactance in the parent–child relationship. The degree to which adolescents experienced reactance, in turn, predicted several problematic outcomes, including externalizing and internalizing problems and noncompliance with parental requests. These findings were obtained across gender, in middle and late adolescents, across informants, across community, and across clinical samples, after controlling for other parenting dimensions, and at the trait and state levels.

Overview of the Findings and Implications

Supporting SDT (e.g., Grolnick & Pomerantz, 2009; Soenens & Vansteenkiste, 2010), the present research consistently found controlling parenting to

be related to adolescents' experiences of pressure in the relationship with their parents. These findings were obtained using adolescent reports (Study 1), mother reports (Study 2), in a sample of clinically referred youth (Study 3), as well as through objective descriptions of parental behaviors (Study 4). Moreover, we found support for the claim made in PRT and SDT that experiences of pressure relate to reactance in adolescents. Hence, the present investigation adds to the limited research applying PRT in a socialization context, as well as to the emerging body of SDT-based research on oppositional defiance (Skinner & Edge, 2002; Vansteenkiste & Ryan, 2013).

Interestingly, these associations were not significantly different for middle versus late adolescents, nor for boys and girls. Although adolescents' conceptions of legitimate parental authority change as they grow older (Smetana, 1995), we found that controlling parenting was related to need frustration and reactance similarly across age groups and gender. These findings do not preclude the possibility, however, that the content of the parental requests that elicit reactance differ by age or gender. Therefore, future research should investigate whether the current findings generalize across domains of social knowledge. Parents' rules about personal issues, for instance, may be experienced as more need frustrating and reactance triggering, as compared to rules about moral issues (cf. Kakihara & Tilton-Weaver, 2009; Smetana, 1995).

Although PRT and SDT share many assumptions about the nature and correlates of reactance, one conceptual issue that may be especially enriching for PRT-based research is SDT's differentiated approach toward the concepts of autonomy and freedom (Ryan & Lynch, 1989). Given that PRT is "a theory of freedom and control" (Brehm & Brehm, 1981; title), this is an important issue, especially as for the question of whether reactance yields freedom and autonomy. When autonomy is defined as independence (i.e., the degree to which one avoids relying on the advice and rules of others), reactance may yield more autonomy and *absolute* freedom (i.e., freedom from external constraints). Yet, when autonomy is defined as volitional functioning (i.e., when actions are grounded in personally endorsed values and interests; Ryan & Deci, 2000), reactance may come with an ironic cost in terms of a reduced sense of *psychological* freedom and volition because one's actions are primarily determined by the external rules against which one reacts (Skinner & Edge, 2002). Consistent with this claim, we found a systematic association of reactance not only with externalizing problems but also with internalizing problems, with the latter possibly signaling a sense of alienation from genuinely valued goals and interests.

The distinction between independence and volitional functioning is also crucial for understanding under which conditions rules and prohibitions relate to reactance (Vansteenkiste et al., 2014). As suggested by the present findings, restrictions of one's independence are not necessarily associated with more reactance. Indeed, perceived parental rule setting, which involves a limitation of adolescents' independence, was largely unrelated to adolescents' experiences of need frustration or reactance. Only when parents are perceived as threatening their volitional functioning (e.g., through the use of pressuring language), do experiences of need frustration and subsequent reactance seem to arise. Indeed, adolescents may feel volitional even when they follow parental rules and regulations (Vansteenkiste et al., 2014).

There was one notable exception to the overall pattern of nonsignificant associations between parental rule setting and need frustration: Mother-reported rule setting was associated with more need frustration and reactance in Study 2. Although this association is consistent with PRT, it was somewhat surprising from an SDT perspective, as rule setting is an element of structure, and SDT postulates that it would foster feelings of competence (e.g., Grolnick & Pomerantz, 2009). Possibly, when mothers reported that they were high on rule setting, this was not necessarily experienced as structuring and as supporting adolescents' needs. Together, the findings point to the importance of obtaining information from different sources as there may be differences between what parents actually do, what parents report, and how adolescents interpret these behaviors (Kakihara & Tilton-Weaver, 2009).

The present findings also have clinical implications. Some scholars have argued that there are qualitative differences between referred and nonreferred youth in the association between parenting and externalizing problems (e.g., Deater-Deckard & Dodge, 1997). Yet, the proposed model also held in a sample of youngsters referred for antisocial behavior, a finding consistent with SDT's universality claim (e.g., Ryan & Deci, 2000). These findings also support the "spectrum hypothesis," which states that a disorder is not a discrete category, but rather entails the extreme endpoint of a continuously distributed dimension (Shiner & Caspi, 2003).

Limitations and Future Research

Although the current investigation yielded several new insights, certain limitations need to be acknowledged. First, even though Study 4 used an experimental design, all constructs were assessed at one point in time, which precludes us from drawing conclusions about direction of effects and naturally occurring developmental changes in the central constructs. Although we interpreted our findings mainly in terms of parent-to-child effects, the associations obtained likely reflect a bidirectional process, with controlling parenting, for instance, also being triggered by adolescents' reactance (Vansteenkiste et al., 2014). Future longitudinal research may yield better insight into the nature and direction of the developmental sequence.

In addition, to fully acknowledge the transactional nature of the socialization process, future research could examine in greater detail adolescents' interpretations of and reactions to parental requests (cf. Kakihara & Tilton-Weaver, 2009). This would help to gain more insight into the way adolescents actively shape socialization. For instance, vignette-based or observational studies would allow researchers to explicitly disentangle objective parenting practices, adolescents' perception of these practices, and their reactions in the situation. Rather than using broad measures of controlling parenting, such studies could disentangle effects of more specific facets of controlling parenting. For instance, it could be examined whether threats with punishment elicit reactance more strongly as compared to guilt induction. Future research also could move beyond the need for autonomy by including measures of the needs for competence and relatedness (Ryan & Deci, 2000). An assessment of all three needs would allow researchers to determine their relative importance and their interplay in processes relevant to adolescent defiance.

Conclusion

In conclusion, by drawing upon the frameworks of PRT and SDT, the present set of studies provided more insight into the reasons why controlling parenting often backfires (Grolnick, 2003). Some adolescents display, at least momentarily, an increase in problem behavior, which may elicit controlling and coercive parenting strategies as parents attempt to enforce obedience. Yet, as the present investigation shows, such practices are likely to yield ironic effects as they may further elicit reactance and problems. Although engagement in an autonomy-supportive parental style sometimes may be easier said than done, such a style may be essential to reduce reactance and to foster successful socialization of adolescents more generally.

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Supporting Information

Additional supporting information may be found in the online version of this article at the publisher's website:

Appendix S1. Information About the Development and Validity of the Hypothetical Vignettes (Study 4)

Boring but Important: A Self-Transcendent Purpose for Learning Fosters Academic Self-Regulation

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Many important learning tasks feel uninteresting and tedious to learners. This research proposed that promoting a prosocial, self-transcendent purpose could improve academic self-regulation on such tasks. This proposal was supported in 4 studies with over 2,000 adolescents and young adults. Study 1 documented a correlation between a self-transcendent purpose for learning and self-reported trait measures of academic self-regulation. Those with more of a purpose for learning also persisted longer on a boring task rather than giving in to a tempting alternative and, many months later, were less likely to drop out of college. Study 2 addressed causality. It showed that a brief, one-time psychological intervention promoting a self-transcendent purpose for learning could improve high school science and math grade point average (GPA) over several months. Studies 3 and 4 were short-term experiments that explored possible mechanisms. They showed that the self-transcendent purpose manipulation could increase deeper learning behavior on tedious test review materials (Study 3), and sustain self-regulation over the course of an increasingly boring task (Study 4). More self-oriented motives for learning—such as the desire to have an interesting or enjoyable career—did not, on their own, consistently produce these benefits (Studies 1 and 4).

Keywords: self-regulation, motivation, purpose, meaning, psychological intervention

Supplemental materials: http://dx.doi.org/10.1037/a0037637.supp

> It's only when you hitch your wagon to something larger than yourself that you realize your true potential and discover the role that you'll play in writing the next great chapter in the American story.
>
> —President Barack Obama, Wesleyan University Commencement Speech, 2008

Many of the tasks that contribute most to the development of valuable skills are also, unfortunately, commonly experienced as tedious and unpleasant (Duckworth, Kirby, Tsukayama, Berstein, & Ericsson, 2011; also see Ericsson, 2006, 2007, 2009; Ericsson & Ward, 2007; Ericsson, Krampe, & Tesch-Romer, 1993). For example, skills in science, technology, engineering, and mathematics (STEM) are in high demand, and, according to some estimates, jobs in the STEM sector will grow by more than 20% in the next few decades (U.S. Congress Joint Economic Committee, 2012). Yet in a

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This research was supported by funding from the Bill and Melinda Gates Foundation, the Raikes Foundation, the National Science Foundation (HCC 0834847, DRL 1235958, to Sidney D'Mello), the National Institutes of Health (5-K01-AG033182-02, to Angela Lee Duckworth), the New Paths to Purpose project at the Booth Center for Decision Research, and a University of Texas Summer Research Assignment grant. Any opinions, findings and conclusions, or recommendations expressed in this article are those of the authors and do not necessarily reflect the views of the funding agencies. The ideas in this research benefitted from discussions with Matthew Andrews and Matthew Bundick. The authors are grateful to the students, teachers, and school administrators who participated in this research. We are also grateful to Bill Swann, Christopher Hulleman, Judy Harackiewicz, Robin Vallacher, Geoffrey Cohen, and Carol Dweck for their helpful feedback. Any remaining errors are the authors'.

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 http://dx.doi.org/10.1037/a0037637

representative sample survey, over half of middle school students said they would rather eat broccoli than do their math homework; 44% would rather take out the trash (Raytheon Company, 2012).

To achieve longer-term aims, learners must sometimes regulate attention, emotion, and behavior in the face of tempting alternatives (Duckworth & Carlson, 2013; Fujita, 2011; Mischel, Shoda, & Rodriguez, 1989). Indeed, individual differences in factors such as "grit" and self-control are predictive of eventual skill acquisition and expert performance, controlling for cognitive ability (Duckworth, Peterson, Matthews, & Kelly, 2007; Duckworth, Tsukayama, & Kirby, 2013; Moffitt et al., 2011). Where do these factors come from? Individuals are known to marshal self-discipline more when they are pursuing personally meaningful goals (see Fishbach & Trope, 2005; Fishbach, Zhang, & Trope, 2010; Loewenstein, 1996; Mischel, Cantor, & Feldman, 1996; Rachlin, Brown, & Cross, 2000; Thaler & Shefrin, 1981; Trope & Fishbach, 2000; also see Eccles, 2009; Marshall, 2001). In the present research we propose that what has been called a *purpose for learning* (Andrews, 2011; Yeager, Bundick, & Johnson, 2012) can foster greater meaning in schoolwork and promote academic self-regulation as students take on tedious learning tasks.

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An enormous amount of research has focused on the wide variety of possible motives for engaging in and succeeding at learning tasks (e.g., Ames, 1992; Atkinson, 1957; Carver & Scheier, 1981; Eccles & Wigfield, 2002; Elliot, Conroy, Barron, & Murayama, 2010; Emmons, 1986; Ford & Nichols, 1987; Harackiewicz & Sansone, 1991; Higgins, 2005; Lepper, Corpus, & Iyengar, 2005; Little, 1983; Markus & Nurius, 1986; Nicholls, 1984; Oyserman & Destin, 2010; Ryan & Deci, 2000). Here we focus on only one distinction—that between self-interest and self-transcendence. Learners may view a task as likely to benefit the self, believing it will be intrinsically enjoyable or lead to a personally fulfilling career (see Eccles & Wigfield, 1995). Learners may also have motives that transcend self-interest. These may involve service to other individuals, to an ideal, to a social justice cause, or to a spiritual entity (Damon, Menon, & Bronk, 2003; Frankl, 1963; Koltko-Rivera, 2006; Maslow, 1969; Schwartz, 1992; also see Eccles, 2009).

