Changes in Children’s Self-Competence and Values: Gender and Domain Differences across Grades One through Twelve

Janis E. Jacobs, Stephanie Lanza, D. Wayne Osgood, Jacquelynne S. Eccles, and Allan Wigfield

This study extended previous research on changes in children's self-beliefs by documenting domain-specific growth trajectories for 761 children across grades 1 through 12 in a longitudinal study of perceptions of self-competence and task values. Hierarchical Linear Modeling was used to (1) describe changes in beliefs across childhood and adolescence within the domains of mathematics, language arts, and sports; (2) examine the impact of changes in competence beliefs on changes in values over time in the same domains; and (3) describe gender differences in mean levels and trajectories of change in competence beliefs and values. The most striking finding across all domains was that self-perceptions of competence and subjective task values declined as children got older, although the extent and rate of decline varied across domains. For example, in language arts, competence beliefs declined rapidly during the elementary school years, but then leveled off or increased to some extent; whereas the decline in self-competence beliefs in sports accelerated during the high school years. Significant gender differences in beliefs were found in most domains; however, the gender differences in developmental trajectories appeared to be domain specific rather than global. Importantly, the gender differences between boys and girls did not systematically increase with age, as predicted by some socialization perspectives. Adding competence beliefs as an explanatory variable to the model for task values revealed that changes in competence beliefs accounted for much of the age-related decline in task values. In addition, competence beliefs accounted for most of the gender differences in task values for language arts and sports.

INTRODUCTION

The development of children's beliefs about self-competence has been of great interest to researchers because such beliefs are related to both achievement motivation and self-esteem. Research on achievement motivation has documented the role of self-competence beliefs as mediators of actual achievement in various domains (for a review, see Eccles, Wigfield, & Schiefele, 1998). According to numerous theories (e.g., attribution theory, self-efficacy theory, self-worth theory) children perform better and are more motivated to select increasingly challenging tasks when they believe that they have the ability to accomplish a particular task (e.g., Bandura, 1994; Covington, 1984; Weiner, 1985). Although early work (e.g., Shavelson, Hubner, & Stanton, 1976) emphasized the relations between global beliefs about the self and achievement, most current research and theory (e.g., Byrne, 1996; Eccles et al., 1998; Harter, 1998; Marsh, 1993a for review) focuses on the links between domain-specific self-competence beliefs and domain-specific motivation and performance.

In addition to competence-related beliefs, motivation researchers have assessed other constructs that may be crucial to children's achievement choices (see Eccles et al., 1998). One such construct is children's valuing of particular tasks or activities. Although less empirical work has focused on the role of task-specific values, related constructs (e.g., importance, intrinsic motivation) have been emphasized in the theoretical models of Harter (1986) and Deci and Ryan (1985). Larson (2000) also highlighted the role of intrinsic motivation in maintaining involvement in extracurricular activities, such as sports. Eccles' and colleagues (Eccles et al., 1983) have developed an expectancy-value theory of task choice in which children's competence beliefs and subjective task values within a specific domain are crucial to motivation and to future achievement choices within that domain. They have emphasized the distinctive contributions made by competence beliefs, expectations for success, and task values to achievement and choice in different domains (e.g., math, English, sports), and have provided support for the expectancy-value model by showing that self-competence beliefs are related to achievement, even after controlling for previous achievement or ability in a variety of domains (Eccles, 1987; Eccles, Adler, & Meece, 1984; Eccles, Wigfield, Harold, & Blumenfeld, 1993; Meece, Parsons, Kaczala, Goff, & Futterman, 1982; Wigfield, Eccles, Mac Iver, Reuman, & Midgley, 1991). In addition, they have found that domain-specific values predict current and future activity choices (Eccles & Harold, 1991; Eccles & Wigfield, 1995; Feather, 1988; Meece, Wigfield, & Eccles, 1990; Wigfield, 1994). Research in the area of sports participation supports the link be-

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tween values and activity choices by showing that inter-

est is highly related to involvement in sports (Gar-
ton & Pratt, 1987), fun or enjoyment is the most often
reported reason for continued involvement in sports
(Wankel & Berger, 1990), and adolescents choose leis-
ure activities that they consider intrinsically moti-
vating and challenging (Larson, 2000; Larson & Verma,
1999).

Given the predictive role of children's competence-
related beliefs and values, a major emphasis in re-
search on motivation has been an assessment of how
these constructs change as children develop (for re-
views, see Eccles et al., 1998; Stipek & Mac Iver, 1989).
Extant studies have relied primarily on cross-sectional
or short-term longitudinal data. In these studies (e.g.,
Alexander & Entwisle, 1988; Eccles, Wigfield, et al.,
1993; Marsh, 1989; Nicholls, 1978; Nicholls & Miller,
1984; Wigfield et al., 1997), researchers report that
self-competence beliefs decline across middle child-
hood and early adolescence. Decreases in perceptions
of academic self-competence have sometimes been
linked with the transition into junior high (e.g., Eccles
et al., 1989; Eccles, Midgley, et al., 1993), leading to
suggestions about the "goodness of fit" between the
adolescent's developmental stage and the junior high
or middle school environment (Eccles & Midgley,
1989; Eccles, Midgley, et al., 1993). Others (Skinner,
Zimmer-Gembeck, & Connell, 1998) have suggested
that a developmental trend toward viewing self-
competence, rather than effort, as a cause of school
performance may be linked to beliefs about perceived
control and the decline in school engagement for
some children during the transition to middle school.
Although no prior studies have tracked the develop-
mental trajectories of self-beliefs from early elementary
school through high school, evidence from studies of
adolescents (e.g., Eccles et al., 1983; Eccles et al., 1989;
Wigfield et al., 1991) suggest that declines in percep-
tions of self-competence may continue through sec-
ondary school, particularly for math.

Age differences in perceptions of competence also
appear to differ by domain. For example, some
studies (Eccles et al., 1983; Eccles et al., 1989; Marsh,
1989; Wigfield et al., 1991) have found that adoles-
cents have more positive competence beliefs than do
elementary children in English, but that the pattern is
reversed in math. In some less studied domains (e.g.,
sports), conflicting results have been reported. Some
researchers (Eccles & Harold, 1991; Wigfield et al.,
1997) have found no age differences in self-competen-
tce perceptions across middle childhood. Others
(e.g., Marsh, 1989; Marsh, Barnes, Cairns, & Tidman,
1984) have reported age-related declines in self-
concept of physical abilities during middle child-
hood, a decline and then increase during early adoles-
cence, and an increase during later adolescence. These
discrepancies may have been due to the cross-
sectional nature of these studies or to the fact that
sports participation has more options than involve-
ment in academics. Individuals may select types of
sports (e.g., football versus badminton) and competi-
tion levels (e.g., varsity teams versus intramurals)
that maintain positive self-perceptions of compete-
tence. Participation in sports clearly becomes increas-
ingly diverse with age (Flammer, Alsaker, & Noack,
1999; Snyder & Spreitzer, 1992; Wankel & Berger,
1990), and this may be due to the optional nature of
involvement.

Fewer studies on developmental trends in task
values have been performed, especially during the el-

erential school years. The one longitudinal study of
changes in elementary school-aged children's values
(Wigfield et al., 1997) showed sharp declines across
the elementary school years for their valuing of music
and sports, and more gradual declines for their valu-
ing of math and reading. Studies of adolescents also
show domain-specific changes in subjective task
values that vary by domain. Early adolescents' values
for math and sports decrease, but their values for En-

glish remain stable and then increase (Eccles et al.,
1984; Eccles et al., 1983; Eccles et al., 1989; Wigfield
et al., 1991). Similar to the patterns for competence
beliefs, decreases in values for math and English have
been linked to the transition to junior high (Eccles
et al., 1989; Wigfield et al., 1991). No research examin-
ing longitudinal change in task values spanning middle
childhood and adolescence has been reported for any
of these domains.

