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Children's Competence and Value Beliefs from Childhood Through Adolescence: Growth Trajectories in Two "Male-Typed" Domains

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Abstract

This study uses hierarchical linear modeling to document sex differences in developmental trends in children's competence and value beliefs from first through twelfth grade and to investigate the relation of these trends to initial differences in parents' perceptions of children's ability. Six separate growth models were tested: 1) math competence, 2) math interest, 3) math importance, 4) sports competence, 5) sports interest, and 6) sports importance. Across all six models, children's self-perceptions declined from first to twelfth grade. Sex differences in competence and value beliefs were found. The gap between boys' and girls' competence beliefs decreased. In addition, parents' initial ratings of children's ability helped to explain mean level differences and variations in the rate of change in children's beliefs over time, with the effect being strongest in the sports models. These results support a launch model of development.

Children's Competence and Value Beliefs from Childhood Through Adolescence

The development of children's competence and value beliefs has been a subject of interest in psychology because of the relationship of these beliefs to motivation and achievement related outcomes (see Eccles, Wigfield, & Schiefele, 1998 for a review). This study describes changes in competence and value related beliefs from first to twelfth grade in two separate domains: math and sports. Girls participate in each of these domains at lower rates than boys (Branta, Painter & Kiger, 1987; Eccles, 1987; Greendorfer, 1992). A great deal of research has been done on why this might be true. One hypothesis is that sex differences in participation rates are linked to sex differences in competence and value beliefs (see Eccles et al., 1983). Previous studies have documented sex differences in children's competence and value beliefs in math and sports, with boys reporting higher ratings of their competence and higher ratings of the value of participating in these domains (Eccles et al., 1983; 1984; Eccles & Harold, 1991; Lirgg, 1992). But few studies actually report longitudinal data over an extended period of development to see if these sex differences are maintained over time.

Because competence and value beliefs play such an important role in children's motivation and participation decisions, it is important to identify the socialization factors that influence their development. Eccles and her colleagues (see Eccles, 1987; 1993) developed an extensive model to explain how socializers influence children's self (competence) and task (value) beliefs. According to this model, parents' perceptions of their children's ability should be a major determinant of children's competence and value beliefs. Parents shape children's beliefs by providing them with messages about their ability and the value of participating in activities that help them to interpret their experiences in achievement contexts. Several researchers have documented the short-term link of parents' beliefs to children's own self and task beliefs (i.e., Eccles, 1993; Jacobs, 1992; Parsons et al., 1982), but no studies have documented the long-term role of such beliefs over an extended period of time. This is one of the primary goals of this paper. In addition, most of the existing work has focused on older children and adolescents. This paper looks at the long-term association of parental beliefs in early elementary school with children and adolescents' competence and value beliefs through the elementary and secondary school years.

Math and sports were chosen for study because they are both "male-typed" domains but differ in important ways. The sex difference in math preference and achievement has been declining due to increased attention to the needs to encourage both boys and girls in this domain (Hyde, Fennema, & Lamon, 1990). Similarly, there has been an increase in girls' participation in sports. However, this domain is still seen as more masculine than math. As a consequence, girls still participate much less in sports than do boys. Therefore, the magnitude of the sex differences in these two domains is likely to be different. Another difference between these domains concerns the degree of choice. Participation in mathematics is required, while participation in sports is voluntary. As a consequence, parents are able to play a more important role in supporting their children's sports beliefs than they can play in shaping their children's math beliefs. For example, if parents do not enroll their children in sports programs at an early age it is unlikely that their children will have opportunities that would support the development of their competence and value beliefs. Moreover, since sports participation is voluntary, fewer boys and girls have experiences seeing that girls can do well in this activity. Since only a subset of girls are involved in sports, fewer girls have experiences to help modify their self-beliefs in this domain. Therefore, stereotypic beliefs should continue to be large in sports.

This paper contributes to the literature on the development of competence and value beliefs, sex differences, and parent socialization in three fundamental ways. First, it provides a complete longitudinal picture of the ontogeny of children's competence and value beliefs from first to twelfth grade. Second, it expands the domains explored; third it provides a more sensitive test of the association of parents' initial beliefs with the developmental trajectories of girls and boys. More specifically, most existing longitudinal studies of children's achievement-related beliefs have been relatively short-term (three to four year maximum). Yet developmental and socialization theories both suggest there are sex changes throughout the childhood and adolescent years (Eccles, 1987; Ruble & Martin, 1998). This study provides a comprehensive longitudinal test of these theories. Second, much of this research has examined motivation in academic domains. Because these findings are limited in scope, we explore the development of motivation in both a "male-typed" school and a "male-typed" non-school skill based domain. Finally, there is substantial evidence that parents play a critical role in children's achievement related beliefs (Eccles et al., 1998). Again, however, very few studies have looked at this relation over extended periods of time.