We define a *purpose for learning* as a goal that is motivated *both* by an opportunity to benefit the self and by the potential to have some effect on or connection to the world beyond the self (Yeager & Bundick, 2009; Yeager et al., 2012; see Burrow & Hill, 2011; Damon et al., 2003). Embedded in this definition is a focus on the motive or rationale for the goal (e.g., "helping people") rather than on content of a goal (e.g., "being an engineer"; Massey, Gebhardt, & Garnefski, 2008). For example, a purpose for learning in a high school science class might be that a student would one day like to use the acquired knowledge to build bridges that help people (a *self-transcendent* component). The same student might also believe that engineering would be a fulfilling, interesting, and enjoyable career (a *self-oriented* component). Both of these types of motives—self-oriented and self-transcendent—can be important for learners and can motivate task persistence (Eccles, 2009; Eccles & Wigfield, 2002). These different motives also frequently coexist (Batson, 1998; also see Feiler, Tost, & Grant, 2012). In fact, in a series of qualitative interviews conducted with a diverse group of high school adolescents, it was common for teens to pair self-transcendent motives with self-oriented motives—much more common in fact than having only a self-transcendent motive (Yeager & Bundick, 2009; Yeager et al., 2012). Here we examine whether adding self-transcendent motives to self-oriented ones—what we call a "purpose for learning"—could produce benefits that self-oriented motives alone could not achieve.

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There is good reason to believe that a purpose for learning could promote the view that a task is personally meaningful (e.g., Grant, 2007, 2013; Olivola & Shafir, 2013; also see Duffy & Dik, 2009; Steger, 2012; Steger, Kashdan, & Oishi, 2008).[1] A classic example comes from Viktor Frankl (1963). In writing about the psychology of surviving a concentration camp, he describes how a self-transcendent purpose in life creates a feeling that one's actions are important for the world, empowering a person to persist even in the most appalling circumstances. He wrote "A [person] who becomes conscious of the responsibility he bears toward a human being who affectionately waits for him, or to an unfinished work, will never be able to throw away his life" (p. 80). Channeling Neitzche, Frankl stated "He knows the 'why' for his existence and will be able to bear almost any 'how'" (1963, p. 80).

Further support comes from observational research of people working in "dirty" jobs—jobs with low status and requiring extremely repetitive tasks (e.g., trash collectors, hospital orderlies, prison guards). Individuals with these jobs find their work more meaningful and carry it out more effectively when they focus on the benefit of these tasks for helping others or society at large (Ashforth & Kreiner, 1999; Hughes, 1958, 1962; also see Dutton, Roberts, & Bednar, 2010; Wrzesniewski, Dutton, & Debebe, 2003; cf. Olivola & Shafir, 2013). Altogether, highly aversive experiences may become more bearable when they are viewed as having consequences that transcend the self.

More directly relevant, Yeager et al. (2012) found that some high school-aged adolescents spontaneously generated a purpose for learning during interviews—mentioning both a self-transcendent motive and an intrinsic, self-oriented motive for their future work, such as "being a doctor to help people *and* because it would be enjoyable." Students with a purpose rated their schoolwork in general as more personally meaningful than adolescents with no career goal or only extrinsic motives (making money, gaining respect), even at a 2-year follow-up (also see Lepper et al., 2005; Ryan & Deci, 2000). Other high school students discussed *only* typical interest-based, self-oriented motives. This group rated their schoolwork as no more meaningful compared to students with no future work goals or only extrinsic motives (Yeager et al., 2012). However, this study was limited in that it did not directly assess perceptions of tedious, skill-building tasks. Nor did it assess behavior or address causality with experimental designs. These limitations are addressed in the present research.

Some past experiments have linked prosocial, self-transcendent motives to behavioral persistence on tasks at work, not school. For example, telemarketers raised more money

[1] A *purpose* is distinct from but related to *personal meaning*. The former includes a person's goal and his or her motives for pursuing it. The latter refers to the sense that something matters and makes sense in the context of one's life or worldview (Steger, Kashdan, & Oishi, 2008; Yeager & Bundick, 2009).

when they were asked to focus on the benefits of their efforts for poor children compared to benefits for the self, while medical professionals were more likely to stop and wash their hands when they focused on others' health as opposed to their own health (Grant, 2008; Grant & Hofmann, 2011; also see Feiler et al., 2012; for findings from other workplaces see, Grant & Rothbard, 2013; cf. Sansone, Weir, Harpster, & Morgan, 1992). Note that a self-transcendent motive makes aversive experiences more bearable, not more enjoyable; prosocial motives diminish the correlation between feeling bad during a task and the reduced motivation to complete it (Grant & Sonnentag, 2010; also see Grant & Campbell, 2007). Prosocial trash men do not find trash more appealing, but they collect it more effectively (Hughes, 1958, 1962).

The present research is among the first to test whether students with more of a self-transcendent purpose for learning can show greater persistence even on tedious learning activities that provide a foundation for uncertain future contributions to the world beyond the self (see Harackiewicz & Sansone, 1991). Some past studies investigated, for instance, raising money for poor children (Grant, 2008; also see Dunn, Aknin, & Norton, 2008) or preventing infection (Grant & Hofmann, 2011). It is easy to see how these actions help others. But when high school students engage in a learning task such as factoring trinomials in algebra, or balancing stoichiometric equations in chemistry, it can be difficult to see the steps through which deeply learning from these tasks can help them benefit others. That is, raising money for poor people is directly prosocial, but learning fractions must be construed as such.

Other past research has found that providing intrinsic versus extrinsic motives for learning tasks (e.g., becoming healthy vs. looking physically attractive) can lead to greater task persistence and deeper processing of information (e.g., Vansteenkiste, Simons, Lens, Sheldon, & Deci, 2004; also see Jang, 2008; for a review, see Vansteenkiste, Lens, & Deci, 2006, or Patall, Cooper, & Robinson, 2008). Similarly, some research has found that asking students to generate reasons why a learning task could be relevant to their daily lives and future goals could improve course performance among low-performers, by enhancing the perceived utility value of a task (Hulleman, Godes, Hendricks, & Harackiewicz, 2010; Hulleman & Harackiewicz, 2009). These studies were foundational to the present research. However they were not designed to distinguish the intended beneficiary of the learning—the self versus something that transcends the self—as the present research seeks to do.

In addition, past studies have focused on the perceived prosocial value of completing a given *task* or learning objective (Eccles & Wigfield, 1995)—for instance, learning about correlation coefficients to interpret education research (Jang, 2008), or using the week's science class lessons to help out on the family farm (Hulleman & Harackiewicz, 2009; see Eccles, 2009; Eccles et al., 1983). However, an important skill for self-regulation is to abstract up a level from the task at hand to one's motives for being involved in an educational enterprise more generally—e.g., "science" or "math" or even "school." It is often uncertain whether or how one will use the knowledge gained from a given learning objective or task. Indeed, teachers very rarely provide *any* rationale for mastering a learning objective (Stipek, 2004; also see Eccles, 2009), let alone a self-transcendent rationale. This is especially true in STEM courses, where many tasks are unexplained (Carnevale & Desrochers, 2003; also see Diekman, Clark, Johnston, Brown, & Steinberg, 2011). It may be helpful to reconstrue a foundational task—such as practicing math facts—more generally in terms of their relation to one's broader, self-transcendent motives for working hard in school or in a subject area.

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Four studies investigated the hypothesis that a higher order, self-transcendent purpose for learning in school would promote academic self-regulation on tedious schoolwork. In Study 1 we hypothesized that a self-transcendent purpose for learning would be correlated with indicators of academic self-regulation both at the trait level (self-reported *grit* and *self-control*) and at the behavioral level (short-term persistence on a boring math task and longitudinal persistence in college). We further hypothesized that these relations would be found above and beyond the effects of more intrinsic, self-oriented motives (e.g., following one's intellectual interests), and of cognitive ability.

Study 2 examined a possible causal effect of a self-transcendent purpose for learning. In order to do so it was necessary to create an exercise to adjust adolescents' purposes for learning, which past research has had difficulty doing (Dik, Steger, Gibson, & Peisner, 2011). Indeed, a purpose is likely to be highly personal and represent the product of a large number of influences in life, including teachers, parents, friends and the media, perhaps making it difficult to manipulate (e.g., Damon, 2008; Harackiewicz, Rozek, Hulleman, & Hydes, 2012; Moran, Bundick, Malin, & Reilly, 2013; Steger, Bundick, & Yeager, 2012). Yet advances have been made in recent years in the optimal design of psychological interventions in educational settings (e.g., Blackwell, Trzesniewski, & Dweck, 2007; G. L. Cohen & Sherman, 2014; Garcia & Cohen, 2012; Hulleman & Harackiewicz, 2009; Walton & Cohen, 2011; also see Walton, 2014; Wilson & Linville, 1982). We were informed by these. We hypothesized that a novel self-transcendent purpose for learning intervention could improve grades in subject areas likely to be seen as tedious, such as high school math and science classes.

Studies 3 and 4 examined potential behavioral antecedents to the outcomes studies in Studies 1 and 2. Specifically, Study 3 examined effects of the novel intervention on behavior on a shorter time-course, testing the hypothesis that a self-transcendent purpose for learning could lead students to learn more deeply from an immediate, real-world academic task. Study 4 sought to isolate the effect of a purpose for learning manipulation on self-regulation more precisely by administering a dependent measure that pitted a boring math activity directly against tempting alternatives.

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Study 1 was a correlational study among a low socioeconomic status (SES) group of high school seniors. Based on prior research, they might have significant difficulty regulating immediate motivations in the service of long-term goals (Evans & Rosenbaum, 2008; Vohs, 2013). We hypothesized that in this population a self-transcendent purpose would correlate with indicators of self-discipline—both self-reported and behavioral—assessed at the same measurement time. We further hypoth-

esized that, in a multiple regression controlling for more self-oriented motives—even intrinsic-interest-focused ones—a purpose for learning would continue to predict greater success at self-regulation.

We also examined longitudinal relations with goal persistence. This was done by collecting data on whether students were enrolled in college in the Fall semester following high school graduation, as they intended to do. Low-income students of color more commonly drop out of the college pipeline in the summer after college or during their first Fall semester, even when they have successfully graduated high school and been admitted to a college of their choice (Ryu, 2012). We hypothesized that a self-transcendent purpose would predict college persistence over time—a potential indicator of successfully regulating competing demands for time and attention in this low-income population. We also hypothesized that this relation would be found when controlling for self-oriented motives in a multiple regression.

a a Participants were $N = 1{,}364$ seniors in their final semester at one of 17 participating urban public high schools (eight charters and two district schools). Ninety-nine percent said that they had applied for college and were planning on attending college in the Fall semester. They were located in Los Angeles, CA; Oakland, CA; New York, NY; Austin, TX; Houston, TX; or Little Rock, AR. They were from low socioeconomic backgrounds: over 90% received free or reduced-price lunch, a measure of low socioeconomic status, and only 9% had one parent who had completed a 2 or 4-year degree; by contrast, 25% of parents did not have a high school diploma. The sample overall was nearly evenly split on gender (57% female) and had a large proportion of students that are typically underrepresented in higher education in the United States, 38% African American, 48% Hispanic/Latino, 5% Asian, 4% White. Some participants did not provide data on some measures, and so degrees of freedom varied across analyses. No other participants were excluded from analyses. There was no stopping rule for data collection because all college-going students in each school were invited to participate.

Participants completed a web-based survey in the school's computer lab during the school day in the Spring semester (February to May) of senior year. Teachers directed students to a website (http://www.perts.net) that delivered the survey session, which lasted one class period. Many months later, toward the end of what was the Fall semester for students in college, college persistence data were collected from the National Student Clearinghouse (NSC).

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Motives for going to college. The primary predictor variables were self-transcendent motives, intrinsic self-oriented motives, and extrinsic self-oriented motives. The preface for the items assessing these motives was: "How true for you personally are each of the following reasons for going to college?" Each was rated on a 5-point scale (1 = *Not at all true*, 2 = *Slightly true*, 3 = *Somewhat true*, 4 = *Very true*, 5 = *Completely true*).

Self-transcendent motives (purpose for learning). We averaged across the following three items to assess students' self-transcendent motives for going to college (a purpose for learning), operationalized as a personally relevant desire to learn in order to make a contribution to the world beyond the self: "I want to learn things that will help me make a positive impact on the world," "I want to gain skills that I can use in a job that help others," and "I want to become an educated citizen that can contribute to society" ($\alpha = .75$).