Although task values and perceptions of compet-
tence have each been linked to achievement out-
comes, few studies have examined the relation be-
tween the two sets of beliefs over time. Harter's
research (1986, 1990) has shown that even when chil-

dren perform similarly in a domain, their self-esteem
varies depending on how much they value the domain.
Poor performance is related to lower self-esteem only
for those who value the domain, suggesting that the
relation between competence and values is important
for self-esteem within a particular domain. Eccles'
model (Eccles et al., 1983) suggests that perceptions
of self-competence impact subjective task values for
a domain, which, in turn, contribute to achievement
outcomes. If children feel competent at a task, they
are more likely to value it over time. Some evi-
dence for this can be found in earlier research (Eccles &
Wigfield, 1995) showing that self-competence and task
values are positively related to each other and that the
relation between competence beliefs and utility value
increases as children get older. Both Harter’s and Eccles’ models and the earlier research suggest that perceptions of competence are likely to be related to increased interest and value for an activity; this may lead children to spend more time on the task, improve their skills, and result in greater long-term engagement over time (Jacobs & Eccles, 2000; Wigfield, 1994). Many others (e.g., Deci & Ryan, 1985; Jacobs, Finken, Griffin, & Wright, 1998; Sansone & Harackiewicz, 1996) have suggested that self-competence is related to intrinsic value for a task and other self-beliefs for children, adolescents, and adults; however, the effects of changes in self-competence beliefs on changes in values have not previously been studied longitudinally. The current study presents the trajectories for longitudinal changes in task values, before and after controlling for self-competence beliefs, to document the effect of one set of beliefs on the other.

An important emphasis of much of the research using the Eccles et al. model has been the role of gender differences in self-perceptions and values as potential mediators of gender differences in achievement choices (e.g., Eccles, Wigfield, et al., 1993; Jacobs & Eccles, 1992; Wigfield et al., 1997). Although gender differences in actual achievement in some academic domains have declined (e.g., math and biology), gender differences in domain-specific self-beliefs continue to be reported (e.g., Crain, 1996; Eccles, Wigfield, et al., 1993; Jacobs et al., 1998; Marsh, 1995a; Marsh & Yeung, 1998; Wigfield et al., 1997). In these studies, boys systematically rated their expectations for success and abilities in male-typed domains (e.g., math, sports) higher than did girls, and girls rated their expectations and abilities in female-typed domains (e.g., English) higher than did boys. In addition, gender differences in participation in sports and other discretionary leisure activities continue to be reported; girls play fewer sports than boys and the differences increase with age (Archer & McDonald, 1990; Larson & Verma, 1999; Shaw, Kleiber, & Caldwell, 1995).

In previous research (Eccles, 1987; Eccles et al., 1984), domain-stereotyped gender differences in self-beliefs appear to emerge during early adolescence and grow larger during the adolescent years. These developmental changes were attributed to differential socialization processes (Eccles, 1987; Maccoby, 1966) and to “gender-role intensification” (Hill & Lynch, 1983). More recently, however, researchers have found that gender differences in competence beliefs and values emerge quite early during the elementary school years (Eccles, Wigfield, et al., 1993; Marsh, 1989; Wigfield et al., 1997), and that the gender differences remain in place through the school years. Interactions of gender and age generally have not been found, providing little evidence for age-related changes in the magnitude of gender differences (Marsh, 1993b; Marsh & Yeung, 1998; Wigfield et al., 1997). No previous studies have traced gender differences in children’s competence beliefs and values across the elementary school, middle school, and high school years. The present study did so.

The evidence just reviewed suggests that critical theoretical and empirical links have already been established between self-beliefs and achievement motivation and that gender differences in self-beliefs may mediate gender differences in selected achievement behaviors. Much less is known about the long-term changes in self-competence beliefs and values during childhood and adolescence, and what is already known is based primarily on cross-sectional or short-term longitudinal data. The goal of this study was to extend previous research by documenting age-related trends across grades 1 through 12 in perceptions of self-competence and activity values across the mathematics, language arts, and sports domains. Although previous studies have investigated changes in children’s perceptions of competence and values, few have used longitudinal data and none have spanned such a large age range. Small perturbations may be magnified and subtle trends may go unnoticed in cross-sectional and short-term longitudinal studies; thus, it is critical to begin to chart changes across longer time periods to create a comprehensive picture of the development of children’s self-beliefs. To accomplish this, we used a cohort-sequential longitudinal design to span a larger age range than has been possible in earlier studies. This design allows for an examination of both longitudinal change and cohort differences, resulting in the strongest test of developmental shifts (see Baltes & Nesselroade, 1979; Menard, 1991); it is rarely used in the field, however, due to the high expense and time demands.

In addition, no previous studies have attempted to examine the impact of changes in competence beliefs on changes in values over time. Changes in the trajectories of subjective task values may be explained, in part, by changes in competence beliefs; but previous studies have been unable to adequately describe the potential impact of changes in self-competence on changes in values over a long period of time, because the appropriate longitudinal data and statistical techniques have not previously been available.

The current study is also unique in that it compared children’s self-beliefs and subjective task values in the three domains of mathematics, language arts, and sports. As suggested earlier, previous studies (Eccles, Wigfield, et al., 1993; Harter, 1982; Marsh, 1989;
Wigfield et al., 1997) have shown that children have clearly differentiated task-specific self-beliefs as early as first grade; therefore, it is important to examine self-beliefs in specific activity domains. Based on the previous literature and our own work, we expected competence beliefs and subjective task values to be highest in the first grade, with decreases across grades 1 through 12 in all domains. In addition, we expected the shape of growth (decline) over time to be generally linear or to be quadratic with a steeper decline during early adolescence, reflecting either gender role intensification or middle school transition (e.g., Eccles et al., 1989; Nottelmann, 1987; Wigfield et al., 1991). Finally, we expected declining competence beliefs to explain some of the decline in values, resulting in flatter trajectories for subjective task values after controlling for competence beliefs. This prediction was based on the expected similarity between the growth curves and the strong relation between changes in competence beliefs and changes in subjective task values.

Due to our interest in gender (e.g., Eccles et al., 1983; Jacobs, 1991; Jacobs & Eccles, 1992; Wigfield et al., 1991), we also examined gender differences in trajectories for these domains. We specifically chose one clearly male-typed domain (sports) and one clearly female-typed domain (language arts). Math was chosen as the third domain, an area that recent research (Campbell, Hombo, & Mazzeo, 2000) suggests is either similar for males and females or only slightly male typed. Based on earlier work (Marsh, 1989; Wigfield et al., 1997) that reported gender differences in both values and competence beliefs exist as early as first grade, we expected to find gender-role stereotypic differences even in the youngest children. In addition, previous reports (Eccles, Midgley, et al., 1993; Huston, 1983; Ruble & Martin, 1998) of increases in gender differences in self-beliefs in middle childhood and adolescence led us to expect longitudinal changes in gender differences that would vary by domain. If gender socialization actually increases differences between males and females over time, we would expect the gaps to increase in line with gender stereotyping, favoring males in the domains of math and sports and favoring females in the domain of language arts.

An important advance in the present study was the use of Hierarchical Linear Modeling (HLM; Bryk & Raudenbush, 1987, 1992) to implement a growth curve analysis to test our hypotheses. This is a particularly good technique for examining the gender differences in developmental trajectories that have been suggested by cross-sectional and short-term longitudinal analyses, because it provides a flexible framework for parsimoniously capturing patterns of linear or non-linear change over time. Thus, because HLM is not limited to linear change, it allows us to examine patterns that include both increases and declines in gender differences over the course of development. Using HLM, we were able to implement an analysis that was strictly limited to within-individual change, controlling for all stable individual differences, while addressing the possible nonindependence of measurement due to repeated measures. This approach also allowed us to take full advantage of our cohort-sequential design by testing for and modeling cohort effects.