Related research: competence and values

Individuals' competence-related beliefs (operationalized as judgments about one's ability to accomplish certain tasks, expectations for one's future performance, and self-efficacy) have received a great deal of research attention. This construct has been linked to effort, persistence, cognitive engagement and achievement, even after controlling for previous performance (Bandura, 1994; Eccles et al., 1998; Schunk, 1991). Motivational researchers have also examined the link between children's task values and achievement-related outcomes. Eccles and her colleagues have developed the most extensive theory of subjective task value (see Eccles et al., 1983; Wigfield & Eccles, 1992 for more description). They broadly define subjective task value as incentives for doing different tasks; individuals will do tasks they positively value and avoid tasks that they negatively value. Eccles and colleagues argue that subjective task value is a function of four distinct components: interest (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 future goals), and cost (negative aspects of engaging in task). Empirical studies have focused on the first three of these characteristics. These studies have show than both interest and importance (operationalized in terms of both attainment value and utility value) predict current and future activity choice across a variety of domains including taking math classes, engaging in sports activities, and choosing a college major (Eccles, 1984; Eccles & Harold, 1991; Feather, 1988; Meece, Wigfield, & Eccles, 1990). In this study, we chart developmental changes in these two determinants of subjective task value.

A major emphasis in the motivational literature has been on how these constructs develop in children (Eccles et al., 1998). Researchers have consistently documented that children's competence beliefs decline across the elementary and secondary school years in a variety of domains (Eccles, Midgley, & Adler, 1984; Marsh, 1989; Stipek & MacIver, 1989; Wigfield et al., 1997). The majority of this work has been based on cross-sectional and short-term longitudinal designs; there is a need for longitudinal research on the development of children's beliefs that spans larger age ranges. In addition, there may be differences in this developmental pattern across different domains. For example, researchers have documented contradictory findings for age differences in sports beliefs. Some have reported declines in children's perceptions of their physical abilities (Marsh, 1989; Marsh, Barnes, Cairns, & Tidman, 1984), while others have found no age differences in perceptions in the upper elementary school years (Eccles, Wigfield, Harold, & Blumenfeld, 1993).

As compared with the work on the development of competence beliefs, there has been less research on age differences in children's value perceptions. Eccles and her colleagues have conducted the most extensive research on this question. They found that mean levels of elementary children's ratings of the importance of mathematics and sports decline over time, though their interest in sports and mathematics remained relatively stable (Eccles et al., 1993; Wigfield et al., 1997). Using data from other samples, Eccles and her colleagues have also documented children's ratings of the importance of math and ratings of interest in math decline across the transition to junior high school and into the high school years (Eccles, Adler, & Meece, 1984; Eccles et al., 1989; Wigfield et al., 1991). However, no prior work has examined longitudinal changes in children's perceptions of task importance and interest from childhood to adolescence.

The evidence to date suggests that, on average, children's competence and value beliefs decline over time. However, the majority of this research has examined mean level changes in children's motivation. This analytic strategy fails to account for individual differences in developmental trajectories. For instance, some children's beliefs remain relatively stable over time, others show the gradual decline that has been documented in the prior literature, and still other children's ratings of their ability and interest actually increase over time. An important question is what individual and socialization factors help to explain differences in individuals' trajectories over time. In this study, we explore how two such factors, sex and parents' initial ratings of children's ability, are related to variations in children's competence and value beliefs in math and sports over time.

Related research: sex differences

In cross-sectional and short-term longitudinal studies, boys rate their ability and the value of participating higher than girls in both math and sports (Eccles et al., 1993; Marsh & Yeung, 1998; Wigfield et al., 1997). There are a variety of theories of sex differences that make different predictions about when these sex differences in competence and value beliefs emerge and how they change over time. Social cognitive development theories of sex-role development suggest large sex differences in the preschool years that then decline during the elementary school years as children develop more flexible beliefs (Ruble & Martin, 1998). Other scholars have argued that gendered socialization pressures should lead to an increase in sex differences over time (see Eccles, 1987; Maccoby, 1966). Advocates of gender-intensification theory (a variant of gendered socialization theory) hypothesize that sex differences should increase with the onset of puberty because pubertal changes are likely to illicit increased gendered socialization pressures (e.g., Eccles & Bryant, 1987; Hill & Lynch, 1983).

In contrast, another hypothesis is that experiences in school should lead to a decline in sex-differentiated math beliefs over time because both boys and girls take math classes and perform at comparable levels in this domain (Hyde et al., 1990). Egalitarian socialization pressures should also lead to a decline in the sex gap across the school years for those children with parents and teachers who try to counter their children's sex stereotypic beliefs and preferences. We believe this would be particularly true for girls of parents who have high expectations for their ability in math and sports. We hypothesize a sex by parent belief interaction. According to this hypothesis, the sex difference should not increase over time among children with parents who have high expectations, whereas the sex difference should increase over time for those children with parents who have low expectations for their ability in these domains.

The empirical evidence concerning the emergence of sex differences and changes in the sex gap over time is mixed. Early in the 1980s, Eccles and her colleagues documented that sex differences in competence and value beliefs in the math domain were stronger during the high school years than the middle school years (Eccles et al., 1984). In fact, they found no sex differences in math competence and value beliefs for girls in fifth through seventh grade. However, in more recent work, Eccles and colleagues examined children's beliefs at earlier ages and found evidence of sex differences in competence and value beliefs in math as early as first grade (Eccles et al., 1993; Wigfield et al., 1997). Other scholars have documented that sex differences emerge early and remain stable over time (Marsh, 1993). In contrast to the research in math, there is less work on sex differences in sports. The limited research indicate that boys have higher sports competence and value ratings in the elementary school years, though it is not clear how these differences change in the secondary school years (Eccles & Harold, 1991; Wigfield et al., 1997). Thus, from the available research it is not clear when these sex differences emerge, whether they become larger over time, and whether these patterns vary by cohort or historical period.