Self-oriented motives. We averaged across the following three items adapted from Stephens, Fryberg, Markus, Johnson, and Covarrubias's (2012) assessment of self-oriented, interest-driven motives for going to college: "I want to expand my knowledge of the world," "I want to become an independent thinker," and "I want to learn more about my interests" ($\alpha = .70$). Note that these are still personally important intrinsic motives for learning, and might be expected to predict greater self-regulation, thus providing a high standard of comparison for the self-transcendent motives.

Extrinsic motives. Finally, we measured typical extrinsic, self-oriented motives for going to college: "I want to get a good job," "I want to leave my parents' house," "I want to earn more money," and "I want to have fun and make new friends." We wrote these items in collaboration with college counselors at the participating high schools. They were designed to reflect the counselors' perceptions of why students want to go to college. Although the internal consistency reliability for these items was somewhat low ($\alpha = .50$), they were face-valid. Below we show that a composite of these items produced relations with each of the constructs measured that replicates past research (Lee, McInerney, Liem, & Ortiga, 2010), supporting the validity of the composite despite low internal consistency. The same findings emerged when analyzing these items separately.

Meaningfulness of schoolwork. To assess individual differences in the meaningfulness of everyday academic tasks, we adapted a measure commonly used in research on action-identification theory: the Behavioral Identification Form (BIF; Vallacher & Wegner, 1989). The standard BIF asks participants to view a task and choose a description of it that either aligns with personally meaningful values or goals, or with concrete actions required to complete the task. In the present research, we treat the choice of the former, more goal-directed description as an indication that a person is viewing it more meaningfully. Indeed, Michaels, Parkin, and Vallacher (2013) stated that "people take meaning from their goals and values rather than the details of their actions" (p. 109).

We created a four-item version of the BIF that was tailored to assess whether students chronically make meaning out of boring and uninteresting everyday academic tasks in high school. See Figure 1 for an example. The measure presented participants with a description of each behavior, accompanied by a picture, and asked participants to select which of two action identifications best matched how they thought about the behavior. The four behaviors were "Taking the SAT," "Doing your math homework," "Writing an essay," and "Using a planner to record upcoming tasks" (for pictures and response options, see the online supplement). In pretesting focus groups with high school students, all four behaviors were evaluated as very tedious and very common. For each of the behaviors (e.g., taking the SAT), we asked students whether a

[2] Pilot research confirmed that the present measure indicated greater personal meaning as expected by theory (Michaels, Parkin, & Vallacher, 2013). In a pilot survey with $N = 151$ high school students, our measure correlated with the presence of meaning in life scale (e.g., "I have a good sense of what makes my life meaningful"; Steger, Frazier, Oishi, & Kaler, 2006) at $r = .30$, $p < .001$.

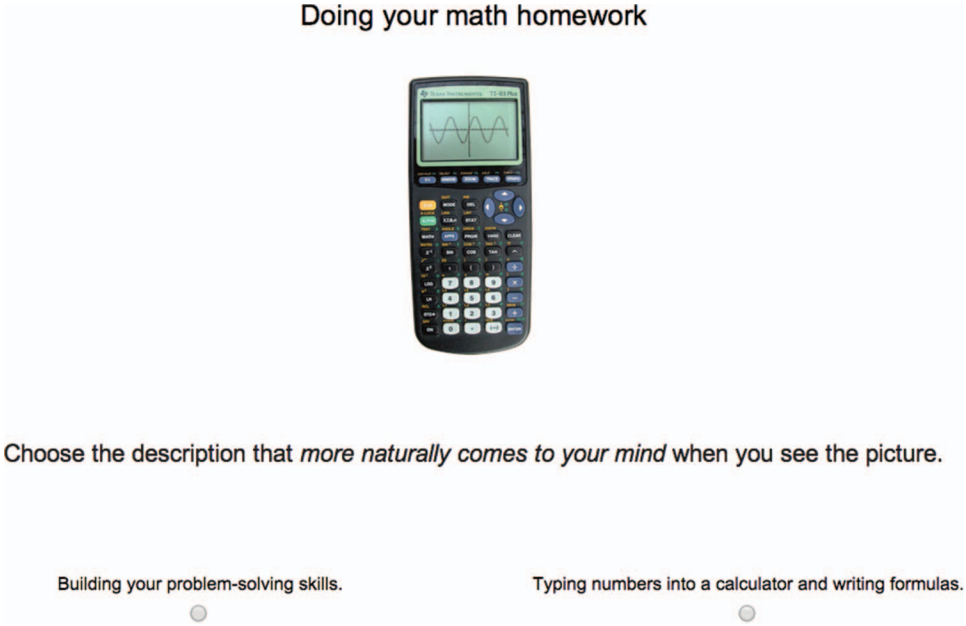

Figure 1. Sample item for assessing the meaningfulness of schoolwork. Image from "File:Ti83plus.jpg," by Westernelectric555, 2008 (http://commons.wikimedia.org/wiki/File:Ti83plus.jpg). In the public domain. See the online article for the color version of this figure.

more concrete, lower level statement (a description that emphasizes the means by which the action is performed, e.g., "Filling out bubbles on the SAT") or a more goal-directed, personally meaningful statement (a description emphasizing the meaning the action can have for a person's pursuits in life, e.g., "Taking steps toward a college degree") best described that behavior. The latter was our operationalization of whether the task was seen as more personally meaningful. We summed across the items, so that higher values corresponded to a greater tendency to see schoolwork as meaningful (Range: 0 to 4).[2]

Grit scale. Participants completed an abbreviated version of the validated grit scale (Duckworth & Quinn, 2009), a measure that signals strong self-regulation in a number of past studies. The scale includes the following: "I finish whatever I begin"; "I work very hard. I keep working when others stop to take a break"; "I stay interested in my goals, even if they take a long time (months or years) to complete"; and "I am diligent. I never give up." Participants answered all items on 5-point fully labeled scales (1 = *Not at all like me*, 2 = *Not much like me*, 3 = *Somewhat like me*, 4 = *Mostly like me*, 5 = *Very much like me*). We averaged across the responses, with higher values corresponding to higher levels of grit (α = .78).

Self-control scale. Participants completed a validated measure of self-control when completing academic work (Patrick & Duckworth, 2013; Tsukayama, Duckworth, & Kim, 2013). Items were "I come to class prepared," "I pay attention and resist distractions in class," "I remember and follow directions," and "I get to work right away rather than procrastinating" (1 = *Not at all like me*, 2 = *Not much like me*, 3 = *Somewhat like me*, 4 = *Mostly like me*, 5 = *Very much like me*). We averaged across these items, with higher values corresponding to greater academic self-control (α = .71). Past research has shown that these items are correlated with other measures of self-regulation (such as grit; e.g., Table 1) but demonstrate divergent validity from them (Duckworth et al., 2007).

The "diligence task": A behavioral measure of academic self-regulation. At the end of the survey, participants completed a novel standardized behavioral measure of self-regulation, called "the diligence task" (Galla et al., 2014). This task was designed to mirror the real-world choices students confront when completing homework and being tempted by the distractions of the digital age. Specifically, this task involved the choice of completing boring math problems (single-digit subtraction) or consuming captivating but time-wasting media (watching one or several entertaining, brief, viral videos [lasting 20–60 s] or playing the video game Tetris). At any time, participants could click on the left side of the screen and complete math problems ("Do Math") or click on the right side of the screen and consume media ("Play game or watch movie"). Participants were told there were no negative consequences for their choices and that they could do whatever they preferred. See Figure 2. The software (unknown to the participant) tracked the number of math problems completed successfully, producing our focal dependent measure.

To make the math problems potentially meaningful in students' eyes—and worth completing—we told participants that successfully completing the tasks could possibly help them sharpen their math skills and stay prepared for their future careers. As a part of this cover story, we presented participants with summaries of actual scientific studies showing that increasingly as people rely on technology to do simple tasks, their grasp of basic skills can atrophy. As a result, all participants could plausibly see the successful completion of boring math problems as preparatory for a future career, if they so desired.

Table 1
Zero-Order Correlations for Study 1 Measures

Variable	Self-transcendent motives ("Purpose for learning")	Self-oriented, intrinsic motives	Extrinsic motives	Meaningfulness of schoolwork	Self-reported grit	Self-reported self-control
Self-transcendent motives ("Purpose for learning")	—					
Self-oriented, intrinsic motives	.66***	—				
Extrinsic motives	.61***	.48***	—			
Meaningfulness of schoolwork	.23***	.20***	.19***	—		
Self-reported grit	.39***	.32***	.32***	.26***	—	
Self-reported self-control	.33***	.26***	.21***	.22***	.58***	—
No. of boring math problems solved during the diligence task	.09**	.04	−.09**	.09**	.07*	.16***

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

The task itself involved three blocks. Block 0 was a warm-up block to become familiar with the layout of the task. It involved a brief (1-min) set of math problems, but without the option to play videos or video games. It is not discussed further. Blocks 1 and 2 lasted 4 min each and involved the key behavioral choice: toggling between the math problems and the media (videos or Tetris). See Figure 2. We totaled the number of correct math responses in each block. In a separate validation study, five blocks were administered and boredom was assessed after each. A large increase in self-reported boredom occurred between the first block and the second, a significant difference, $t(1019) = 4.69$, $p < .001$, and boredom appeared to level-off after that. Therefore in the present study, values from Block 2, the more boring of the two blocks, were used in analyses. The same overall pattern of results and level of statistical significance was found when Blocks 1 and 2 were averaged and analyzed as a single metric.[3]

Finally, to ensure that the task elicited boredom as expected, one question assessed boredom on the math problems, immediately after Block 2: "How bored were you when working on the math problems?" (1 = *Not bored at all*, 2 = *A little bored*, 3 = *Somewhat bored*, 4 = *Very bored*, 5 = *Extremely bored*).

College persistence. College enrollment data were obtained from the NSC, which is a nonprofit database that reports on students receiving financial aid to both private and federal loan providers (Dynarski, Scott-Clayton, & Wiederspan, 2013). Colleges submit student names to this database, and so it allows for objective, longitudinal assessment of student behavior with little or no missing data. In the present study, a value of 1 indicates that students were still enrolled at a 4-year college during the Fall of 2013 after the "census date" (the date after which students owe tuition, normally 4–8 weeks into the term). A value of 0 means that they did not have an official enrollment value in the database at that time. Possible reasons for not being enrolled in the Fall include students who were admitted to a college but did not ever appear at their college in the Fall, or students who appeared at their college but withdrew during the semester.[4]

Initial analyses support the interpretation that college persistence was indeed meaningfully affected by self-regulation. The number of boring math problems solved during the diligence task positively predicted college persistence six to 10 months later (odds ratio [OR] = 1.006, $Z = 4.05$, $p < .001$, $r = .14$), and the number of tempting videos or games consumed negatively did so (OR = .91, $Z = 2.09$, $p = .036$, $r = -.08$). This was true even controlling for cognitive ability (measure described below). Thus college persistence was at least one informative variable for assessing theory regarding longitudinal behavioral self-regulation.

Cognitive ability. To rule out the alternative hypothesis that observed correlations between variables were due to shared variance in cognitive ability, we administered a brief (10-item) set of moderately challenging problems from Raven's progressive matrices (Raven, Raven, & Court, 1998). We used a subset of items rather than the full battery due to time limitations in the school setting. Although brief, this set of items showed substantial convergent validity with other measures of cognitive ability in a validation study that administered a full battery of IQ measures to a subsample of the present study's participants (see online supplemental materials).

Our primary hypothesis was that a greater endorsement of self-transcendent motives for going to college would predict (a) the tendency to view tedious academic tasks in a more personally meaningful fashion and (b) the tendency to display greater academic self-regulation. Analyses focus first on the concurrently measured variables, followed by the analysis of the longitudinal

[3] There were some missing data for Block 2 because some participants (10%) did not even begin the block and instead waited for the browser to advance, without playing games or watching videos. Reports from teachers administering the task suggested that this was likely because students found Block 1 so aversive that they gave up on the task. Thus, rather than treating these participants' performance on Block 2 as missing data—effectively dropping participants—they were instead coded as having completed zero problems. We found that doing this and retaining all participants for analysis did not sacrifice validity—for instance, the correlation of boring math problems solved and self-reported trait self-control was $r = .15$, $p < .001$, both when we counted these students' Block 2 performance as missing data and when we counted the students as having completed zero problems. All conclusions about the significance of the predictors of diligence task data remained the same regardless of the missing data technique.