The use of growth modeling in the present study contrasts with the many studies of the development of self-beliefs that have relied on path analyses or structural equation models, in which explanatory variables on one occasion influence later perceptions of self-competence or values (e.g., Marsh & Yeung, 1998). Such analyses did not suit our purposes because they do not address changes in mean levels over time, which is our focus. Although changes in mean levels of self-beliefs have been tested in short-term longitudinal studies (e.g., Wigfield et al., 1997) by using repeated-measures MANOVA, such an approach becomes quite unwieldy for six waves of data covering a span of 12 grade levels. The HLM growth model used in this research was an improvement over that approach because it efficiently captured developmental trajectories with only a few parameters and allowed us to include all respondents, even when they did not provide data for the full set of six observations. A similar strategy was used by Skinner and colleagues (Skinner, Zimmer-Gembeck, & Connell, 1998) to examine longitudinal changes in perceived self-control during middle childhood and early adolescence.

**METHOD**

Participants

The present study is part of the Childhood and Beyond longitudinal project (Eccles et al., 1983) investigating the development of children's self-perceptions, task values, and activity choices. Children, parents, and teachers were recruited through the children's schools; all children in each classroom were asked to participate. Seventy-five percent of the children both agreed to participate and obtained parental permission. Data were collected between 1989 and 1999 from children who were attending 10 elementary schools in four middle-class, primarily European American school districts in the suburbs of a large midwestern city. The schools were all public schools with varied curricula. Due to the longitudinal nature of the study,
as students moved through middle and high school, they experienced a wide variety of teachers and courses. No attempt was made to limit the sample by ability, course selection, or school context, although performance was controlled in the analyses.

A cross-sequential design was employed, in which three cohorts of children were followed longitudinally across the elementary, middle, and high school years. Children were in the first, second, and fourth grades during Year 1. The results reported here are based on 761 students who were present at the first wave and who provided data for both gender and grade. Additionally, for each outcome measure, participants were excluded if they were missing the relevant objective indicator of performance. The grade at each wave and sample size for each cohort appear in Table 1. Due to a 3-year gap in the data collection, these children were in grades 9, 10, and 12 at Year 6; thus, the combined cross-sequential sample provides information on children from grade 1 through grade 12. In addition, the design yielded data for more than one cohort of children at the same grade level at various time points in the study, which provided replication of grade-level effects across cohorts.

The original sample consisted of 53% girls and 47% boys, and these proportions remained the same throughout the waves of data collection. Information about income provided by the school districts indicated that the children were from middle-class backgrounds; average family income in the districts in 1990 was $50,000. Over 95% of the children were European American. Attrition in the sample was due mostly to children moving far away from the school districts sampled. Every effort was made to locate the participants each year, and the longitudinal sample included children who continued to live in the same general area, even if they no longer attended the participating schools. Analyses reported elsewhere (see Wigfield et al., 1997) indicated that for each of the variables of interest, the mean scores for the full cross-sectional sample and the longitudinal sample were not significantly different.

<table>
<thead>
<tr>
<th>Cohort</th>
<th>1 (n = 250)</th>
<th>2 (n = 278)</th>
<th>3 (n = 233)</th>
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<tr>
<td>1</td>
<td>1</td>
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Procedure and Measures

Each spring, the children completed questionnaires measuring their competence beliefs and subjective task values about the math, language arts, and sports, as well as many other constructs. Children completed the questionnaires in their classrooms in the participating schools. Most items were answered using 1 to 7 Likert-style response scales, and the items were modified from earlier questionnaire items developed by Eccles and colleagues to assess children’s and adolescents’ beliefs about the same domains. The items have good psychometric properties (see Eccles et al., 1983; Eccles et al., 1984; Eccles & Wigfield, 1995; Eccles, Wigfield, et al., 1993; Parsons, Adler, & Kaczala, 1982). Because the current study included children younger than those in previous studies using these measures, great care was taken to ensure that the children understood the constructs being assessed. The items were pilot tested on 100 children to check for comprehension, and illustrations were added to the answer scales to foster children’s understanding of how to use them (for a more detailed discussion, see Eccles, Wigfield, 1993). All questions were read aloud to all the children in Years 1 and 2 and to the youngest cohort in Year 3; after that, all children read the questionnaires on their own. The questionnaires were administered in three sessions lasting 20 min each.

**Competence belief items.** For math, language arts, and sports, five competence belief items were asked to assess children’s self-perceptions of their abilities in each domain. Comparable wording was used in each domain. Alphas are presented in Table 2.

**Subjective task value items.** For math, language, and sports, the subjective task value items asked children how interesting/fun each activity was, how important they thought being good at the activity was, and how useful they thought each activity was. Four items were used at each year and comparable wording was used in each domain, except for the name of the domain. Alphas are presented in Table 2.

**Scale construction.** Based on factor analyses and theoretical considerations (for more details about the factor analyses, see Eccles, Wigfield, et al., 1993), scales were developed for the competence belief and subjective value constructs. Internal consistency reliabilities for the various competence belief scales ranged from .73 to .92 across domains and times of measurement (see Table 2). Thus, overall the internal consistency of the competence beliefs and interest measures ranged from good to excellent.

**Performance measures.** Indicators of performance in each domain were collected for all children. The
Table 2 Reliabilities of Seven Outcome Measures

<table>
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<th>Wave 2</th>
<th>Wave 3</th>
<th>Wave 4</th>
<th>Wave 5</th>
<th>Wave 6</th>
<th>Wave 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Math ability (5 items)</td>
<td>.76 (855)</td>
<td>.79 (992)</td>
<td>.84 (910)</td>
<td>.90 (706)</td>
<td>.92 (488)</td>
<td>.92 (545)</td>
</tr>
<tr>
<td>Math value (4 items)</td>
<td>N.A.</td>
<td>.61 (995)</td>
<td>.71 (917)</td>
<td>.79 (708)</td>
<td>.84 (491)</td>
<td>.84 (551)</td>
</tr>
<tr>
<td>Reading ability (5 items)</td>
<td>.82 (862)</td>
<td>.84 (986)</td>
<td>.86 (910)</td>
<td>.93 (708)</td>
<td>N.A.</td>
<td>.93 (545)</td>
</tr>
<tr>
<td>Reading value (4 items)</td>
<td>N.A.</td>
<td>.73 (992)</td>
<td>.73 (906)</td>
<td>.84 (709)</td>
<td>N.A.</td>
<td>.86 (547)</td>
</tr>
<tr>
<td>Sports ability (5 items)</td>
<td>.84 (880)</td>
<td>.84 (982)</td>
<td>.89 (906)</td>
<td>.93 (707)</td>
<td>.93 (480)</td>
<td>.94 (525)</td>
</tr>
<tr>
<td>Sports value (4 items)</td>
<td>N.A.</td>
<td>.85 (987)</td>
<td>.89 (881)</td>
<td>.92 (711)</td>
<td>.93 (491)</td>
<td>.92 (548)</td>
</tr>
<tr>
<td>Social ability (2 items)</td>
<td>N.A.</td>
<td>.84 (998)</td>
<td>.79 (910)</td>
<td>.88 (711)</td>
<td>.89 (487)</td>
<td>.90 (548)</td>
</tr>
</tbody>
</table>

Note: Values represent Cronbach's α (n). Alphas are based on complete sample, not restricted sample used in analyses. N.A. = not available.

Slosson Intelligence Test–Revised (1991 edition) was given to all children when they joined the study. This measure, which yields a total score only, is designed for use as a "quick estimate of general cognitive ability" (Slosson, Nicholson, & Hillpshman, 1991, p. 1). The Bruininks–Oseretsky Test of Motor Proficiency (Bruininks, 1977) also was given to all children when they joined the study. This measure includes the performance of gross motor tasks, such as running, ball throwing, and jumping, as well as fine motor tasks, such as tracing and joining dots (Bruininks & Bruininks, 1977).

Description of Analyses

The central goal of the present study was to describe the changes in children's ability perceptions and task values in three domains from first through twelfth grade. Hierarchical Linear Modeling (HLM; Bryk & Raudenbush, 1987, 1992) was used for the analyses. HLM extends multiple regression to nested or repeated-measures data. Because there are several observations for each person, waves of data are nested within persons. In the terminology of HLM, the Level 1 units of analysis are waves or occasions of measurement, and the Level 2 units of analysis are persons.