<u>Related research: parents' beliefs</u>

Parents' beliefs about their children's ability may also help to explain individual differences in children's beliefs over time. A positive link between parents' expectations and children's achievement motivation and performance has been well established (see Eccles et al., 1998). This research has tended to use mothers' ratings of ability, with only limited research on the influence of fathers' ratings of ability on children's motivation (see Frome & Eccles, 1998;

Phillips, 1987). There is a growing body of literature on the influence of parents' beliefs on adolescents' beliefs in the math domain, though there is less work at younger ages. Mothers' ratings of adolescents' ability have been found to be a significant predictor of adolescents' estimates of their own ability and interest in math, even after controlling for performance differences (Eccles, 1993; Frome & Eccles, 1998; Jacobs & Eccles, 1992; Parsons et al., 1982). Parents' self-perceptions of ability are also hypothesized to play an important role in sport socialization (Brustad, 1992; Woolger & Power, 1993), though the empirical findings are mixed. Some studies have documented a strong correspondence between parents' and children's appraisals of ability (Eccles et al., 1998; Feldson & Reed, 1986; McCullagh, Matzkanin, Shaw, & Maldonado, 1993), while others have failed to find a relation between parents' and children's beliefs (Babkes & Weiss, 1999).

We hypothesize children's motivational trajectories in math and sports are set by early experiences in the family and that once these differences in initial motivation level are established they continue over time. This assumption fits within a launch model of development because children's trajectories are hypothesized to be a function of their initial differences (Skinner, Zimmer-Gembeck & Connell, 1998). This model of change assumes that early influences set the stage for the unfolding of later development. There are a variety of mechanisms that may explain why early parents' beliefs are associated with children's beliefs over time. One possibility is that positive feedback from parents enhances children's feelings of their competence, which helps them to maintain high motivation over time. It is also likely that the relation between parents' beliefs and children's beliefs is mediated through the types of experiences parents provide to their children. In fact, there is evidence that parents' beliefs are predictive of parents' provisions of opportunities in the home (Eccles et al., 2001).

An alternative to the launch model is the change-to-change model of development, which assumes changes in one trajectory are a function of changes in another (Skinner et al., 1988). According to this perspective, changes in children's beliefs would vary as a function of changes in parents' beliefs. An important question that arises from a change-to-change model concerns the stability of parents' beliefs and the causal relations between parent and child. Using cross-lagged structural equation modeling, Eccles and her colleagues examined the across-time impact of parents' beliefs on changes in children's perceptions versus the across-time impact of children's beliefs on changes in parents' beliefs (Eccles et al., 2000; Yoon, Wigfield, & Eccles, 1993). They found that mothers' and children's beliefs were reciprocally related. However, over time, mothers' beliefs were highly stable and had a stronger influence on children's self-perceptions than children's self-perceptions had on parents' beliefs. The results provide support for both a launch model and a change- to-change model, but indicate that the direction runs more strongly from parent to child than vice versa.

Purpose

We use hierarchical linear modeling techniques to chart changes in children's competence and value beliefs in math and sports from the beginning of elementary school to the end of high school. This study expands the literature by using a more sophisticated analytic technique to examine data spanning a larger age range than has been explored in previous research (see also, Jacobs et al., in press). Our analysis strategy contrasts with much of the previous research that has relied on path analytic techniques (e.g., Marsh & Yeung, 1998) and repeated measures MANOVA (e.g., Wigfield et al., 1997). Path analytic techniques do not take full advantage of repeated measurements (Bryk & Raudenbush, 1987), while repeated measures

ANOVA models are less flexible in dealing with missing data. HLM growth models permit the inclusion of all respondents, even if they do not provide data for the full set of observations.

The prior literature on the development of children's competence and value beliefs, sex differences, and parent socialization were used as a guide to develop the following predictions. First, we hypothesize children's perceptions of competence, interest, and importance will decline over time. Second, boys will have higher ratings of their ability and higher ratings of the value of participating in math and sports. Third, this sex gap will increase in adolescence due to the differential socialization processes associated with gender-role intensification. We expect this sex gap to be larger in sports than in math because this domain is more stereotypically masculine. Fourth, children with parents' who have higher perceptions of their competence with have higher competence and value beliefs. We hypothesize that parents' early beliefs will be positively related to children's competence and value beliefs over time. We also expect that parents' beliefs will be more strongly related to children's beliefs in sports than in math because parents have a stronger role in socialization in this domain.

Method

Participants

The present study is part of the Childhood and Beyond Study (CAB), a longitudinal study of the development of children's self-perceptions, task values, and activity choices (Eccles, Wigfield & Blumenfeld, 1984, Eccles, Wigfield, Blumenfeld, & Harold, 1993). The study began in 1987. Children were initially recruited through their school districts; seventy-five percent of children agreed to participate. These children attended 10 elementary schools in four middle class school districts in small cities near Detroit. The final longitudinal sample used in these analyses includes approximately 514 children (the sample size varies slightly across the growth models because of small variations in missing data). The analysis includes all children who had corresponding parent information.