[4] The large majority of students said that their goal was to attend and graduate from a 4-year college (85%), while the remaining students said their goal was to attend a 2-year college. Interestingly, many students who said in May they would attend a 2-year college ended up at a 4-year college in the Fall, and so, to be conservative, our primary analyses included all participants regardless of their stated goal during senior year. However, we conducted supplemental analyses of the college persistence outcomes that were limited only to the subgroup who said they were planning on attending a 4-year college. The significance tests for the focal variables were no different.

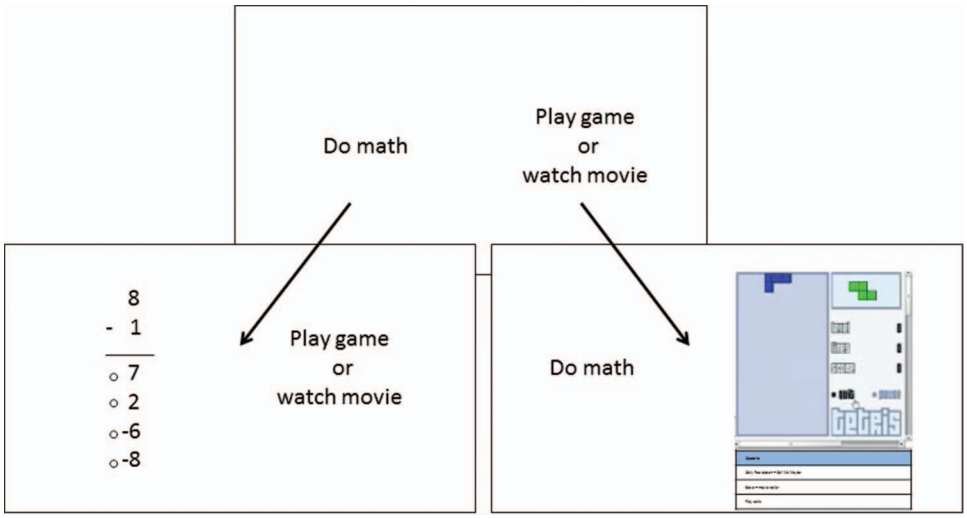

Figure 2. The "diligence task": a behavioral measure of academic self-regulation. See the online article for the color version of this figure.

behavioral outcome: college persistence. Our secondary hypothesis was whether individual differences in the endorsement of the self-oriented motives showed the same pattern as the self-transcendent motives.

a When inspecting zero-order correlations (Table 1), students who reported more of a self-transcendent purpose for learning also scored higher on the meaningfulness of schoolwork measure ($r = .23$, $p < .001$), conceptually replicating past research (Yeager & Bundick, 2009) but with a novel and more theoretically precise measure. A self-transcendent purpose for learning also predicted more grit ($r = .39$, $p < .001$) and more academic self-control ($r = .33$, $p < .001$) and showed a modest correlation with a greater number of boring math problems solved in the face of tempting media ($r = .09$, $p < .01$).

Supplemental analyses of survey questions asked after the diligence task help clarify those results. Students who endorsed a self-transcendent purpose for learning did not perceive the single-digit subtraction problems as less boring ($r = -.02$, $p = .47$). Furthermore, 91% of participants reported at least some boredom, and 72% were "Extremely," "Very," or "Somewhat" bored. Thus the task was indeed boring. Yet those with more of a purpose solved somewhat more math problems despite the boredom (also see Grant & Sonnentag, 2010).

The overall correlations with measures of self-regulation were maintained when controlling for potential confounding variables in a multiple regression: self-oriented, intrinsic motives for learning (e.g., exploring your interests), extrinsic motives for going to college (e.g., making more money), as well as sex, race and ethnicity, and cognitive ability. Regression models are shown in Table 2. Inspecting the standardized regression coefficients in Table 2 shows that a self-transcendent purpose for learning predicted greater personal meaningfulness of> schoolwork ($\beta = .15$, $p < .001$), grit ($\beta = .27$, $p < .001$), academic self-control ($\beta = .29$, $p < .001$), and the number of correctly solved boring math problems ($\beta = .09$, $p = .01$). In

Table 2
Ordinary Least Squares Regressions Predicting Construal and Academic Self-Regulation in Study 1

	Dependent measure											
	Meaningfulness of schoolwork			Grit			Self-control			No. of boring math problems solved during the diligence task		
Predictor	β	*t*	*p*	β	*t*	*p*	β	*t*	*p*	β	*t*	*p*
Self-transcendent motives ("Purpose for learning")	.15	4.06	.00	.27	7.04	.00	.29	7.05	.00	.09	2.59	.01
Self-oriented, intrinsic motives	.09	2.74	.01	.10	2.63	.01	.09	2.45	.01	.01	0.41	.68
Extrinsic motives	−.10	−3.50	.00	−.09	−3.04	.00	−.10	−3.47	.00	−.11	−3.58	.00
Cognitive ability	−.07	2.78	.01	−.10	−2.49	.01	−.02	−0.34	.73	−.02	−0.34	.73
Sex	−.02	−.76	.45	−.10	−4.25	.00	−.05	−1.87	.06	−.05	−1.87	.06
Ethnicity	−.07	−2.61	.01	−.11	−4.21	.00	−.10	−3.75	.00	−.10	−3.75	.00
Adjusted R^2		.07			.20			.13			.09	
N		1,360			1,358			1,358			1,234	

Note. β = standardized regression coefficient. Sex: 1 = female, 0 = male. Ethnicity: 1 = Hispanic/Latino, 0 = non-Hispanic.

this multiple regression, a self-oriented, intrinsic motive for learning did not significantly predict number of math problems solved (see Row 2 in Table 2), and it was a significantly weaker predictor of reported grit and self-control compared to a purpose for learning, Wald test of equality of coefficients, $F(1, 1349) = 4.74$, $p = .03$.

Note that these analyses do not show that self-oriented motives are unimportant. Almost *all* participants who reported at least some self-transcendent motives (e.g., at or above the scale midpoint) also expressed at least modest levels of intrinsic, self-oriented motives (also at or above the scale midpoint; also see Yeager et al. 2012). Nevertheless, more strongly endorsing a self-oriented motive was not related to individual differences self-regulation. By contrast, in a sample of adolescents with at least some level of self-oriented motivation, greater endorsement of self-transcendent motives consistently predicted greater self-regulation.

Finally, zero-order correlations showed that intuitively appealing extrinsic self-oriented motives such as making money in a future job were significant positive predictors of meaningfulness of schoolwork and trait-level self-regulation (Table 1). However, this appeared to be due to shared variance with the other motives. The extrinsic self-oriented items include variance both due to a general motivation to go to college—which would be shared with the purpose items—as well as variance due to more specific extrinsic motives (making money, getting out of the house), which might not be. In regression analyses that presumably remove the former source of variance, extrinsic motives were in every case strong *negative* predictors of both personal meaningfulness of schoolwork and academic self-regulation (see Row 3 in Table 2). That is, wanting to go to college in order to make money or get out of the house predicted significantly *worse* academic self-regulation, net of other motives to go to college.

a a Many factors are likely to affect whether high-school graduates follow through with their college aspirations. These include academic preparation or the need for financial aid. Yet students also face barriers that require self-regulation, such as navigating the bureaucratic difficulties of completing the paperwork for enrollment, housing, course and major selection, etc., as well as the need to take entry-level, sometimes-tedious or disconnected introductory courses (Ryu, 2012). College students also have more freedom with their time compared to high school students, and they must freely choose to work in service of their long-term goals even as they face daily temptations to engage in social activities or consume entertaining media. Because self-regulation, in theory, should help students complete these tasks and therefore persist in college—and recall that diligence task behavior predicted college enrollment—we hypothesized that a purpose for learning might predict goal persistence across the socially, academically, and bureaucratically difficult transition to college.

Consistent with this theoretical expectation, in a logistic regression with no covariates, a self-transcendent purpose for learning significantly predicted college enrollment (OR = 1.40, $Z = 4.82$, $p < .001$). Controlling for sex, race and ethnicity, cognitive ability, as well as cumulative high school grade point average (GPA), did not diminish this relation (OR = 1.40, $Z = 4.62$, $p < .001$). Estimated values from this model are depicted in Figure 3. This figure shows that for students with responses at the bottom of the purpose scale (the lowest two out of five points), only 30% of students were still enrolled at college in the Fall immediately following high school graduation. Among students at the midpoint of the purpose scale, 57% were still enrolled in college. For students at the highest two out of five scale points, this number was even greater: 64%.[5] Controlling for self-oriented, intrinsic motives for learning as well as extrinsic motives for going to college did not diminish the significant relation between a purpose for learning and college enrollment (OR = 1.34, $Z = 2.77$, $p = .006$).[6] These additional motives did not significantly predict college enrollment: self-oriented, intrinsic motives (OR = 1.10, $Z = .85$, $p = .40$), and extrinsic motives (OR = 1.11, $Z = 1.05$, $p = .30$). Wald tests comparing the sizes of these coefficients to a self-transcendent purpose for learning failed to reach statistical significance ($ps = .35$ and .22, respectively). Altogether, a self-transcendent purpose for learning predicted persistence toward the eventual goal of college graduation. In the full regression model, other, more self-oriented motives did not.

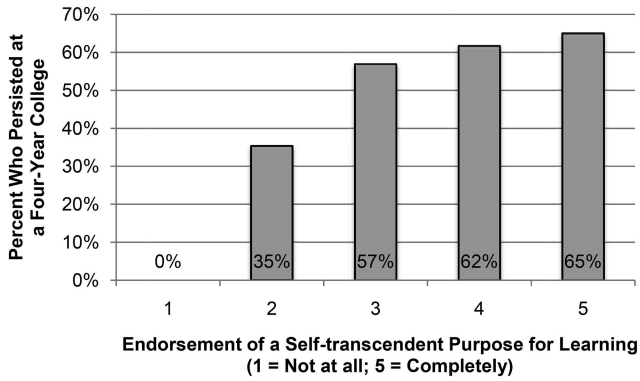

Figure 3. A self-transcendent purpose for learning predicts long-term persistence toward an academic goal (enrollment at a 4-year college 6–10 months postassessment, among college-going high school graduates) in Study 1. Predicted values that adjusted for cognitive ability, gender, racial minority status, and high school grade point average are depicted. All participants were high school graduates who stated that their goal was to graduate from college.

This research was conducted with a large sample of low-income, mostly racial minority students, many of whom would be the first in their families to graduate from college. In this sample, those who expressed more of a self-transcendent purpose for learning as they were leaving high school also viewed tedious academic activities as more personally meaningful and both reported and behaviorally displayed greater academic self-regulation. They

[5] The relation was not exclusively driven by the low-purpose individuals. When reconducting analyses only with the sample at or above the midpoint of the purpose scale (3, 4, or 5, excluding 1 and 2; see Figure 3), a self-transcendent purpose for learning remained a significant predictor of college enrollment (OR = 1.32, $Z = 2.77$, $p = .006$).

[6] For a subset of students, we were able to obtain college-admissions test scores (SATs and ACTs). When reconducting analyses with test scores as covariates, all conclusions about the significance of each of the motives (self-oriented and self-transcendent) were unchanged ($ps < .05$).

were also more likely to continue toward their stated goal of persisting in college. These effects were independent of cognitive ability. In addition, stronger endorsement of more typical self-oriented motives did not as consistently predict greater self-regulation, suggesting that there is a unique contribution of adding more self-transcendent motives.