When applied to the cohort sequential research design, HLM provides a powerful and flexible framework for analyzing individual change over time; determining whether individual characteristics, such as gender, are related to initial status or to change; and analyzing time-varying factors that might explain change over time in the outcome. The HLM framework was especially useful for our purposes because there is no assumption that the number and spacing of observations will be consistent across individuals or across time. Thus, HLM was quite compatible with the complexities of this study's research design (which are apparent in Table 1), including multiple cohorts sampled in different years of school, a 3-year gap in data collection, and sample attrition.

The Level 1 model. A two-level HLM model such as ours is defined by two types of regression equations. The first is the Level 1 or within-person model, which expresses the outcome variable in relation to explanatory variables that vary across time. This study used a growth curve model, which means that the pattern of change for each person was modeled by a polynomial function of time (Bryk & Raudenbush, 1987, 1992):

\[ Y_{it} = \beta_0 + \beta_1 (\text{Grade}_{it} - 6) + \beta_2 (\text{Grade}_{it} - 6)^2 + e_{it} \]

In this equation, person i's score on the outcome variable Y at time t equals a quadratic function of current grade, plus the residual term e_{it}. Three β parameters capture the quadratic growth function, and each carries the subscript i to indicate that it is specific to this individual. β_0 is a constant term, indicating the expected value of Y for this person when other variables in this equation equal 0. Notice that the value of 6 has been subtracted from grade, so this constant characterizes the sixth grade (when β_1 and β_2 will be multiplied by 0). By "centering" the equation in this way, parameters that would otherwise be meaningless can be interpreted in relation to the age in the middle of the span being studied (Bryk & Raudenbush, 1992, pp. 25–29). The coefficients β_{1i} and β_{2i} summarize change over time, with β_{1i} equal to the rate of change at grade 6, and β_{2i} expressing change in slope over time. The three parameters of the growth curve provide an efficient summary of patterns of change across the 12 grades spanned by this study.

The Level 2 model. The Level 1 model defines the meaning of the Level 2 model because the coefficients of the Level 1 equation serve as the outcome variables for the Level 2 equations. The explanatory variables for the Level 2 equations are variables that do not change over time, either because they are inherently stable characteristics or because they were measured on
only one occasion. The individual level constant, $\beta_{ij}$, serves as the outcome measure in the first Level 2 equation:

$$\beta_{i0} = \gamma_{00} + \gamma_{01} \text{Gender}_i + \gamma_{02} \text{Ability}_i + \gamma_{03} \text{Mean(Grade - 6)} + \nu_{i0}.$$  

This equation indicates that person $i$’s level on the outcome variable in the sixth grade, $\beta_{i0}$, is equal to a constant, $\gamma_{00}$, plus the products of several regression coefficients, $\gamma_{0j}$, times explanatory variables, plus a residual term, $\nu_{i0}$. The individual slope and “acceleration” terms from equation 1 serve as the outcome variables in the remaining Level 2 equations:

$$\beta_{i1} = \gamma_{10} + \gamma_{11} \text{Gender}_i + \gamma_{12} \text{Ability}_i + \gamma_{13} \text{Grade2}_i + \nu_{i1},$$  

$$\beta_{i2} = \gamma_{20} + \gamma_{21} \text{Gender}_i + \gamma_{22} \text{Ability}_i + \gamma_{23} \text{Grade4}_i + \nu_{i2}.$$  

The set of constant terms for the Level-2 equations defines the growth curve when all of the explanatory variables in those equations equal 0. In the present study, all of those explanatory variables were centered at their sample means (i.e., the mean was subtracted from the original scores) so that these constant terms characterized the average growth curves for the entire sample. Thus, $\gamma_{00}$ was the sample mean in grade 6, $\gamma_{10}$ was the average rate of change in the outcome variable at that grade, and $\gamma_{03}$ reflected the degree of curvature averaged across the sample (Bryk & Raudenbush, 1992, pp. 25–29).

The coefficients for gender, $\gamma_{01}$, $\gamma_{11}$, and $\gamma_{21}$, indicate the difference in the growth curves for males and females, with $\gamma_{01}$ reflecting the mean gender difference in the sixth grade; $\gamma_{11}$ the difference in slope in the sixth grade; and $\gamma_{21}$ the difference in curvature. Because gender is a dummy variable with 0 assigned to males and 1 to females, positive values indicate higher means, slopes, and more convex curvature for females than for males. The coefficients $\gamma_{02}$, $\gamma_{12}$, and $\gamma_{22}$ play the corresponding role for the relation of growth curves to the measure of ability for each domain. We include this element in our analysis as a statistical control to ensure that the findings for gender differences in patterns of change were not attributable to initial differences in ability. Thus, although we present these coefficients in tables, they are not discussed in the presentation of results.

Individuals’ means for grade and grade-squared appear in the equation for the Level 1 constant (Equation 2). These terms serve the important function of ensuring that the equations for linear and quadratic change (Equations 3 and 4) reflect only within-individual change, and not stable individual differences that are confounded with the timing of data collection. Growth curve models are not inherently analyses of within-individual change. Random coefficient statistical models such as HLM use all of the available variance of a Level 1 variable to estimate the relations in the corresponding Level 2 equation. Consider a single cohort panel study with no attrition, in which every person contributes data on the same set of occasions. In that case, there is no between-person variance on the Level 1 explanatory variables for time, which define the growth curve, so the growth curves can only reflect within-individual change. In our analysis, however, age differences between cohorts and attrition create differences between people in average grade. As a result, growth curve estimates would be influenced not only by within-individual change over time, but also by any stable individual differences between cohorts or between respondents who stayed in the study and those who were lost. Fortunately, Bryk and Raudenbush (1992, pp. 121–123) showed that adding the means of the Level 1 variables to Equation 2 solves this problem by separating within-individual relations from between-individual relations. As with the coefficients for ability, these elements of the model are of no substantive interest in their own right, but serve as a control for extraneous individual differences.

Two dummy variables representing cohort membership are the final explanatory variables in the Level 2 model. Including these terms in Equations 3 and 4 allows for the possibility that the pattern of within-individual change differs across cohorts by allowing each cohort to have different average values for $\beta_1$ and $\beta_2$. Intercepts will also differ across cohorts due to $\gamma_{03}$ and $\gamma_{04}$. Students who were in the first grade at the beginning of the study serve as the reference group for the comparisons between cohorts. The variable Grade2 identifies students who were in the second grade during the first year of data collection, whereas the variable Grade4 identifies students who were in the fourth grade.

The last element in each of the Level 2 models is the residual term $\nu_{i0}$. For each equation containing this residual, HLM estimates a variance component that reflects unexplained individual differences in the corresponding growth curve coefficient, $\beta_{ij}$. Under the HLM model, it is assumed that these residual terms have a multivariate normal distribution.

**Simplifying the model.** Equations 1 through 4 present the most complex version of our model. We began our analysis by determining whether it was appropriate to simplify this model in two ways that would aid in the interpretation of results. Although this full model allowed the pattern of change over time to vary across cohorts, our interest was in consistencies that
generalized across them. Thus, the first step was to test whether cohorts differed in their growth curves, which was accomplished with a multiple-parameter significance test of whether the four coefficients for the cohort variables differed from 0. For all but one of the outcome measures, this test failed to reach significance, indicating that a single growth curve could be generalized to all three cohorts and that these terms could be eliminated from the model.

Significant cohort differences in patterns of change emerged only for the value respondents placed on math. Comparison of fitted values to actual means suggested that this result might really be due to a period effect. All cohorts placed exceptionally high value on math in the first wave included in this analysis, even though that wave occurred at different grades for the different cohorts. We therefore expanded Equation 1 by adding a dummy variable for the period-specific effect (coded 1 for that wave and 0 for all others), and this eliminated the significant cohort differences. Therefore, the final model for this outcome included the dummy variable for the period specific effect, but not the cohort differences. It is important to note that the source of this single period effect could not be identified; however, we were confident that it was not an artifact created by changes in the wording of the items or response categories, because no changes occurred.