The sample is approximately equally divided by sex (50% male and 50% female). The sample is primarily European-American (95%), with a small minority population of African-Americans, Native Americans, Asians, and Hispanics. The sample consists of primarily two-parent intact middle class families. The average family income at the beginning of the study (1987) was $40,000 to $49,000. The families' income ranged from under $10,000 to over $80,000, with the majority of families earning between $30,000 and $60,000. Overall, the parents were well educated (78% of mothers and 88% of fathers had completed at least some college). These characteristics match the demographic characteristics of the communities chosen for study. We chose middle class families for this study in order to examine the association of parents' beliefs and children's beliefs independent of variations in parents' financial ability to act on these beliefs and provide developmental experiences for their children.

Design

A cohort sequential design was employed. The study began when children were in the first, second, and fourth grade (wave 1). These three cohorts of students were followed for three subsequent years ending in third, fourth, and sixth grade. After a three-year gap in data collection, these children were followed for three more years, beginning in sixth, seventh, and ninth grade. By wave 6, these children were in grades nine, ten, and twelve. Thus, the combined cross-sequential sample provides information on children from Grades 1 to Grade 12.

Attrition is a major concern with multiple wave panel studies; it becomes more difficult to track families over time and participants can become fatigued by multiple visits (Menard, 1991). Sample attrition can lead to biased results if those participants who are lost differ from those participants that are retained in systematic ways. Because of these potential biases, we examined the patterns and distributions of missing data to determine the extent to which our results were a product of anomalies in the data. 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 5.5% of the sample was in the early attrition group (left during the elementary school years), 29% of the sample was in the late attrition group (left during the high school years), 13% of the sample had data missing at random, and 52.5% of the sample had complete data at all six measurement points. The higher percentage of participants in the late attrition group may reflect the three-year gap in data collection. We used analysis of variance techniques to examine mean differences by attrition group in both demographic factors and variables used in the hierarchical linear analyses. We did not find significant mean differences in any of the constructs used in the statistical analyses by attrition group. However, both the early and late attribution groups had slightly lower household income than did the group with full data. As a consequence, the sample analyzed in this study tends to under represent lower socioeconomic students. However, this effect is small. The mean family income of the early attrition group was less than three tenths of a standard deviation lower than the full sample; the mean family income for the late attrition group was less than two tenths of a standard deviation lower than the full sample. Since it is unlikely that this small effect constrained variances, we believe the findings are not adversely affected by attrition.

<u>Measures</u>

<u>Child measures.</u>

During each wave of data collection, children completed questionnaires measuring their competence and value beliefs in math and sports, as well as other constructs. These items were modified from earlier questionnaires developed by Eccles and her colleagues to assess children and adolescents' beliefs about mathematics, English, sports, and social activities (Eccles, et al., 1989; Wigfield, Eccles, MacIver, Reuman & Midgley, 1991). The current study included children younger than participants in previous studies, and therefore great care was taken to ensure that children understood the constructs being assessed. The items were pilot tested on 100 children to refine them for use with younger children. The likert-style scales were illustrated with stars, bars, and other graphical representations of increasing quantity to help children understand the scales (see Eccles et al., 1993 for more detailed discussion).

Based on factor analytic and theoretical considerations (see Eccles et al., 1993 for more details), scales were developed for the competence beliefs, perceptions of importance, and perceptions of interest in math and sports at each measurement point. Previous research using these scales has shown excellent face, convergent, and discriminant validity (see Eccles et al., 1993, Wigfield et al., 1997). Prior work with older children has documented the predictive validity of these scales (e.g., Eccles, 1984; Eccles et al., 1990; Updegraff et al., 1996).

The reliabilities for the competence scales ranged from .76 to .93 (5 items). For subjective task values, separate scales were created for interest and importance in each domain. For interest, the reliabilities ranged from .73 to .95 (2 items at wave 1, 3 items at subsequent waves). For importance (2 items at wave 1, 4 items at subsequent waves), the internal consistency was low in Year 1 (.36 for math and .58 for sports), but ranged from .61 to .92 at the other waves of data collection. The lack of internal consistency at the earlier ages may have occurred because young children have a more difficult time determining which activities are useful and/or important to them.

A concern is that the lower reliability in the task values scales would result in less difference between students at the earlier waves, which would consequently inflate differences at the later waves. Because of this potential problem, the interest and importance growth models were run using information from third to twelfth grades, excluding the earlier measurements points with lower reliability. The results of these growth models from 3rd to 12th grade were similar to the results when the interest and importance growth models were run using the complete data from 1st to 12th grade. This finding indicates that it is appropriate to project these results backward to the first grade. The competence models were run using all six waves of data, resulting in information from first to twelfth grade. The specific items used in the analyses for math are presented in the Appendix (comparable items were asked in sports).

Parent measures.