More generally, the results of Study 1 raise the intriguing possibility that an intervention designed to promote a self-transcendent purpose for learning might improve adolescents' academic performance over time. We tested this in Study 2.

a

Study 1 was the first to show that a self-transcendent purpose for learning could predict a tendency to display greater diligence and self-regulation on academic activities as well as greater college persistence. Although encouraging support for our theory, these correlational analyses are limited in their ability to isolate causal processes. We therefore created a novel purpose for learning intervention and assessed its effects on behavior over time. This was informed most directly by pioneering research by Hulleman and Harackiewicz (2009; also see Hulleman, Durik, Schweigert, & Harackiewicz, 2008; Hulleman, Godes, Hendricks, & Harackiewicz, 2010). It was also informed by past studies showing that even brief persuasive messages that alter students' appraisals of recurring events in school can improve student achievement months or years later (Aronson, Fried, & Good, 2002; Blackwell et al., 2007; G. L. Cohen, Garcia, Purdie-Vaughns, Apfel, & Brzustoski, 2009; Sherman, Hartson, Binning, Purdie-Vaughns, Garcia, Taborsky-Barba, Tomassetti, & Cohen, 2013; Walton & Cohen, 2011; see Garcia & Cohen, 2012; Yeager & Walton, 2011). Building on this, a one-time purpose intervention might produce a shift in students' thinking that buffers them from a loss in self-regulation when confronted with uninteresting tasks on a daily basis (cf. Grant & Sonnentag, 2010). Specifically, we hypothesized that an intervention promoting a self-transcendent purpose for learning could improve GPA in STEM courses several months later, compared to a control group that completed a neutral exercise.

a a Participants were 338 ninth grade students at a middle class suburban high school in the Bay Area of Northern California. Exactly half were male and half were female; 60% were Asian, 28% were White, 9% were Hispanic/Latino, and 1% were African American. The present study's population adds to Study 1's, which showed the importance of a purpose for learning among predominately low-income students of color attending urban public schools. In the present study, poverty and poor quality instruction were not common barriers for students; only 8% percent were eligible for free or reduced-price lunch and over 85% were considered proficient in math and science on state tests. Thus it was possible to examine whether the effects of a self-transcendent purpose could generalize beyond the type of sample employed in Study 1. There was no stopping rule for data collection in the present study because all students in the school were invited to participate.

The intervention was delivered in the school's computer lab during the school day. Teachers directed students to a website (http://www.perts.net) that delivered the session via a computer. All that was required of the teachers was to keep the class orderly. The materials took less than one class period (20–30 min) to complete.

The school has four grading periods in the year, each producing independent grades, and each lasting one fourth of the school year. In the first week of the fourth grading period of the year (in March), students completed Study 2's web-based self-transcendent purpose intervention or a control intervention (see below). This allowed for a test of the intervention on grades in the final quarter of the year, controlling for prior grades in the third quarter.

The intervention was delivered during an elective period, not in a math or science class. This provides a strict test of the hypothesis that students themselves could create a purposeful framework that they could apply even with no explicit associations between the intervention content and STEM course learning objectives. We made no mention to students that the purpose intervention was designed to affect their thinking or behavior—instead, it was a framed as a student survey requiring their input. No teacher at the school had access to the intervention materials (so they could not reinforce it knowingly), and they were unaware of treatment and control assignments.

Purpose for learning intervention. A number of insights informed our intervention design. First, in past qualitative research (Moran et al., 2013; Yeager & Bundick, 2009; Yeager et al., 2012) many high school students spontaneously named *both* self-oriented motives *and* self-transcendent motives. Students who did so showed the greatest improvements in terms of the meaning of their schoolwork over a 2-year period (Yeager et al., 2012; for analogous research in the workplace, see Grant, 2008). Almost no adolescents (8%), however, mentioned *only* self-transcendent motives. We therefore expected that teens would find it implausible to only focus on the world beyond the self, especially because high school is transparently a preparation for one's future personal academic and professional goals. Therefore the intervention asked students to *connect* self-transcendent aims to self-relevant reasons for learning, rather than asking them to be completely altruistic.

Next, a premise of our approach is that it is either not possible or extremely difficult to *tell* a teenager what his or her purpose for learning should be. Doing this could threaten autonomy, a key concern for adolescents (Erikson, 1968; Hasebe, Nucci, & Nucci, 2004; Nucci, 1996). Indeed, teens commonly express reactance in response to adults' attempts to influence their personal goals (Brehm, 1966; Erikson, 1968), rejecting adult's suggestions—or even endorsing their opposite—to reassert autonomy (see Lapsley & Yeager, in press). Furthermore, Vansteenkiste et al. (2004) showed that autonomy-supportive framing was especially important when providing intrinsic motives for a learning task. At the same time, it may be possible to lead a teenager to *reflect on* and *construct* motives in a certain direction, in a way that leads them to develop their own self-transcendent purposes for learning (see Hulleman & Harackiewicz, 2009). In past research on service learning activities with adolescents, reflecting on the personal meaning of one's past prosocial behaviors led to changes in beliefs, attitudes, and thinking styles (Eyler, 2002; Eyler & Giles, 1999). Informed by these insights, our intervention did not seek to *give* a personally relevant, self-transcendent purpose to a student. Instead it sought to serve as an "enzyme" to catalyze students'

reflections about their own self-transcendent purposes for learning and facilitate connections to self-oriented motives.

More concretely, the intervention first primed students' self-transcendent thoughts by asking them to write an open-ended essay response to a question about social injustices they found particularly egregious. The prompt was,

> How could the world be a better place? Sometimes the world isn't fair, and so everyone thinks it could be better in one way or another. Some people want there to be less hunger, some want less prejudice, and others want less violence or disease. Other people want lots of other changes. What are some ways that you think the world could be a better place?

Student responses dealt with issues such as war, poverty, or politics. Some examples were "Without discrimination, there would be much less violence and war in this world" or "The hunger problem can be solved if we have proper energy sources." With those prosocial concerns in mind, students next completed a structured reading and writing exercise.

In doing so, the intervention drew on a variety of strategies designed to be maximally persuasive without threatening autonomy (Yeager & Walton, 2011; see Aronson et al., 2002; Walton & Cohen, 2011). The intervention conveyed the social norm that "many students like you" have a self-transcendent purpose for learning. Such descriptive norms can motivate behavior change (Cialdini, Reno, & Kallgren, 1990; Goldstein, Cialdini, & Griskevicius, 2008; see Cialdini, 2003), especially during adolescence (G. L. Cohen & Prinstein, 2006). To create a descriptive norm, we presented results of a survey that communicated that, in addition to common motives like making money or having freedom, most students also (sometimes secretly) are motivated to do well in school in order to gain skills that can be used for prosocial ends. Survey statistics presented to participants indicated that most students were motivated to do well in high school at least in part "to gain knowledge so that they can have a career that they personally enjoy" and "to learn so they can make a positive contribution to the world." These statistics were also designed to counteract pluralistic ignorance about the norm that people are purely self-interested (also see Grant & Patil, 2012; Miller, 1999). As in similar social-psychological interventions (e.g., Walton & Cohen, 2011), summary statistics were accompanied by representative quotes purportedly from upperclassmen at the school that reinforced the focal message. One such quote stated,

> For me, getting an education is all about learning things that will help me do something I can feel good about, something that matters for the world. I used to do my schoolwork just to earn a better grade and look smart. I still think doing well in school is important, but for me it's definitely not just about a grade anymore. I'm growing up, and doing well in school is all about preparing myself to do something that matters, something that I care about.

Finally, building on self-perception and cognitive dissonance (Bem, 1972; Festinger, 1957), past research finds that when a person freely chooses to advocate for a message this can lead a person to internalize it (Aronson, 1999; Aronson et al., 2002). Therefore, students next wrote brief testimonials to future students about their reasons for learning. Specifically, students explained how learning in high school would help them be the kind of person they want to be or help them make the kind of impact they want on the people around them or society in general. Participants on average wrote two to four sentences. In this way, rather than being passive recipients of the intervention, students themselves authored it. This allowed students to make the message both personal and persuasive to the self (Yeager & Walton, 2011).

We conducted a pilot experiment to confirm that the self-transcendent purpose intervention could indeed promote personal meaning in school as expected by theory (Yeager & Bundick, 2009; also see Study 1). This pilot involved $N = 451$ high school students from 13 different high schools across the United States (extensive detail is presented in the online supplemental material). In the pilot, students were randomized to the purpose intervention or a neutral control activity (see below). Students then completed a more extended version of the Study 1 meaningfulness of schoolwork measure—the academically oriented BIF (Figure 1; cf. Vallacher & Wegner, 1989). As expected, in this pilot the purpose manipulation led to greater personal meaningfulness of tedious academic tasks compared to a neutral control, $t(446) = 2.67$, $p = .007$, $d = 0.25$ (Control raw $M = 4.78$, $SD = 2.53$ vs. Purpose raw $M = 5.39$, $SD = 2.41$). This confirms that the purpose intervention can operate as expected, at least in the short term in the pilot sample.

Control exercise. In a control condition, participants read about and then explained how high school was different from middle school. As in the purpose condition, participants saw summary statistics, read messages purportedly from helpful upperclassman (e.g., statements discussing the differences in the number of teachers or difficulty of time management), and wrote essays about how their lives were different now compared to when they were in middle school. Thus the control exercise was age-appropriate, social, and engaging but was devoid of the focus on motives for learning. It primarily rules out the alternative explanation that *any* positive and friendly message about school from older students could create a sense of connection with others and facilitate prosocial motivation.

a

STEM GPA. The primary dependent variable was grades in STEM courses (math and science) for the fourth grading period of the year. As is common, we scored grades from individual courses on a 4-point GPA scale (i.e., A = 4, A− = 3.67, B+ = 3.33, etc.) and then averaged them. We did the same for the preintervention grading periods. Math courses were Algebra 1, Algebra 2, or geometry (depending on where guidance counselors placed students); all students took biology, although some students were in more advanced biology classes than others.

a a a The two conditions did not differ in terms of word count of their written responses, $t(319) = -0.10$, $p = .92$, suggesting that, at least along this index, the two interventions elicited similar levels of engagement with the activity. Next, students successfully responded to the prompt. Some examples for the purpose intervention condition were:

> I would like to get a job as some sort of genetic researcher. I would use this job to help improve the world by possibly engineering crops to produce more food, or something like that.

or

> I believe learning in school will give me the rudimentary skills to survive in the world. Science will give me a good base for my career in environmental engineering. I want to be able to solve our energy problems.

or

> I think that having an education allows you to understand the world around you. It also allows me to form well-supported, well-thought opinions about the world. I will not be able to help anyone without first going to school.

a a Did the purpose intervention improve overall grades in STEM-related courses (math and science)? It did, as shown in Figure 4. In an OLS regression, there was a full-sample effect of the one-time intervention on STEM-course GPA in the months following the experiment (Control covariate-adjusted M = 2.93, SD = 1.03; Purpose covariate-adjusted M = 3.04, SD = 0.89), $t(337) = 3.20$, $p = .001$, $d = 0.11$.[7] As is standard procedure in analyses of psychological intervention effects on GPA (Blackwell et al., 2007; G. L. Cohen et al., 2009; Walton & Cohen, 2011; Yeager et al., 2014), this analysis was conducted controlling for prior performance (in the present case, third grading period grades; the same findings emerged controlling for all prior grading periods). Indeed, doing so reduced the standard errors associated with the condition variable, allowing for more precise estimates of treatment effects and maximization of statistical power.[8] Additional models that added controls for race, gender, age and level of math course did not change the finding of a main effect of condition on GPA ($p = .001$). These control variables also did not moderate treatment effects (all interaction effect ps $> .15$).[9]

Under the assumption that low-achieving math and science students might be more likely to be disinterested (see, e.g., Skinner, Kindermann, & Furrer, 2009; also see Hulleman & Harackiewicz, 2009), we tested whether the purpose for learning would have the greatest effect on students who were earning the lowest math and science grades preintervention. Indeed, there was a significant Purpose Intervention × Preintervention GPA interaction, $t(338) = -2.92$, $p = .004$, such that lower performing students benefitted more. To illustrate this interaction, which was tested using the continuous preintervention GPA variable, it is possible to examine simple effects within meaningful subgroups of lower performers (students with a GPA < 3.0) and higher performers (GPA of 3.0 or higher). A cut-point of a GPA of 3.0 was selected for this illustration because an analysis of high school transcripts and college enrollment statistics identified this as the best GPA threshold for college readiness (Roderick, Nagaoka, & Allensworth, 2006). Among lower performers, who are typically less likely to successfully complete college on the basis of their high school GPAs, there was a significant treatment effect of 0.2 grade points, $t(119) = 2.90$, $p = .005$, $d = 0.21$. This is shown in Figure 4. Among higher performers, there was a nonsignificant effect of 0.05 grade points, $t(207) = 1.38$, $p = .17$, $d = 0.06$.