Significance tests were also conducted to determine whether a linear, rather than quadratic, growth curve model was adequate to characterize patterns of change, using a multiple-parameter significance test for the regression coefficients of equation 4 ($y_2$). This test proved significant for all but one of the outcome measures, indicating that the changes in those variables were curvilinear. For the single exception, the quadratic elements were dropped from the model. Finally, the quadratic element of change did not vary significantly across individuals for any of the variables, so we eliminated this variance component from the model.

RESULTS

In this section the results of three sets of HLM analyses are presented. The first set examined gender differences in the trajectories for competence beliefs in the domains of mathematics, language arts, and sports. This was followed by a set of analyses that examined gender differences in the trajectories for subjective task values in each of the same domains. The final set of analyses examined the potential of self-competence beliefs to account for gender differences and trajectories of change in task values. This final set of analyses required some elaboration of our HLM model, which is described below.

Competence Beliefs

Competence beliefs were examined in three domains: math, language arts, and sports ability. On the basis of previous research, competence beliefs were expected to be highest in first grade with declines across the school years; in other words, the fitted values for the earliest grade would be near the top of the possible range and the slopes would be significant and negative. As shown in Figure 1, competence beliefs were highest in first grade in all three domains, at least 5.8 for boys and 5.2 for girls out of a possible score of 7.0. Figure 1 reveals that decline was clearly the dominant trend for competence beliefs in all three
domains, and tests indicate that the rate of decline was highly significant (see Table 3).\footnote{For both linear and quadratic models, the intercept term for linear change ($\gamma_0$ from Equation 3) provides a useful index of the average rate of change over the period of study. The model for beliefs about math ability is linear, so in this case this term is the constant rate of change for the entire period. In the quadratic models, the rate of change at any grade equals $\gamma_0 + 2\gamma_2$ (Grade - 6), that is, the derivative with respect to grade, which means that the rate of change grows by $2\gamma_2$ (or shrinks if $\gamma_2$ is negative) for each unit of increase in grade level. Thus, the average rate of change would fall at the middle of the range of grades under study, which is roughly grade 6. $\gamma_0$ is the rate of change at that grade.}

The quadratic aspects of the growth curves were significant for competence beliefs about language arts and sports, but the curves were in opposite directions. For language arts, the intercept term for grade-squared was positive, so the rate of decline slowed over time. As can be seen in Figure 1, average beliefs in ability for language arts declined more rapidly during the elementary years, but changed very little after the seventh or eighth grade, perhaps even increasing for males during the final years of high school. In contrast, the rate of decline in competence beliefs for sports accelerated over this age span (see Figure 1). Although there was minimal change during the first years of elementary school, the average student’s sense of competence in sports fell faster and faster as the end of high school approached.

Prior research led us to expect that males would have much higher competence beliefs in sports, females would have much higher competence beliefs in language arts, and males would have slightly higher competence beliefs in math. As can be seen in Table 3, tests of gender differences in the Level 1 intercept indicated that, at grade 6, males and females held significantly different competence beliefs in math, language arts, and sports. Males believed that they were more competent, on average, in the domains of sports and math; whereas females believed that they were more competent, on average, in the domain of language arts. This upheld our expectations for all domains.

Although gender differences in the Level 1 intercept were found in all achievement areas, gender differences in the rate of change varied by domain. As can be seen in Figure 1, males and females began with significantly different perceptions of their math competence, and significant gender effects for slope and acceleration emerged by grade 6. Boys had higher perceptions of their competence in math at first grade, but their competence beliefs decreased at a faster rate than did those of girls, as evidenced by the significant and positive coefficient for gender in relation to linear change. As a result of differential rates of decline,
boys and girls had similar beliefs about their math abilities by high school.

The picture was very different in the language arts domain (see Figure 1). Although males and females had the same level of competence beliefs in first grade, their growth curves differed considerably in slope and acceleration, so that there was a dramatic gender difference by grade 6. Boys' competence beliefs decreased rapidly until they reached a plateau during middle school. Girls' beliefs dropped more slowly and more steadily over time, reaching a plateau during middle school that remained higher than the boys' level during both middle school and high school. It appears that the gender difference in language arts shrank somewhat during high school. Finally, a third pattern emerged for the sports domain, with no effects of gender on the slope or acceleration for sports (see Figure 1). Boys had significantly higher competence beliefs in sports at grade 1, and both boys and girls declined in competence beliefs at similar rates. Thus, boys consistently perceived themselves as markedly better at sports than did girls across all grades of school.

In summary, our predictions about gender differences across the three domains were generally supported; however, the gaps between males and females decreased or remained the same, rather than increasing. Although boys began elementary school with slightly higher math competence beliefs than girls, these gender differences disappeared by high school because boys' math beliefs decreased more rapidly than girls' beliefs. In contrast, girls and boys had similar competence beliefs for language arts in the first grade, but their beliefs diverged in elementary school, with girls maintaining higher self-perceptions over time because their beliefs again decreased at a slower rate than boys' beliefs. The only domain in which there was no effect of gender on the rate of change was sports: boys had higher competence beliefs in sports ability initially and these gender differences were maintained over time.

Table 4  Growth Models for values in Three Domains, with and without Controlling for Competence Beliefs

<table>
<thead>
<tr>
<th></th>
<th>Math Values</th>
<th>Reading Values</th>
<th>Sports Values</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Model 1</td>
<td>Model 2</td>
<td>Model 1</td>
</tr>
<tr>
<td></td>
<td>Coef.   SE</td>
<td>Coef.   SE</td>
<td>Coef.   SE</td>
</tr>
<tr>
<td>For Intercept</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercept</td>
<td>5.084* .043</td>
<td>5.091* .039</td>
<td>5.008* .042</td>
</tr>
<tr>
<td>Gender</td>
<td>.025   .085</td>
<td>.058   .074</td>
<td>.189* .080</td>
</tr>
<tr>
<td>Ability test</td>
<td>-.008* .003</td>
<td>-.012* .002</td>
<td>-.002  .003</td>
</tr>
<tr>
<td>Average T</td>
<td>.005  .025</td>
<td>-.018  .023</td>
<td>.066* .022</td>
</tr>
<tr>
<td>Average T²</td>
<td>-.021* .010</td>
<td>-.013  .009</td>
<td>-.008  .010</td>
</tr>
<tr>
<td>Average competence beliefs</td>
<td>-.020  .043</td>
<td>.068   .039</td>
<td>.159* .044</td>
</tr>
<tr>
<td>For linear change</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercept</td>
<td>-.120* .014</td>
<td>-.068* .013</td>
<td>-.122* .010</td>
</tr>
<tr>
<td>Gender</td>
<td>-.016  .021</td>
<td>-.047* .019</td>
<td>.002  .018</td>
</tr>
<tr>
<td>Ability test</td>
<td>-.0006 .0006</td>
<td>-.0015* .0006</td>
<td>-.0002 .0006</td>
</tr>
<tr>
<td>For quadratic change</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercept</td>
<td>-.007  .004</td>
<td>-.008* .004</td>
<td>.017* .003</td>
</tr>
<tr>
<td>Gender</td>
<td>.007   .011</td>
<td>.011   .006</td>
<td>.009  .006</td>
</tr>
<tr>
<td>Ability test</td>
<td>.0008* .0002</td>
<td>.0008* .0002</td>
<td>.0003 .0002</td>
</tr>
<tr>
<td>For period</td>
<td>.605* .063</td>
<td>.626* .060</td>
<td></td>
</tr>
<tr>
<td>For competence beliefs</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercept</td>
<td>.428* .029</td>
<td>.433* .029</td>
<td>.780* .032</td>
</tr>
<tr>
<td>Residual variance</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>For intercept</td>
<td>.358* .223</td>
<td>.320* .155</td>
<td>1.142* .325</td>
</tr>
<tr>
<td>For linear change</td>
<td>.029* .020</td>
<td>.011* .006</td>
<td>.030* .013</td>
</tr>
<tr>
<td>For competence beliefs</td>
<td>.067* .083</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Within individual</td>
<td>.714  .603</td>
<td>.802  .594</td>
<td>1.209  .963</td>
</tr>
</tbody>
</table>

Note: Coef. = coefficient.
*y < .05.
Subjective Task Value

Subjective task values were expected to follow patterns similar to those found for competence beliefs, with students' values declining across grades in all domains. This expectation was upheld: the fitted values were highest in the early grades and the slopes were significant and negative (see Table 4). As can be seen in Figure 2, initial subjective task values were high in all domains; above 5.4 for boys and above 5.3 for girls out of a possible score of 7.0, and the slopes at grade 6 ranged from −.11 to −.20 for both boys and girls. Although the growth curves are all curvilinear, the figures suggest that decline was the dominant trend for task value beliefs in all three domains. In Table 4, tests of the intercept term for linear change in all models indicated that the overall rate of decline was highly significant.