During the first three waves mothers and fathers were given self-administered questionnaires assessing among other things, their perceptions of their children's abilities in math and sports. The first wave of information collected from mothers and fathers were used in the analyses (n=575 mothers, n=397 fathers). These scales have strong psychometric properties (alpha=.93 to .95). Previous research using comparable scales has shown excellent predictive validity (Eccles, 1993; Eccles et al., 2000; Parsons et al., 1982). The specific items used in the analyses are presented in the Appendix.

Aptitude measures.

In order to get an independent estimate of the relation of sex and parents' expectations to children's beliefs, we included measures of children's aptitude in all analyses. Teachers completed individualized surveys on each child participating in the study during the first three waves of the study. Teachers' ratings of children's math ability were used as the control for children's math ability (n=515). Because of missing information from teachers at some measurement points, we used all available information collected from teachers during the first three waves of data collection to create this measure. We felt this was an appropriate analytic technique because teachers' beliefs were highly stable over time (r=.53-.63). Each teacher rated the ability of each child in math (see Appendix). These items had strong psychometric properties (alphas = .83-.89). The validity of our teacher's ratings measure is evident in their significant relation with children's performance on our tests of cognitive and physical skills (see Wigfield & Harold, 1992).

Children were given the Bruininks-Oseretsky Test for Motor Proficiency (1978) to estimate their sports aptitude at the first measurement point (kindergarten, first, and third grade). Children were tested on their large motor skills: (1) running, (2) jumping and clapping, (3) broad jumping, (4) catching a ball, and (5) throwing a ball, and their fine motor skills: (1) tapping their feet, (2) drawing lines, and (3) copying circles. This test has been widely used to assess the proficiency of individuals' motor performance (Hattie & Edwards, 1987).[1]

Results

Descriptive Analysis/Correlations

To assess the relations among variables, we ran correlations between children's beliefs, parents' beliefs, and the aptitude measures in both math and sports at the beginning of the study (wave 1). In addition, we ran correlations between parents' beliefs, aptitude measures, and children's beliefs at the end of elementary school (wave 3) to examine how these relations changed over time. These correlations are presented in the Appendix (tables 1-4). Children's competence beliefs related positively to their perceptions of interest and to their perceptions of the importance of the activity at the both time points. In both domains, the strength of this relation was stronger in the later grades.[2] The relation among children's perceptions of competence, importance, and interest was stronger in sports than in math. Parents' ratings of children's ability were most strongly related to children's perceptions of competence; the strength of the relation between parents ratings and children's beliefs increased over time.

Analysis Plans

Hierarchical Linear Modeling (Bryk & Raudenbush, 1992) was used to model changes in children's self and task perceptions in math and sports over time. Six separate growth models were estimated: (1) math competence, (2) math interest, (3) math importance, (4) sports competence, (5) sports interest, and (6) sports importance. HLM is an appropriate technique for studying individual change because repeated measures can be considered as nested within individuals and can be represented as a two level hierarchical model. At Level-1, each person's development is modeled as a unique growth trajectory. At Level-2 the growth parameters of these trajectories become the outcome variables, which are then modeled as a function of some person-level characteristics (Bryk & Raudenbush, 1992). HLM provides a powerful and flexible framework for plotting individual change over time in a cohort sequential design. Both the number and the spacing of the observations may vary (Bryk & Raudenbush, 1992). In addition, HLM allows for random missing observations at level 1. We believe the flexibility of HLM makes it an appropriate technique for the cohort sequential dataset used for these analyses.

Testing for grade by cohort interactions

Because of the multiple cohort nature of this design, it was first necessary to test for grade by cohort interactions. This is necessary in any accelerated longitudinal design in order to rule out the possibility of attributing differential change within cohorts as developmental effects (Raudenbush & Chan, 1993; Miyazaki & Raudenbush, 2000). If there are no differences by cohort, it is possible to formulate a single common developmental curve across all cohorts. Following the suggestion in Miyazkai & Raudenbush (2000) to test the plausibility of a single underlying developmental trajectory, a full cohort based hierarchical model was formulated. At level-1, each person's development was conceived as a polynomial function of grade and random error.[3] At level-2 these growth parameters were allowed to vary as a function of cohort. In the second step, we formulated a competing "reduced" model that was based on the assumption that all cohorts followed a single underlying age trajectory. The likelihood ratio test was used to test the "reduced" model against the "full" model. This was possible because the reduced model is a special case of the linear model. A similar strategy was used to test the plausibility of a single underlying trajectory across all of the growth models.

Comparing the "full" and "reduced" models revealed a significant change in model deviance for all growth models, except math interest. This finding indicates that the model attributing differences to cohort membership fit the data better than the model assuming that all cohorts follow a single underlying age trajectory. Therefore, in order to aggregate data across waves and assume a common underlying model, it was necessary to control for cohort membership. Two separate dummies representing cohort membership were included in all analyses. The first dummy variable compared the youngest cohort to the two oldest cohorts; the second dummy variable compared the two oldest cohorts.

<u>The level-1 model.</u>

At level 1, the observed status at time *t* for individual *i* is a function of a growth trajectory and random error (Bryk & Raudenbush, 1992).

$$Y_{ti} = \pi_{0i} + \pi_{1i}(a_{ti} - 6.5_{ti}) + \pi_{2i}(a_{ti} - 6.5_{ti}) + e_{ti}$$

Y_{ti} is the ratings of self or task perceptions for the person *i* at time *t*.