Thus, the self-transcendent purpose for learning increased STEM-course grades for students overall, but especially so for low-performers who were on track for being underprepared for higher education. This result mirrors past intervention studies, which have found that lower performing students tend to benefit most from activities that redirect their thinking about academic work in a positive way (e.g., G. L. Cohen et al., 2009; Hulleman & Harackiewicz, 2009; also see Wilson & Linville, 1982). It is of course possible that this moderation by baseline grades is a statistical issue; indeed, A, A−, and B + students have less room to improve. At the same time, to the extent that lower grades could be caused by disinterest and disengagement (see, e.g., Skinner et al., 2009), the present moderation is consistent with the theory that the purpose intervention would confer the greatest benefits when disinterest and disengagement are greatest.

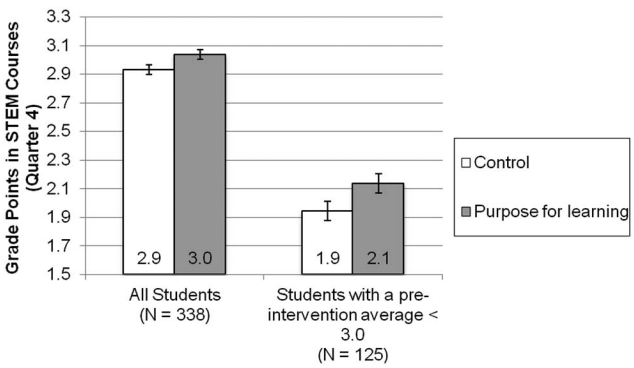

Figure 4. A self-transcendent purpose for learning intervention raises grades in math and science for all students but especially for poor performers in Study 2 (students with a GPA below 3.0 in the preintervention quarter). Error bars indicate 1 standard error. STEM = science, technology, engineering, and mathematics.

Extending the Study 1 correlational findings, Study 2 showed that a self-transcendent purpose intervention could affect overall achievement in STEM courses several months into the future. How could a brief purpose intervention increase official GPA? In the next two studies we sought to illuminate some of the behavioral processes that might be set in motion by the self-transcendent purpose manipulation.

a

Study 2 was a contribution in showing a causal effect of a one-time self-transcendent purpose intervention on accumulated behavior over time—specifically, GPA in high school STEM classes. It provides causal evidence for the kinds of achievement effects that may have produced the Study 1 correlational finding that purpose for learning predicted college persistence. However, a

[7] Cohen's d effect sizes were calculated by dividing the covariate-adjusted treatment effect by the raw, pooled standard deviation.

[8] Even without controlling for baseline performance—which reduced the standard error for the treatment effect by more than 250%—the treatment effect on final grades was marginally significant ($p = .06$).

[9] While our primary focus was on STEM course GPA, the participating school also provided students' English grades. Supplemental analyses showed that there was a full-sample effect of the purpose intervention on fourth grading period English grades of .15 grade points, $t(329) = 2.18$, $p = .03$, including the same covariates noted above. Perhaps this was because students found freshman year English to be boring, or perhaps this is because the intervention led to a general increase in engagement in school that spilled over to English class.

number of issues remain. Study 2 did not document which short-term behaviors were affected by the intervention and that subsequently added up to the long-term treatment effect. For instance, we do not know if a self-transcendent purpose increased overall grades by making students more likely to truly learn from their academic experiences, as opposed to moving as quickly as possible through their academic work without trying to retain the information for future use (see Jang, 2008).

Study 3 was a naturalistic field experiment conducted among undergraduates preparing for one of their final exams in their psychology course. A few days before the exam, the instructor e-mailed students a survey link that randomized them to a purpose intervention or a control exercise. The survey then directed students to complete a tedious (>100-question) web-based test review. Our hypothesis was that the self-transcendent purpose intervention would increase students' attempts to seriously review the material, operationalized as the average amount of time spent on each question. Notably, the materials were presented as an actual extra-credit exercise, not as a study, in order to more closely recreate the real-world choices students might have been making in Study 2.

a a A total of 89 second- through fifth-year students in an undergraduate psychology course received an e-mail inviting them to access a test review and receive extra credit. A total of 71 (80%) completed the intervention materials and provided any data on dependent measures. Of these, 78% were women. There was no stopping rule because all students in the class were invited. No data were excluded.

Note that in this study (and Study 4), participants are college students, not high school students. In part this is because of our interest in understanding the processes that lead to the attainment of long-term educational goals such as college graduation (e.g., Study 1). This sample was also convenient. This difference in sample provides the benefit of possibly generalizing the prior results. It would be informative if a self-transcendent purpose for learning intervention produced analogous effects among high school freshmen (Study 2), high school seniors (Study 1), and college students (Studies 3 and 4).

Near the end of the term, students completed the online purpose intervention and exam review activity. During the review activity, the survey software tracked students' behavior (e.g., time spent on each practice problem), and this constituted the primary dependent measure.

More specifically, 2 days before an exam, students were sent the following e-mail from their professor:

> Hello class. I'm currently working on an online activity to help the students in my class do better. This online activity involves two things. First, it helps you think about how our psychology class fits into the context of your lives. Second, I've created an online activity to help you study the course material and prepare for your next exam, which involves showing you several sample multiple-choice questions that are similar to the kinds of questions that you will be tested on during EXAM 3. Since this online tool is still a work in progress, I'm offering you 2 points extra credit (to be applied to your lowest exam score) if you decide to go through it and help refine it. . . . [It] will take as long as you'd like–you can answer as many or as few questions as you want.

Purpose and control exercises. The self-transcendent purpose materials were highly similar to those used in Study 2. They were edited slightly to refer to reasons for learning psychology, so that the materials could conceivably be seen as related to the psychology course. The normative quotes were also framed as coming from former students in the course, as opposed to upperclassmen in general. The control exercise was highly similar to the Study 2 control group, only it discussed how learning in college is different from learning in high school. Both of these changes were made because the experiment was conducted as institutional research, which means that the goal of the study was to improve instructional practice, although the data could also be used for generalizable knowledge. And in fact the review boosted grades, dramatically so for the lowest performers across conditions (see online supplemental materials). This ethics arrangement also had implications for random assignment. Because the research team already possessed evidence that the intervention could benefit students (e.g., Study 2) and because there were real-world grades at stake for students, for ethical reasons 75% of students received the purpose intervention and 25% received the control. Furthermore, no self-report attitudes or other psychological measures were assessed. Only students' postmanipulation behaviors on the review materials were measured.

a As a dependent measure, we created a situation that was tedious: reviewing for a test by answering over 100 multiple-choice questions. We then measured behavior that could signify an intention to truly learn from it: time spent on each review question. All questions were taken from a psychology test bank. On average, students answered 90 questions and spent 40 min doing so. Review questions were programmed so that students could not proceed to the next question until they answered it correctly, and task instructions clearly stated that spending more time on each question—rather than just guessing randomly until they got it right and could move on—signaled a desire for deeper learning. The instructions were,

> IMPORTANT: HOW TO ACTUALLY LEARN FROM THESE QUESTIONS
>
> New cognitive psychology research shows that simply guessing on multiple-choice questions does not promote deep learning on the activity, because it doesn't force you to retrieve the information. . . . So, if you want to deeply learn from this activity, it is best to look through your notes and the textbook and try to recall the information while answering the questions, as if you were really taking an important exam.

Students were also given web links to actual published empirical articles showing that memory is improved only by earnest retrieval behaviors. Thus, we created a situation in which the longer students thought about each question before trying to answer it, and the longer they spent clarifying their understanding before moving on, the more they were choosing to "learn deeply" from the activity. We conducted a number of additional analyses to confirm this theoretical interpretation of the data, and they are reported in the online supplement.

The survey software recorded the number of milliseconds that each question was displayed before students ultimately submitted a correct answer. These values were summed and then divided by the number of questions attempted, to produce an average time per

question per person. Treatment versus control students did not differ in terms of the number of questions students completed ($p = .38$), but the effect was in the direction of treated students completing more problems (see online). As is common in analyses of time, our measure showed significant skew and kurtosis (joint test $p < .00001$). We therefore conducted a "ladder of powers" analysis (Tukey, 1977) to identify the transformation that best reduced deviation from normality (it was one divided by the square root of the number of seconds). The ladder analysis and subsequent transformation were done blind to the effect of the transformations on the significance of the intervention effect. The transformed measure had no significant skew or kurtosis (joint test $p = .90$). Time was ultimately coded so that higher numbers corresponded to more time on average on each page, and then *z*-scored to have a mean of zero and a standard deviation of 1. All analyses are from regressions that control for prior test performance, which significantly predicted time per page and reduced standard errors associated with treatment effects.

Results showed that a self-transcendent purpose for learning increased the tendency to attempt to deeply learn from the tedious academic task. Students who completed the self-transcendent purpose intervention spent more time working on each review question (Z-scored time per question: Control $M = -0.43$, $SD = 1.11$; Purpose $M = 0.13$, $SD = 0.93$), $t(69) = 2.11$, $p = .038$, $d = 0.56$. In the untransformed data, this corresponded to spending roughly twice as much time on each question (Control $M = 25$ s per question vs. Treatment $M = 49$ s per question).[10]

Study 3 investigated one of the short-term behaviors that might have led to the long-term effects of a purpose in Study 2: deeper learning on a tedious exam review. Students spent twice as long on their review questions when they had just written about how truly understanding the subject area could allow them to contribute to the world beyond the self, compared to controls. Importantly, this was done in a naturalistic setting—that is, looking at real world student behavior on an authentic examination review. Perhaps the purpose intervention increased grades over time in Study 2 because it led students to complete their academic work in a qualitatively distinct fashion—one that privileged learning and retention over "getting through it."

a a a

The findings from Study 3 suggest one way in which a one-time self-transcendent purpose intervention might have increased overall grades in STEM courses in Study 2: deeper learning during review activities. However we have not shown that the purpose manipulation altered students' abilities to regulate their competing desires. That is, we have not shown effects in situations that clearly require self-regulation. To begin to answer this, a more precise behavioral test is required—one that pits the desire to meet one's learning goals against the desire to give up and engage in a tempting alternative.

Therefore Study 4 examined behavior on the "diligence task" described in Study 1 (also see Figure 2). This task simulates a common experience for students: having to complete problem sets for math and science classes while being tempted to consume entertaining media on the Internet. Thus, the present study allowed for a face-valid test of our hypothesis that a self-transcendent purpose for learning could lead students to continue to solve math problems and eschew tempting alternatives even as boredom is increasing.

Second, it would be helpful to know if a self-transcendent purpose could benefit all learners, but especially when a task is most uninteresting. Therefore, instead of examining between-person differences that might moderate treatment effects, as in Study 2, Study 4 focused on within-person differences. That is, Study 4 examined whether the purpose manipulation would lead to more math problems solved on the later trials of the diligence task, when boredom is greatest.