The curvilinear aspects of the task value growth curves take different forms for math and language arts. In language arts, the intercept term for grade-squared was positive, so the rate of decline slowed over time; in math, the intercept was negative, indicating a slight increase in the rate of decline over time. Average values for language arts declined most rapidly during the elementary years, whereas average values for math declined most sharply during high school. For sports values, the curvilinear component was not significant on average, but as we shall see, this average masked opposite patterns for boys and girls.

Prior research led us to expect that males would have higher values for sports and math and that females would have higher values for language arts. These differences were expected to grow larger over time due to gender role socialization. As can be seen in Table 4, tests of the Level 1 intercept for gender indicate that males and females held significantly different task values in language arts and sports at grade 6, but not in math. Males placed higher value on sports than did females; on average; females held higher values for language arts than did males, on average; and no gender differences in the intercept were found in the domain of math.

Although gender differences in the Level 1 intercept were found in language arts and sports, significant gender differences were found in the rate of change only in sports. In that domain, boys and girls differed in the quadratic component of the growth curve, with a convex curve for females and a concave curve for males (see solid lines in Figure 2). The large gender difference favoring males in the first grade increased until grade 6, because females' values for sports fell more rapidly than males' values. After grade 6, however, the gap gradually shrank because females' values reached a plateau, whereas males' values for sports continued to fall at an accelerating rate. By grade 12, the gender difference was negligible. Although the pattern in language arts was only a statistical trend, $p = .12$, girls began higher than boys in first grade; but because girls' values declined more rapidly than did boys, the gap narrowed by late elementary school, and then increased again during high school as girls' values for language arts increased and boys' values leveled off (see Figure 2).
In summary, the dominant pattern was once again one of declining values across all domains. Significant gender differences in the average values were found only for language arts and sports, but no gender differences for average math values were found. A significant gender difference in the rate of change was found only for sports, with the greatest similarity between boys and girls found at the end of high school, because boys' values for sports declined more rapidly than girls' values. Nonetheless, the trend for differences in slope for language arts suggested that girls' valuing of language arts may increase during the high school years whereas boys' valuing does not rebound during high school.

The Contribution of Competence Beliefs to Subjective Task Values

This final set of analyses examined the potential of competence beliefs to account for gender differences and trajectories of change in subjective task values. Theoretical links between those constructs have been suggested (Eccles et al., 1983; Harter, 1983, 1992, 1998) and prior cross-sectional research has demonstrated relations between them (Deci & Ryan, 1985; Eccles & Wigfield, 1995; Sansone & Harackiewicz, 1996); however, longitudinal analyses demonstrating how increases or decreases in perceived competence are associated with shifts in values have not been conducted. It is possible to determine this by adding competence beliefs as an explanatory variable in the HLM model for task values. To the extent that competence beliefs are related to trajectories of change in subjective task values, introducing that variable to the model would reduce coefficients for change over time and the trajectories would become more flat, showing less change. To the extent that competence beliefs are related to gender differences, the coefficients for gender would be reduced, the trajectories for males and females would be more similar in slope and shape, and their trajectories would lie closer together.

These analyses are more illustrative than definitive for two reasons. First, based on prior research (e.g., Wigfield & Eccles, 1992) and theoretical models (e.g., Eccles et al., 1983; Harter, 1986), the direction of influence specified in these analyses is from competence beliefs to subjective task values, but it is also possible that there is influence in the opposite direction as well. If so, then our analyses will tend to overestimate the influence of competence beliefs. Second, like most other multiple regression models, HLM assumes that all explanatory variables are measured without error, and the presence of error would reduce the weight placed on a variable. There was a moderate amount of error variance in our measures of competence beliefs (see Table 2), which resulted in a slight underestimation of the influence of competence beliefs. These two limitations of the analysis tend to cancel one another out.

Modifying the HLM model. For these analyses, our original HLM model was modified by adding the time-specific measure of competence beliefs to the Level 1 equation of the model (Equation 1) and the individual mean for competence beliefs to the Level 2 equation for the Level 1 intercept (Equation 2). Including both ensured that the Level 1 relation was restricted to within-individual change. Both measures of subjective task value were grand mean centered, which ensured that adding these variables did not change the meaning of other coefficients and variance components in the model. Also, in the domains of math and language arts, the Level 1 relation of subjective task values to competence beliefs varied significantly across individuals, so this variance component was added to the HLM model.

The relation of competence beliefs to subjective task values. Table 4 shows that respondents were much more likely to value math, language arts, and sports when they felt competent in the domain. All three coefficients for competence beliefs were large (at least .43) and highly significant, t values above 14. The strength of the relation was also reflected in the variance explained by competence beliefs. Perceptions of competence explained between 38% and 71% of the previously unexplained variance in stable individual differences in subjective task values (i.e., residual variance for intercept) for each domain. Competence beliefs also explained substantial portions of variance in change over time, in the form of both individual differences in slope (31% for math, 46% for language arts, and 57% for sports) and within-individual variation around the growth curves (16% for math, 26% for language arts, and 20% for sports). In sum, individuals' competence beliefs were strongly associated with their entire pattern of task values over time.

Trajectories of subjective task values. A time-varying explanatory variable like competence beliefs has the potential to explain not only between-individual variation in trajectories of task values, but also the amount and pattern of change in the average trajectory. For this to occur, competence beliefs must be strongly associated with subjective task values, and, as previously shown, this was the case. Furthermore, the pattern of change in competence beliefs must be similar to that of task values, and many similarities are apparent when Figures 1 and 2 are compared. The extent to which competence beliefs account for the overall trajectory will be reflected in the impact of controlling for competence beliefs on the intercept terms for
linear and quadratic change in Table 4 and in the difference in trajectories before and after controlling for competence beliefs, as shown in Figure 2.

For the domain of math, controlling for competence beliefs reduced the linear trend at grade 6 by over 43%, \( \gamma \) from \(-.120\) to \(-.066\), but raised the curvilinear component of the trend to statistical significance, \( \gamma \) from \(-.007\) to \(-.008\). Figure 2 reveals that the curvilinearity arose because self-competence beliefs explained almost all of the decline in math values for grades 2 through 5 (i.e., the slope became much flatter), relatively little of the decline from grades 6 through 8, and some of the decline from grades 9 through 12. This effect was especially pronounced for boys in the early grades. This was consistent with the trajectories for math competence beliefs shown in Figure 1, which declined most dramatically during the elementary years. Osgood et al.'s (1996) index of the strength of a curvilinear relation was used to determine the change in the relation between the dependent variable and the explanatory variable. Competence beliefs accounted for 41% of the change over time for boys and 28% of the change for girls. It appears that self-perceptions of competence in math explained a substantial share of the changes in boys' and girls' math values over time.

Competence beliefs were also closely tied to the trajectory of values for language arts. Coefficients for both linear and quadratic change were reduced over 40% by controlling competence beliefs, and competence accounted for 54% of age-related change for boys and 44% for girls. Our earlier analyses found that self-competence in language arts declined rapidly during the elementary school years. Accordingly, Figure 2 shows that competence beliefs accounted for much of the decline in language arts values during that period for both boys and girls.