$(a_{ti} - 6.5a_{ti})$ represents the linear component of the growth curve

$(a_{ti} - 6.5a_{ti})$ represents the quadratic component of the growth curve

e_{ti} is independent and normally distributed with a mean of zero and a constant variance.

For purposes of these analyses, the intercept term (π_{0i}) was centered at the midpoint of the data. The linear component was centered at the middle of sixth grade for the competence models and the middle of seventh grade for the task value models. We chose a location where an otherwise meaningless parameter can be interpreted in relation to a relevant grade in the study (Bryk & Raudenbush, 1992). The coefficients π_{1i} and π_{2i} summarize change over time; with π_{1i} equal to linear rate of change and π_{2i} expressing nonlinear curvature in the trajectory over time. For all six models, likelihood tests were used to examine whether the addition of a quadratic term (π_{2i}) would significantly improve the model fit. A linear function best fits the data for math competence and sports interest growth models. In the other four growth models, the quadratic term was significant and included in the analyses.

The level-2 model

We tested whether the level-1 model growth trajectories varied across individuals. A level-2 model was formulated to account for variation in both the intercept and the linear term. The constant (intercept) and slope (linear) term served as outcomes measures in the level-2 equations. The explanatory variables for the level-2 equation are variables that do not change over time. A similar set of predictors was included in all six of the growth models, which allowed for the comparison of effects across outcomes. In all models, sex and parents' beliefs were included as predictors of both the intercept and slope. Gender-intensification and gendered socialization theories led us to expect sex differences in the rate of acceleration. However, sex was not a significant predictor of the quadratic term in any of the growth models. Therefore, we fixed the quadratic term and treated it as a constant across individuals to improve the efficacy of the maximum likelihood algorithm. In addition, we created an interaction term for parents' beliefs by sex and tested whether it was a significant predictor of both the slope and the intercept. For all models, the interaction term was not significant and therefore was dropped from subsequent models. This finding did not support our hypothesis of a sex by parent belief interaction.

Children's aptitude was also included as a control in the growth models to insure that our finding concerning differences in the pattern of change were not a function of initial differences in ability. This allowed us to interpret the association between parents' perceptions and children's beliefs independent of ability differences. For example, parents perceptions of children's ability was more strongly associated with children's beliefs than one would have expected given children's initial ability. In addition, dummies representing cohort membership were included as controls for both the intercept and the slope. Only those dummies that were significant were included in the final models.

Separate growth models were run using mothers' and fathers' ratings of children's ability. Several theorists have suggested that fathers are particularly important socializers in "male-typed" domains (Johnson, 1975; Siegel, 1987). However, the empirical research on the influence of fathers' beliefs on children's beliefs has been limited. To help expand this knowledge base, we discuss the similarities and differences in the association of fathers' and mothers' beliefs with their children's trajectories. The HLM results for the six growth models with mothers' beliefs and fathers' beliefs are presented in Tables 1-6. The models with fathers' beliefs as a predictor include only children whose fathers completed the survey, a smaller sample then the growth trajectories run for children with mothers' beliefs as a predictor.

We plotted the curves derived from the HLM models by sex and mothers' perceptions of children's ability (see Figures 1-7). The trajectories for boys and girls were plotted separately for the math and sports competence models. We plotted these sex differences to illustrate the difference in the sex gap in competencies beliefs across the two domains. Because we used grand mean centering the growth curve represented boys and girls of average ability with mothers who have average ratings of their ability. In addition, for the math and sports competence model we plotted the trajectories for children who had mothers with high perceptions of their competence (1 standard deviation above the mean) and children who had mothers with low perceptions of their competence (1 standard deviation below the mean). In the sports model, we also included the trajectories for children who had fathers with high perceptions of their competence and children who had fathers with low perceptions of their competence to illustrate differences in the strength of mothers' and fathers' beliefs on children's beliefs over time (see Figure 4). In addition, the importance and interest models were plotted on the same graph to illustrate differences in the developmental trajectories for these constructs (see Figure 5 and 6).[4] Finally, we plotted the trajectories for sports interest for children who had mothers with high ratings of their ability (1 standard deviation above the mean) and children who had mothers with low ratings of their ability (1 standard deviation below the mean). On the same figure, we plotted the trajectories for children's sports interest by fathers' ratings of ability to illustrate the difference in the influence of mothers' and fathers' beliefs on children's value beliefs (see Figure 7).

Competence Models

Math

The results of the growth model for math competence are presented in Table 1. There was a significant decline in children's perceptions of their math competencies from first to twelfth grade. Differences by cohort were in the expected direction. The older cohorts who began the study in second and fourth grade had lower ratings of their math ability and more significant declines over time when compared to the youngest group of participants who began the study in first grade. The cohort findings further demonstrate the developmental decline in children's beliefs over the course of schooling.