Study 4 was primarily designed to address these two research questions. However a third objective was to test whether simply emphasizing the self-oriented benefits of learning in school would be sufficient to promote academic self-regulation. Recall that Studies 2 and 3 compared the purpose manipulation to a neutral control exercise, something that has often been done in many past social-psychological interventions that have affected long-term educational outcomes (e.g., Hulleman & Harackiewicz, 2009; Walton & Cohen, 2011). Yet it is unknown whether an analogous self-oriented manipulation would show the same benefits as the purpose manipulation. While Study 1 is helpful in showing the unique correlational effect of a self-transcendent purpose, an analogous experimental study has not been conducted. To address this, in the second of the two samples included in the present study we added a self-oriented condition, making it a three-cell design. We hypothesized that the self-oriented condition would not be sufficient to lead to higher numbers of math problems solved when boredom was greatest, compared to controls. We did not have a strong prediction about the comparison between the self-oriented condition and the purpose condition, however, because the former was intentionally designed to share much of the same content, and because past research has found these two groups do not differ significantly (Yeager et al., 2012; also recall the inconsistent Wald test results in Study 1).

a a Participants (total $N = 429$) were two samples of students taking introductory psychology at the University of Texas at Austin in consecutive semesters. They participated in exchange for partial course credit. Forty-eight percent were male, and 52% were female. Race and ethnicity information was not collected from these students; however, the freshmen cohort at the university (which historically closely mirrors introductory psychology) is 57% White, 18% Asian, 17% Hispanic/Latino, and 5% African American. Students were predominately first- or second-year students: 37% were 18 years old, 36% were 19 years old, and

[10] It was also possible to explore treatment effects on actual scores on the final exam administered a few days after the study. Exploratory analyses found that the large majority of students showed greater improvement in test scores in the purpose condition compared to the control. Analyses are presented in the online supplemental materials.

15% were 20 years old. Data were collected during daytime hours in the last few days of the semester, a time when self-regulation might have been precarious due to final exams.

Sample 1 had no stopping rule. We sought to collect as much data as possible (final $n = 117$) before the end of the term, and data were not analyzed until after the term was over. Sample 2 was collected the following semester and so it was possible to conduct a power analysis based on the results of Sample 1 before collecting data. This led to a target sample size of 300 for Sample 2, because a power analysis revealed that roughly 95 participants per cell would be required to have 80% power to detect an effect of $d = 0.41$ between any two conditions (the effect size estimate for the purpose intervention from Sample 1). Ultimately Sample 2 involved usable data from a maximum of $n = 312$ students (data collection was stopped at the end of the first day on which more than 300 complete responses had been collected). Some students did not provide data for some measures, and so degrees of freedom varied across analyses. No data were excluded except for those mentioned here or in the online supplement.

The intervention procedures were nearly identical to those used in Study 3. Immediately after completing the intervention materials, participants completed the diligence task as described in Study 1.

Purpose and control exercises. These were nearly identical to those used in Study 2.

Self-oriented control exercise. Sample 2 had a three-cell design that added a self-oriented (and intrinsic) condition to the control and self-transcendent purpose conditions. The self-oriented manipulation was similar to the purpose manipulation in nearly every way except for the elimination of self-transcendent prompts in the stimuli. It was future-oriented, goal-directed, and highly focused on learning and on developing skills—all things expected by theory to promote a commitment to learning (e.g., Lepper et al., 2005; Ryan & Deci, 2000; Vansteenkiste et al., 2006). This is a highly conservative test in that the manipulations shared much of the same content—approximately 90% of the text was the same. Also recall that Study 1 indicated that self-transcendent and self-oriented motives were strongly correlated ($r = .66$). The present self-oriented control group was designed to rule out the alternative explanation that *any* manipulation involving reading and writing about intrinsic personal motives for learning would be sufficient to lead to greater self-regulation on an uninteresting task.

In the self-oriented exercise, an initial essay question asked about changes in the world. This held time-perspective and counterfactual thinking constant, both shown to affect level of construal, which could promote self-regulation (Trope & Liberman, 2010, 2011). However, this prompt asked how the world might be changed to benefit the self, rather than to address an injustice in the world:

> How could the world be better for you? Sometimes the world isn't what you want it to be, and so everyone thinks it could be better for them in one way or another. Some people want more fun, some want it to be less stressful, and others want to be more interested in what they're doing. Other people want lots of other changes. What are some ways that you think the world could be better for you?

All but one of the summary statistics and all but one of the representative quotes were identical across conditions. For the one quote that was not the same, we removed self-transcendent information without sacrificing a focus on building skills, so that it read,

> For me, getting an education is all about learning things that will help me do something I *can be good at—something that I can be the best at.* I used to do my homework just to earn a better grade and look smart. I still think doing well in school is important, but for me it's definitely not just about a grade anymore. I'm growing up, and doing well in school is all about preparing myself to do a job *that I can be good at. That seems really rewarding to me—knowing that at the end of the day you completed an important job, and you did an awesome job at it.* [Differences from the quotation in Study 2 shown in italics.]

Next, participants were asked to share their own testimonials. The prompt closely mirrored the purpose condition and strongly emphasized the acquisition of skills (rather than the accumulation of extrinsic benefits). It asked "Why is learning important to your goals," and "How will learning in school help you be the kind of person you want to be and help you have a career in life that you enjoy or are interested in?" It was designed to promote a suite of self-oriented motives, including task value (i.e., personal interest) and utility value (i.e., gaining a fulfilling career; Eccles & Wigfield, 1995, 2002). Supplementing this was a clear invocation of mastery goals for learning (Elliot & McGregor, 2001). All of these motives, on their own, might be expected to promote persistence. Yet this manipulation lacks explicit mention of the potential to use that mastery to benefit others, allowing for a test of our theory regarding the benefits of *adding* self-transcendent motives, above and beyond this suite of more self-oriented motives.

a Participants completed the same behavioral measure of academic self-regulation (i.e., the diligence task) that was used in Study 1 (see Figure 2). As in Study 1, we analyzed the total number of correct math responses.[11] Performance on each of the two blocks was analyzed separately to allow for a test of whether self-regulatory benefits would be greatest when boredom had increased. To verify the extent to which the task was boring for participants in all conditions, at the end we asked participants whether the task was in fact boring, using the same item described in Study 1.

a **a** The primary theoretical interest was in whether the purpose for learning condition differed from the control condition in terms of behavior on the diligence task. Because, as will be shown, this focal comparison was significant independently within Samples 1 and 2, we primarily analyze a stacked data set and in statistical models we include a dummy variable for sample (and of course the self-oriented condition data are excluded in those analyses).

A secondary question was whether the self-oriented manipulation produced the same or a different pattern of results as the purpose for learning manipulation. Therefore we next conducted analyses of the self-oriented manipulation using only data from Sample 2. We hypothesized that the self-oriented condition would

[11] As in Study 1, we treated people who stopped the task altogether after the first block as a "0," as in Study 1, to avoid dropping data. The statistical significance levels of the focal analyses (Block 2 math problems successfully answered) were no different when omitting participants who did not begin Block 2.

not differ from controls. We did not have strong hypotheses about differences from the purpose condition, given the overlap between the two manipulations and the strong endorsement of learning goals in the self-oriented condition.

a a a The experimental manipulations again appeared to elicit similar levels of thinking and writing about their respective topics; there were no differences across conditions in terms of the word count on the open-ended essay prompts: Sample 1 $t(116) = 0.50$, *ns*; Sample 2 $F(2, 282) = 0.13$, *ns.* Next, the diligence task was experienced as truly boring. Fully 73% of participants said they were "Extremely," "Very" or "Somewhat" bored when working on the math problems, while only 4% said they were "not bored at all." Ratings of boredom did not differ by condition: Sample 1 $t(116) = 0.47$, *ns*; Sample 2: $F(2, 282) = 1.27$, *ns*. Thus, this study was a test of whether participants would display greater self-regulation on a task that was experienced as equally boring across conditions.

a a a Did the self-transcendent purpose manipulation affect the number of math problems correctly solved? On the first block in the stacked data set, the purpose manipulation had no effect compared to the control, $t(310) = 0.18$, $p = .86$ (or in either sample): Sample 1 $t(116) = 0.19$, $p = .85$; Sample 2 $F(2, 283) = 0.57$, $p = .56$). However recall from the methods of Study 1 that the second block in the diligence task is experienced as much more tedious and aversive compared to the first block (and significantly so). Therefore differences were predicted to emerge precisely when participants became most bored, in Block 2.

This is what the data showed, as depicted in Figure 5. Specifically, for participants in the control condition, the number of math problems solved dropped precipitously from the first to the second block. Control participants completed 44% fewer problems in Block 2 compared to Block 1 (Control Block 1 raw $M = 66.47$, $SD = 46.29$; Control Block 2 raw $M = 37.12$, $SD = 45.10$), a significant difference, paired $t(164) = 7.51$, $p < .001$, $d = 0.65$. However, for participants who completed the purpose manipulation, the drop in math problems solved from the first to the second block was mitigated. Purpose condition participants completed only 26% fewer problems in Block 2 (Purpose Block 1 $M = 68.62$, $SD = 45.11$; Purpose Block 2 $M = 50.56$, $SD = 49.00$), still a significant difference, paired $t(165) = 4.21$, $p < .001$, $d = 0.38$. Importantly, an OLS regression analysis comparing difference scores (Block 2 problems solved minus Block 1 problems solved, by condition) showed that the decline experienced by the purpose condition was significantly smaller than that experienced by participants in the control condition, $b = 12.45$, $t(309) = 2.10$, $p = .03$, $d = 0.28$. Thus, by the second block, there was a significant effect of the purpose manipulation compared to the control, $t(309) = 2.81$, $p = .005$, $d = 0.32$, such that purpose condition participants completed 36% more boring math problems compared to controls in the second block. This condition difference in Block 2 was significant independently within Sample 1, $t(115) = 2.14$, $p = .03$, $d = 0.40$, and Sample 2, $t(192) = 2.13$, $p = .03$, $d = 0.31$, and did not differ across samples, interaction $t(308) = 0.11$, $p = .90$. Hence, it was a reproducible finding (see Figure 5).

a By contrast, the highly similar self-oriented control group—emphasizing intrinsic motives for learning—did not appear to improve self-regulation on the boring math task compared to controls. Recall that these analyses could only be conducted with data from Sample 2, which is the sample that involved the three-cell experiment. The self-oriented condition did not differ from the control in terms of number of math problems solved, either in Block 1, $t(287) = 0.90$, $p = .39$, $d = 0.11$, or Block 2, $t(287) = 0.92$, $p = .38$, $d = 0.11$, although comparisons were in the direction of more math problems solved for the self-oriented group versus the control. Note that this nonsignificant difference is not likely due to limited statistical power; the purpose condition showed a significant difference from control on Block 2 in Sample 2 (see Figure 5). The self-oriented condition did not differ from the purpose condition in either block, Block 1, $t(285) = 1.37$, $p = .17$, $d = 0.16$, Block 2, $t(285) = -0.99$, $p = .32$, $d = 0.11$.

Also informative is an analysis of changes across blocks. Participants in the self-oriented condition showed a decline in the number of math problems solved that mirrored the control condition, as shown in Figure 5. Participants in the self-oriented manipulation condition solved 32% fewer problems in Block 2 than in Block 1 (Self-oriented Block 1 $M = 82.43$, $SD = 73.52$; Block 2 $M = 55.63$, $SD = 45.65$), $t(86) = 6.00$, $p < .001$, $d = 0.45$. An analysis of difference scores found that this change across blocks did not differ from the same changes seen in the control condition, $t(286) = 0.35$, $p = .73$. However the change score did differ significantly from the changes seen in the purpose condition, $t(286) = -2.17$, $p = .03$, $d = 0.26$, showing that the purpose manipulation was significantly better at warding off a decline in math problems solved across blocks compared to the highly similar self-oriented manipulation.

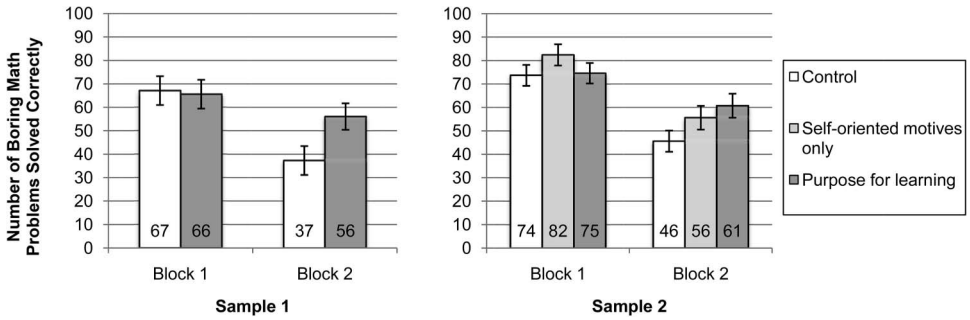

Figure 5. A self-transcendent purpose for learning intervention sustains self-regulation on the "diligence task" in Study 4. Error bars indicate 1 standard error.