Competence beliefs played a somewhat smaller, although still substantial, role for trajectories of task values for sports. In this case, controlling for competence beliefs reduced the intercept coefficient for linear change by 46%, although the originally small coefficient for quadratic change increased significantly. Our analysis of competence beliefs for sports (see Figure 1) showed that the trajectory of change for boys' competence beliefs matched that of values (see Figure 2), with a gradual rate of decline in the elementary years accelerating to faster decline through high school. As a result, competence beliefs accounted for 55% of age-related change in boys' competence beliefs about sports, leaving an essentially linear trend. For girls, the timing of decline in competence beliefs differed from that of task values, with the decline in self-competence concentrated in the high school years and the decline in values concentrated in the elementary school years. Therefore, competence beliefs did not explain much of the change in girls' values for sports during the early years, but the inclusion of competence beliefs resulted in a reversal of the trend in the later years. Overall, competence beliefs explained 36% of the change in girls' values for sports and altered the shape of the trajectory considerably.

**Gender differences in subjective task values.** The pattern of gender differences in subjective values was quite different for the three domains. As a result, the degree to which competence beliefs accounted for gender differences in subjective task values varied as well. Competence beliefs in math differed for boys and girls, both in mean level over time and in trajectory over time, although boys and girls were nearly identical in math values. Accordingly, controlling for those competence beliefs raised the coefficients for gender in the model for math values, and the corresponding change in trajectories can be seen in Figure 2. Controlling for competence beliefs raised the modest average gender difference across waves by 52%, from .08 to .13.

Our earlier analyses indicated that girls consistently felt more competent in language arts than did boys after first grade, and boys' competence beliefs declined at a faster rate than did those of girls. Figure 2 shows that competence beliefs explained much of the gender difference during the middle grades, whereas a moderate difference remained during the earlier and later grades. Averaging across grades, controlling for competence beliefs reduced the gender difference in values by 62%, from .28 to .11. Thus, the higher sense of self-competence that girls experienced in language arts may have been an important source of the higher value they placed in this domain.

The connection of competence beliefs to gender differences in values was strongest and most complex for the domain of sports. Boys had higher competence beliefs in sports than did girls at all ages, as can be seen in Figure 2. When competence beliefs were not taken into account, boys typically placed more value on sports than did girls, but the gender difference varied widely over time, growing until grade 6, and then shrinking to near equality at grade 12. The consequence of this combination was apparent in the second set of lines in Figure 2, demonstrating that competence beliefs in sports accounted for a substantial portion of the gender difference in values at all ages, causing mirror-image curves for girls and boys that came together and crossed at third and ninth grades. This unusual pattern showed that when competence beliefs were controlled, girls and boys had a similar value for sports in the early years, and girls had lower
values for sports in the middle school years and finished high school with higher values for sports. Controlling for competence beliefs reduced the average gender difference in values from .76 to -.06, a decline of 108%.

DISCUSSION

The purpose of this study was threefold: (1) to describe changes in self-beliefs and values across childhood and adolescence within the domains of mathematics, language arts, and sports; (2) to examine the impact of changes in competence beliefs on changes in values over time in the same domains; and (3) to describe gender differences in mean levels and trajectories of change in each. The domains were selected to represent one strongly male-typed area of achievement (sports), one strongly female-typed area (language arts), and one achievement area that has been male-typed in the past, but has become more gender neutral in recent years (math).

The most striking finding across all domains was that self-perceptions of competence and subjective task values declined as children got older. This pattern was expected for competence beliefs during the early elementary school years, because previous research has shown that before the age of 7 or 8, children's perceptions may be unrealistically high (Nicholls & Miller, 1984; Stipek, 1984), they may not make use of social comparison (Marsh et al., 1984; Stipek & Mac Iver, 1989), and they may have limited opportunities for comparison (Wigfield et al., 1997). The downward trajectory found in these data, however, clearly continued beyond the early elementary school years. Although previous short-term longitudinal studies have reported sharp drops in academic self-perceptions at the point of transition into junior high or middle school (e.g., Eccles, Midgley, et al., 1993; Marsh, 1989; Nettelmann, 1987), the value of having a longer time perspective is that it is clear that the declines at that period are part of a larger and consistent downward trend rather than a qualitative leap in self-perceptions (a similar continuous decline in perceived control beliefs between grades 3–7 was reported by Skinner et al., 1998). It should be noted, however, that a downside to a longitudinal study that follows groups of children as they make two school transitions is that the researcher has limited control over the kinds of teachers, teaching methods, and courses that the children will experience over the course of the study. Thus, the downward trajectories documented in this sample and in other studies could have been due to common factors experienced in the classroom or elsewhere, but the causal factors cannot be pinpointed.

Declines in academic self-beliefs have been found in other studies, albeit not over such long periods; however, the decline in sports self-perceptions has not been documented previously. One explanation for such declines in self-beliefs is that they are reality based and inevitable in any skill-based domain as children become aware of others’ levels of competence and where they fall in the “pecking order” (Jacobs & Eccles, 2000; Nicholls & Miller, 1984). This may continue throughout the years of formal schooling, because children move into situations in which there are larger pools of potential competitors and the number of “slots” on sports teams or in advanced-placement classes is limited. During the elementary school years children play a variety of and are greatly interested in sports (Wigfield et al., 1997). As children get older, sport activities become more selective and competitive, and fewer children are selected to be on competitive teams. The child who was the best basketball player in his or her elementary school may feel less skilled after playing with others on the basketball team in middle school, and, after sitting on the bench some of the time in middle school, may decide not to try out in high school. A similar phenomenon occurs for the child who is a star academically in the lower grades, but encounters higher standards (e.g., Eccles & Midgley, 1989) and others who are equally talented in advanced grades. However, children and adolescents cannot select themselves out of academic courses in quite the same way as they do with sports activities (e.g., Flammer et al., 1992; Snyder & Spritzer, 1992; Wankel & Berger, 1990) if they find that they are not succeeding as well as they did at younger ages.

It is not surprising that the same downward trend was seen for subjective task values. Most theories that relate values to achievement suggest that values and perceptions of competence should be linked (e.g., Deci & Ryan, 1985; Eccles et al., 1983; Harter, 1983; Renninger, 1990; Schiefele, 1991). The analyses of subjective task values alone indicated that growth trajectories were similar, although not identical, to those found for competence beliefs in each domain. Once again, these data showed a consistent downward trend over most years of schooling that has not been clear in short-term studies.

Although the relation between task values and perceptions of competence has been highlighted in research and theory (e.g., Eccles et al., 1983; Harter, 1986, 1990; Wigfield & Eccles, 1992; Wigfield et al., 1997), other studies have not examined the way in which changes in one set of beliefs might impact changes in the other. The earlier work suggested that children’s beliefs about their competence in a given domain should influence their subjective valuing of tasks in the same domain; thus, the second goal of the
present study was to examine the impact of changes in competence beliefs on changes in values over time for mathematics, language arts, and sports. We found that perceptions of ability accounted for much of the decline in each case, explaining over 40% of the decrease in values in every domain and flattening the downward trajectories. This finding supports both Harter's and Eccles' models (e.g., Eccles et al., 1983; Harter, 1986) and is consistent with previous research suggesting that self-perceptions of competence are related to changes in value for an activity over time (e.g., Wigfield & Eccles, 1992; Wigfield et al., 1997). These data make it clear that children's and adolescents' changes in self-perceptions of competence explain a large percentage of their changing values for particular domains.

The third major goal in this study was to document gender differences in the developmental trajectories of self-competence and subjective task values. Previous studies have documented gender differences in sports beliefs, favoring boys (Eccles & Harold, 1991; Hyde, Fenema, & Lamon, 1990; Jacobs & Eccles, 1992; Wigfield et al., 1997) and differences in English beliefs, favoring girls (Eccles et al., 1984; Hyde & Linn, 1988; Jacobs & Eccles, 1992). In addition, earlier studies typically found differences in math beliefs favoring boys (Eccles et al., 1983; Linn & Hyde, 1989), although more recent investigations have reported only small gender differences in math self-beliefs and no differences in math achievement, at least during adolescence (e.g., Hyde et al., 1990; Marsh, 1989; Marsh & Yeung, 1998). Explanations for such gender differences have focused on gender role socialization by parents, peers, media, and schools (e.g., Eccles, 1987; Maccoby, 1966) and on gender intensification at puberty that may heighten boys' and girls' interest in doing gender-appropriate activities (e.g., Hill & Lynch, 1983). Both gender intensification and gender socialization hypotheses are predicated on the idea that the gender gap increases with age; however, the longitudinal data presented here does not suggest a consistent increase in the differences between boys and girls with age. Indeed, the gender gap is not generally widening, but decreasing (math competence, sports values) or not changing (sports competence, math values). Language arts is the only domain in which any increase in the gender gap was found across time, and even in that domain, the gender difference in slope was significant only for perceptions of competence. Interestingly, the gender differences in subjective task values for language arts and sports were even smaller after controlling for competence beliefs. In the math domain, in which little gender difference was found for values, girls valued math more than did boys by the end of high school, after controlling for their perceptions of competence in the area.