Both sex and parents' ratings of children's math ability accounted for variance in the intercept term (middle grade of study). Moreover, sex was a predictor of changes in children's competencies over time. Boys believed that they were more competent in math than did girls (see Figure 1). However, girls' perceptions of their math ability declined at a slower rate than boys. We had hypothesized that the sex gap would increase in the later grades. Instead, we found that this gap decreased over time. The growth models for math competencies by parents' ratings of ability are presented in Figure 2. The results for the mothers and fathers differed. Mothers and fathers' initial beliefs were a significant predictor of the intercept and were a significant predictor of the slope for fathers but only a marginally significant predictor for mothers.

Sports

Sports competence beliefs declined over the course of schooling (see Table 2). This decline accelerated over time, as indicated by the negative linear term in conjunction with the negative quadratic function. This acceleration began during the middle school years. Prior research led us to expect that males would have higher sports competence beliefs than females. Boys had higher perceptions of their competence than did girls. However, we did not find sex differences in the rate of change over time. Thus, the sex gap was maintained over time, instead of increasing as we had hypothesized.

The growth models for children's competence by parents' perceptions of ability are presented in Figure 4. Children who had parents with high initial perceptions of their sports ability (1 standard deviation above the mean) had higher perceptions of their competence in the early years than children who had parents with low perceptions of their sports ability (1 standard deviation below the mean). Further, parents' initial ratings of children's ability helped to explain variations in the rate of change. After controlling for initial aptitude differences, children with parents who had high initial ratings of their sports competence in the early years had much less dramatic declines over time. This finding was stronger for children who had fathers with high ratings of their sports competence than children with mothers who had high ratings of their competence.[5]

Task Value Models

Math

The results of the HLM analyses for children's perceptions of math interest are presented in Table 3. Overall, participants reported a decline in their math interest over time. Although there was significant variation between individuals in math interest in both the intercept and linear terms, sex was not a significant predictor of the intercept and was only a marginally significant predictor of the slope. Parents' ratings of children's initial ability were a significant predictor of the intercept, but were not a predictor of variation in the rate of change over time. In addition, we documented a decline in children's perceptions of the importance of math from first through twelfth grade, though the pattern for math importance was different than the pattern for math interest. In addition to a negative linear term, there was a positive quadratic function, which indicated a deceleration in the rate of decline over time. Children's self-reported perception of math importance increased slightly at the beginning of tenth grade (see Figure 5). Sex was not a significant predictor of either the intercept or the slope (see Table 4); parents' ratings were only a significant predictor of the intercept.

Sports

The results of the growth curve analysis for children's interest in sports are outlined in table 4. Overall, there was a slight decline in children's ratings of sports interest from first to twelfth grade for the whole sample. As hypothesized, boys started out with higher ratings for how much they liked sports than did girls. However, the interest gap did not increase over time as we had predicted. In fact, in the father models the sex gap actually decreased over time. The results for the sports task value indicate some differences in the influence of mothers' and fathers' beliefs. Fathers' beliefs were a significant predictor of both the intercept and the slope for the sports interest model. In contrast, mothers' beliefs were a significant predictor of the intercept, but were not related to changes in children's interest over time. When fathers had high initial ratings of children's ability, children reported liking sports more and had relatively stable sports interest over time. In contrast, when fathers had low initial ratings of children's ability, children reported lower interest in sports and more dramatic declines over time (see Figure 7).[6]

Table 6 presents the findings for children's perceptions of sports importance. Overall, there was a decrease in children's perceptions of the importance of sports over time. The decline in task beliefs became larger over time, as indicated by the negative linear term in conjunction with the negative quadratic function. Students began to perceive sports as less important to them at the end of elementary school; this decline continued through high school (see Figure 6). Further, girls reported that athletics was less useful than boys. However, the sex gap in perceptions of the importance of sports did not increase over time as hypothesized and actually decreased in the model for fathers. In addition, fathers' beliefs were a significant predictor of both the intercept and the slope. In contrast, mothers' beliefs were not related to changes in children's perceptions of sports importance over time.

Discussion

This study had several purposes: (1) document changes in children's competence beliefs, perceptions of importance, and interest from childhood through adolescence in two separate domains, (2) describe sex differences in trajectories across these two domains, and (3) examine the effect of parents' initial beliefs on children's motivational trajectories in math and sports over time.

Developmental Changes

Our results extend the prior research on the development of competence beliefs that has used cross-sectional and short-term longitudinal designs (Stipek & MacIver, 1989; Wigfield et al., 1991; Wigfield et al., 1997). Our findings extend previous research documenting declines in math ability perceptions across the school years (Eccles et al., 1993; Marsh, 1989), [7] and expand the limited research on developmental changes in sports perceptions. Although there is less research on developmental changes in value perceptions, our results are in line with the decline in task value at the transition from elementary to junior high (Eccles et al., 1989; Wigfield et al., 1991). Our longitudinal analysis indicates that these declines in interest and importance are part of a consistent downward trend.

There are a variety of possible explanations for the decline in competence beliefs (see Tables 1-2). One explanation is that these declines reflect natural developmental changes. Young children (ages 7 or 8) tend to have overly optimistic perceptions of their competence (Nicholls & Miller, 1984; Parsons & Ruble, 1977), and tend to use less comparative standards to judge their ability, relying more on wishful thinking (Ruble, 1983; Stipek & MacIver, 1989). As children grow older they are more like to engage in social comparison, resulting in a more critical evaluation of their ability. These declines also may reflect increases in the competitiveness of the school and athletic context as children progress through school. In addition, the nature of evaluation changes throughout the school years. Most elementary school teachers use criterion-mastery grading, whereas middle school and high school teachers use more normative/social comparative grading that tends to give children information about their ability relative to other children (Eccles et al., 1993b).