Inspecting Figure 5, it is interesting that students in the self-oriented manipulation condition showed an initial, nonsignificant boost in Block 1 problems solved compared to controls. This may have been contributing to the significant comparison between the purpose and self-oriented conditions in terms of difference scores across blocks. It is possible that the self-oriented manipulation led individuals to try harder initially, on Block 1, but this effort sapped their self-regulatory ability on the subsequent trial, Block 2. This will be important to investigate in future research. Regardless, simply reading and writing about intrinsic self-relevant motives for learning did not lead to significant differences from controls when the task became most boring. By contrast, a highly similar activity that added self-transcendent motives was effective at sustaining self-regulation.

Study 4 extended the evidence about the effects of a self-transcendent purpose on academic self-regulation. It put learners in a situation in which they were asked to complete a tedious, low-level task that had only a tenuous relationship to future work goals, and they were told they could quit at any time and entertain themselves online. In many regards this is the modern dilemma: With ubiquitous entertainment at our fingertips, learners must exercise self-discipline even when they do not know whether they themselves or someone else will benefit from their hard work in the long term. We showed that learners could be helped in such situations when they reflected on how their future role in society might contribute in some ways to the world beyond the self. These individuals were better able to maintain their level of persistence and overcome temptation even when boredom was growing.

a

Many repetitive, foundational, skill-building math and science tasks are experienced as tedious or boring (Raytheon Company, 2012; Stigler & Hiebert, 1999). Our research found that when it is difficult to make a task *interesting* it can be helpful to focus on creating personal *meaning* by promoting a prosocial, self-transcendent *purpose* for learning (see Brophy, 2008).

In correlational, experimental, and longitudinal studies involving roughly 2,000 high school and college students, a purpose for learning predicted or caused more effective academic self-regulation in the immediate term and over time. A self-transcendent purpose was correlated with more diligence in the face of tempting alternatives and also greater college persistence rates among low-income, urban, predominantly minority students (Study 1). A brief experimental intervention to promote a self-transcendent purpose increased overall STEM-course grades several months later (Study 2). Studies 3 and 4 clarified the nearer-term effects of this manipulation. A self-transcendent purpose doubled the amount of time students spent on tedious exam review questions (Study 3) and increased by 35% the number of boring math problems students solved compared to controls, even when they had the option to consume entertaining Internet media at any time (Study 4). Adolescents with more of a self-transcendent purpose for learning also literally saw learning tasks differently. They were more likely to say that pictures and descriptions of quotidian academic tasks were linked to important and personally meaningful academic goals (Study 1; for causal evidence, also see the pilot randomized experiment reported in the online supplement and referenced in Study 2). All told, it seems that when adolescents had a personally important and self-transcendent "why" for learning they were able to bear even a tedious and unpleasant "how" (cf. Frankl, 1963).

Previous research has shown that having a prosocial, self-transcendent motive for engaging in a behavior can lead to greater persistence on repetitive and uninteresting tasks at work (see Grant, 2007, 2013). The present research extended this by examining situations in which a person was completing skill-building tasks that have no immediate payoff for others but may prepare one to make a contribution in the future—such as doing single-digit subtraction or completing tedious multiple-choice questions. We found that a self-transcendent purpose for learning could alter a person's self-regulation in such circumstances.

This type of result might well generalize to nonschool settings. Do armed forces cadets engage in more vigorous physical exercise when they see themselves as preparing to protect civilians from harm versus protecting themselves from harm? Do computer hackers spend more hours learning syntax when they anticipate using it to resist an oppressive government versus stealing money or content for personal consumption? We believe the findings here might offer a perspective on the causes of persistence on foundational skill-development tasks in a number of settings.

The present research is also an advance because it documents the development of a new research tool to examine the causal impact of a self-transcendent purpose for learning. Unlike research that has developed psychological interventions to undo the belief that academic struggle might mean you are "dumb" (Aronson et al., 2002; Blackwell et al., 2007; Wilson & Linville, 1982), or that you might not belong or be valued in a setting (G. L. Cohen et al., 2009; G. L. Cohen & Sherman, 2014; Harackiewicz et al., 2014; Walton & Cohen, 2011), research on youth purpose has to date been limited mostly to correlational survey analyses or qualitative interviews, preventing strong causal inferences (Bronk, 2012; Burrow & Hill, 2011; Yeager & Bundick, 2009; see Hill, Burrow, & Sumner, 2013; but see Hulleman & Harackiewicz, 2009). The intervention developed here has the advantage of web-based scalability and replicable effects in different populations using different outcomes. It will hopefully spawn future experimental investigations on the effect of a purpose for learning and perhaps, eventually, improvements to educational practice.

Another innovation of this research stems from the fact that the self-transcendent purpose predicted or affected consequential educational behaviors, even among disengaged students or students attending urban public high schools. Behavioral economic strategies to reduce inequality such as paying low-income students for completing their homework have been applied broadly and found to have no consistent positive effects on overall achievement (Fryer, 2011). Yet a free, roughly 20-min, web-based intervention led students to choose to persist on unpleasant academic tasks and also earn higher grades. This is a testament to the power of psychological theory (e.g., Damon et al., 2003; Hulleman & Harackiewicz, 2009), to lead to behavior change in situations where more traditional economic efforts fail (also see Ross & Nisbett, 1991). Furthermore, this research counteracts potential stereotypes about how to motivate low-income students attending urban public

schools. Many of the students in Study 1 said that they wanted to contribute to the world beyond themselves, not just make money. And when they said this, they were more likely to demonstrate self-control and make progress toward long-term goals. This suggests that telling these students to focus on how they can make more money if they go to college may not give them the motives they need to actually make it to college graduation. Instead, perhaps cultivating motives that transcend the self could provide them with the personal meaning they need to sustain self-regulation.

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Social psychology has a long history of documenting counterintuitive but reproducible effects of brief interventions that affect health, stress, or achievement months or years later, even though the mechanisms for these effects have remained obscure (e.g., G. L. Cohen & Sherman, 2014; Wilson & Linville, 1982; see Pennebaker, 2004). In these past studies and in the present research, it is often easier to understand why a manipulation would affect immediate outcomes than it is to understand why the intervention would "stick" over time, resulting in effects on overall GPA (G. L. Cohen & Sherman, 2014; Yeager & Walton, 2011). High school students undoubtedly receive many messages from valued adults entreating them to pay greater attention to their schoolwork. Why would the brief message delivered over the Internet in Study 2 stand out?

Extant theory and some of the present data speak to this issue, but more research is needed. Specifically, theory has pointed to the fact that school is an environment in which recursive processes abound. Later knowledge builds on prior knowledge, later interactions with peers or teachers depend on relationships and reputations built in prior interactions, and later self-views and goals depend on prior thoughts and experiences (G. L. Cohen et al., 2009; G. L. Cohen & Sherman, 2014; Yeager & Walton, 2011). When a social-psychological intervention redirects a key motive for doing well in school, then it is possible for a "virtuous cycle" to gain momentum and affect diverse outcomes. A social psychological intervention might add up to accumulated effects via small adjustments in the probabilities of exerting self-control or deeply learning during tedious tasks (Abelson, 1985; also see G. L. Cohen & Sherman, 2014; Garcia & Cohen, 2012; Walton, 2014). Studies 3 and 4 speak to this possibility directly, but the full mediational process remains undocumented.

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One limitation of our research is that we did not investigate participants' strategies for self-regulation. Did participants with more of a self-transcendent purpose engage in mental actions to make uninteresting tasks more *appealing* or were they simply better at *suppressing* the urge to quit and engage in the tempting alternative? Past research suggests that both are possible (e.g., Fishbach & Shah, 2006; Fishbach et al., 2010; Fishbach, Zhang, & Koo, 2009). For instance, Sansone et al. (1992) showed that when participants were asked to complete an uninteresting task and were given a rationale for why it might be personally important, participants implemented ways to make it feel subjectively more interesting. They randomly varied their method of completing the task (also see Sansone, Wiebe, & Morgan, 1999). Meanwhile, Mischel, Ebbensen, and Zeiss (1972) found that self-regulation on a delay of gratification task was facilitated through cognitive strategies to mentally transform the tempting alternative into something that felt less appealing. Unpacking which of these alternative strategies emerge from the self-transcendent purpose for learning could shed light on the underlying psychological processes in the present research.

A crucial caveat is that our research does *not* definitively show that intrinsic interest-driven motives are unimportant for self-regulation. Instead, what we showed was that with the same statistical power the self-transcendent purpose manipulation—which also invoked self-oriented motives–was more reliably different from the control manipulation that focuses exclusively on self-oriented motives (Study 4; also see the Study 2 pilot reported in the online supplement). Self-transcendent motives were sometimes but not always stronger predictors than self-oriented ones in a multiple regression (Study 1). The finding that the intrinsic-interest-driven motives were "in the middle" mirrors past longitudinal research (Yeager et al., 2012) and has some intuitive appeal. If learners are seeking tasks that interest them or have some other intrinsic benefit to them, then they may show a general boost in motivation on school-related tasks. However, those only seeking benefits for the self may not persist on aversively tedious, low-level learning tasks in the face of alternatives that more readily satisfy their desire for interesting activities.

The present research has focused on the role of a purpose for learning in skill-building activities. However when expert performance is of interest, then the belief that others are counting on you to perform well may not be beneficial. Such worries may interfere with working memory and increase the chance that a person will "choke" due to heightened anxiety (Beilock, 2011). Indeed, experimental procedures designed to induce anxiety and undermine performance sometimes explicitly involve telling participants that others' outcomes will be negatively affected if they fail (e.g., see Beilock, Kulp, Holt, & Carr, 2004). Perhaps a self-transcendent purpose would undermine high-stakes performance. Thus, an important avenue for future research will be to illuminate whether a self-transcendent purpose is as effective in performance contexts as it appears to be in learning contexts.

Finally, it is crucial to underscore that the self-transcendent purpose intervention is not a "magic bullet" for underachievement. Rather, it is a context-dependent solution to a particular psychological barrier (G. L. Cohen & Sherman, 2014; Yeager & Walton, 2011)—in this case, the feeling that tedious academic tasks are meaningless and school has no connection to one's purposes in life. In settings or among individuals where this belief is not prominent—or in settings that are not quite as recursive—then the type of intervention tested here would not be predicted to have a lasting effect. We think of the present results as an existence proof, not a guaranteed effect size across all settings. Research designed to understand the moderating mechanisms of brief interventions and likely boundary conditions for them is a high priority in social and developmental psychology (G. L. Cohen & Sherman, 2014; Garcia & Cohen, 2012; Walton, 2014; Yeager & Walton, 2011; also see Wilson, 2011).

In a recent nationally representative survey, 69% of American K–12 teachers reported that students' lack of interest in learning was a problem in their classrooms. In fact, this was the classroom problem most frequently cited by teachers (Bridgeland, Bruce, & Hariharan, 2013). Of course, sometimes low motivation can be addressed by simply making coursework more interesting. Yet not all assignments can be made interesting at all times. If a teacher connects the day's lesson to the idiosyncratic interest of one student (e.g., emphasizing the relevance of math for understanding sports) it may disengage another student (e.g., a student who does not like sports). Even when relevant connections can be made for large groups of students, it can be difficult, logistically and convincingly, to do this for all tasks every day.

In such instances a higher order, self-transcendent *purpose* for working hard and learning in school might effectively lead to self-regulation. Strikingly, however, there is little or no focus on promoting self-transcendent aims in expert guides for educational practitioners (e.g., Mitchell et al., 2005; National Research Council, 2000; National Research Council & the Institute of Medicine, 2004; Pintrich & Schunk, 2002). We hope the present experimental interventions, combined with past experimental research (e.g., Grant, 2007, 2013), can begin to encourage a shift in thinking toward beyond-the-self aims. Of course, encouraging a self-transcendent motive is not a replacement for other motivational strategies, especially not self-oriented, interest-based ones. But the data presented here show that a self-transcendent motive can in some cases serve as an important addition to interest-based approaches.

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Received September 16, 2013
Revision received March 10, 2014
Accepted March 31, 2014 ■