These results showed no dramatic shift in trajectories during early adolescence that would be consistent with a gender intensification hypothesis. Instead, gender differences in perceptions were largest at the youngest ages and the rates of change in perceptions for both boys and girls were most dramatic during elementary school, typically leveling off during middle school and into high school. The gender intensification issue, although intuitively appealing, has not been systematically assessed in long-term longitudinal studies. The results of the present study, which indicated that gender differences decline with age, complement and extend earlier shorter term longitudinal studies (e.g., Eccles et al., 1989; Wigfield et al., 1991, 1997). The findings also are consistent with those reported by Marsh that showed no age-related changes in gender differences for self-concept (Marsh, 1993b) and no gender differences in developmental models (Marsh & Yeung, 1997, 1998). All of this work leads to the conclusion that at least in the domains considered here, most gender differences in beliefs decrease or remain stable over time. If any gender difference gets magnified during adolescence, it is in language arts, with boys' feelings of competence and values decreasing more rapidly than girls during the middle school or junior high years.

Boys and girls in the present study apparently entered school with different competence beliefs and values. Others have suggested that such differences may be due to socialization experiences in the home and in the larger society, such as the portrayals of males and females in the media and role models they see around them (e.g., Lytton & Romney, 1991; Signorella, 1990). The experiences that these children had both in and out of the classroom during the school years appeared to lessen these differences. Thus, rather than gender intensification, these data from the present research suggest a growing similarity in the competence beliefs and values of the participating boys and girls in the study who were attending school between 1989 and 1999. It should be noted, however, that the sample used in this study was not representative of the general population. The children came from predominantly European American middle-class and upper middle-class homes, and they attended public schools within four districts surrounding a large midwestern city. The trends toward decreasing differences between boys' and girls' academic self-competence beliefs, however, parallel recent reports of diminishing differences in actual achievement with much more representative samples of high school students, such as the National Assess-
ment of Educational Progress (NAEP) and National Educational Longitudinal Study (NELS) data sets (see Marsh & Yeung, 1998 for the NELS88 data; and Campbell et al., 2000 for the NAEP data, 13-year-olds and 17-year-olds in 1999).

Unfortunately, the large, representative data sets that are currently available do not have longitudinal data on the broad span of ages found in the present study’s data set. This necessitates relying on less representative data sets and existing theoretical frameworks to begin to examine longitudinal changes in self-beliefs, while remaining mindful of the fact that the same pattern may not be found in more diverse populations or in different educational contexts. Before drawing any definitive conclusions, it will be important to document trends in more diverse samples and contexts. It also would be worthwhile to extend this work to other domains or to specific activities within domains to assess the prevalence of this phenomenon.

With these caveats in mind, the findings from this study lead us to four general conclusions about the population studied here. First, the gender differences in growth trajectories appear to be domain specific rather than global. This suggests that explanations for gender differences also may have to be domain specific rather than general. Factors such as changing cultural stereotypes about an area of achievement (e.g., math) and local school expectations and opportunities for each gender may need to be considered for the particular achievement arena. Theoretical achievement models, such as the one proposed by Eccles and colleagues (Eccles et al., 1983), that incorporate information about the task are more likely to be successful than global models for explaining gender differences.

A second important point that comes out of these findings is that language arts is clearly gender typed. This domain has not been the focus of attention as frequently as math or science, but the fact that self-competence beliefs in this domain become increasingly differentiated by gender with age suggests that the skills emphasized in language arts may be one factor to consider in future research. According to a recent report, most children master decoding and comprehension skills during the early grades, but by middle school they are typically interpreting what they read, making inferences, analyzing literature, and writing (National Center for Education Statistics, 1999). At least one author (Brush, 1980) has suggested that girls prefer language arts because of the emphasis on interpretation and opinions that allows them to use their verbal skills. It is possible that girls’ feelings of competence in language arts are related to other factors, however, such as reading more books (Hedges & Nowell, 1995), early gender differences in language development (Hyde & Linn, 1988), or general stereotypes about reading being a feminine activity (Eccles, Jacobs, & Harold, 1990; Stein, 1971).

The third point that we would like to raise is that boys’ self-perceptions were declining more rapidly than girls’ perceptions in both of the academic domains of the present study. The gender gap in math decreased because the self-competence beliefs of boys declined at a faster rate than those of girls. In fact, in the twelfth grade, there was some indication that girls’ self-perceptions were higher than boys’ self-perceptions in math. In the area of language arts, boys and girls started similarly, but the boys’ perceptions of competence again declined more rapidly than the girls’ perceptions—in this case, leaving girls with much higher self-perceptions. Although no significant gender differences in math values were found, boys’ values for language arts continued to decline whereas girls’ values appeared to level off. These trends may reflect patterns of actual achievement because research over the past decade has shown a consistent pattern of diminishing gender differences in math and no differences in language arts or differences favoring girls. Although girls’ self-perceptions have often been a cause for concern, these trends for boys are troubling. If boys do not feel successful in school or value academics, they are more likely to drop out or turn to other achievement domains. Recent data suggests that this may be happening already—boys comprise only 43% of the college population at this point (compared with 48% in 1985), and that percentage is expected to decrease (Gerald & Hussar, 2000).

The fact that boys have not kept pace with the educational gains made by girls has been noted by other researchers (e.g., Marsh & Yeung, 1998), as well as in the popular press (e.g., Sommers, 2000). Research efforts may need to focus on boys’ declining self-beliefs as they move through school, as well as on continuing to monitor girls’ self-perceptions.

The final general observation that can be made based on these results is that competence beliefs and task values need to be studied together, rather than separately. We found that changes in competence beliefs had a dramatic impact on changes in values, explaining most of the gender differences and much of the change over time. The implication of this finding is that beliefs within the self-system are closely linked and the importance of changes in one versus another may be overestimated if they are studied in isolation. It should be noted that based on earlier research (e.g., Wigfield & Eccles, 1992) and theoretical models (e.g., Eccles et al., 1983; Harter, 1986), the direction of influence in these analyses was specified to be from competence beliefs to subjective task values. As men-
tioned earlier, however, it is also possible that the influence is bidirectional. Therefore, the critical point for future research is that the changes in beliefs are highly related and need to be studied within the same longitudinal models.

In conclusion, we found that the competence beliefs and subjective task values of boys and girls in this study generally declined across the entire elementary and secondary school period. These results complement and extend earlier studies that used cross-sectional and short-term longitudinal designs by examining within-individual change between first and twelfth grades and by showing that changes in competence beliefs explain most of the changes in task values over time. Our data also provide new information suggesting that gender differences in children’s and adolescents’ competence beliefs and values in this sample decreased rather than increased with age. Despite these contributions to the understanding of age-related changes in self-beliefs, generalizations from this study are limited due to the homogeneity of the sample. Future research should examine patterns of change for more diverse groups of children and adolescents and in different educational contexts. It would also be worthwhile to extend this work to other domains or to specific activities within domains to assess the prevalence of the patterns of growth trajectories and gender differences in trajectories described here.

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REFERENCES

Alexander, K., & Entwisle, D. (1988). Achievement in the first two years of school: Patterns and processes. Mono-


Eccles, J. S., Jacobs, J. E., & Harold, R. D. (1990). Gender-role stereotypes, expectancy effects, and parents’ role in the