Both contextual and individual factors also can explain the decline in task values over time (see Figures 5 and 6). As competition increases, children are more likely to experience a drop in their performance. As a consequence, individuals may lower their perceptions of the value of the activity to help protect their self-esteem (Steele, 1998; Wigfield & Eccles, 1992). Declines in math task value also may reflect the way it is taught (Eccles, 1989). As children progress through school, there is less personal attention, greater use of ability grouping, and an increase in the use of traditional instructional techniques. It is clear that more research is needed into the causes of developmental declines in interest and evaluation of importance across multiple domains.

Although there were similar linear declines in the growth models, there were some interesting differences in the developmental pattern across the trajectories. These results highlight the importance of examining nonlinear trends in future studies. For example, an interesting finding is the accelerated rate of decline in children's perceptions of athletic competence beginning in the secondary school years (see Figure 3). Developmental changes at early adolescence may help to explain the start of this acceleration. The onset of puberty results in physical changes, which can alter an individual's performance in athletics. In addition, as early adolescents spend more time with their friends and in other activities, it is likely they will have less time to develop their athletic skills. The acceleration may reflect changes in the context of sports teams in the secondary school years. During the elementary school years, children can play on a variety of sports teams in both the school and in the community. In contrast, in middle school, sports teams become more selective and competitive, both at school and in the community. Consequently, children are competing for fewer positions on teams and fewer children will be able to play on a team of their choice. The increased competition associated with sports teams at this stage provides more opportunities for social comparison that can in turn lead children to lower their ratings of their own sports ability.

Another interesting nonlinear change was in the mathematics importance trajectory. The increase in children's perception of math importance at the tenth grade may reflect children's recognition of the increasing importance of mathematics in high school for future educational and occupational pursuits, something currently being stressed in many high schools. However, the increase in perceptions of the importance of mathematics is not mirrored in the math interest curve, which continues to decline (see Figure 5). This finding supports Eccles' contention that interest and importance are distinct components of value and that developmental changes in these constructs will not necessarily follow the same pattern (see Eccles et al., 1983). Interest and importance become more distinct as children get older, with importance playing a greater role in children's motivation as individuals become more future oriented (Wigfield & Eccles, 1992).

Interestingly, this differential pattern of change is reversed for sports (see Figure 6). The children maintained relatively high interest in sports from childhood through adolescence, despite declining perceptions of its importance. One possible explanation for the different developmental patterns in math and sports is that declines in interest and importance reflect the reality of the changing value of academic and nonacademic activities in adolescents' future life options. Math performance does have a greater influence on college options than does sports, except for those few outstanding college athletes who will get scholarships. Another difference between the two domains is that sports has become much more competitive and children are discouraged from engaging in sports in a way that is not true for math. As a consequence, children may lower their perceptions of the importance of sports as a way to protect their self-esteem, even though they still enjoy participating in the activity.

An even more interesting finding is the direction of the discrepancy in math and sports. There has been less work to date on the motivational consequences of a discrepancy between a person's assessment of interest and importance. Eccles and her colleagues have documented that importance was a much stronger predictor of both math and sports participation than interest (Eccles et al., 1983; Updegraff et al., 1996). In contrast, intrinsic motivation theory says that the quality of learning is improved by interest and not utility value (Deci & Ryan, 1985). Together these two perspectives suggest that the discrepancies in interest and importance should lead to more individuals dropping out of sports than math, accompanied by a lower quality of learning math in advanced high school math courses. We know of no tests of this prediction.

Sex Differences

Our results add more evidence of sex differences that boys have higher ratings of their ability and value of participating in sports and math (Marsh & Yeung, 1998; Eccles et al., 1993; Lrigg, 1992). However, the findings regarding sex differences in the rates of change in math and sports beliefs over time were surprising (see Tables 1 and 2). Gender-intensification (e.g., Hill & Lynch, 1983) and gendered socialization theories (e.g., Eccles, 1987; Maccoby, 1966) led to the hypothesis that this sex gap should increase with age, with the rate of change accelerating at early adolescence. Although these theories are intuitively appealing, there has been limited empirical research testing the validity of their claims over long periods of time with longitudinal data. Our results do not support these predictions, but instead support egalitarian theories. Although boys and girls enter school with sex-typed beliefs and interests, these findings suggest that their experiences in and out of school help to reduce these differences. As expected, we did find differences in the sex gap across the two domains. In math, the sex gap decreased over time, while the sex gap in sports remained stable from childhood to adolescence. Although both math and sports are traditionally "male-typed", these results suggest there are some important differences between these domains. Participation in math has become more socially acceptable for girls over the past two decades, while sports involvement is still viewed as a more masculine activity. Because girls participate at lower rates in sports than in math, they will likely have fewer opportunities to receive feedback that will modify their competence beliefs.

There are two possible explanations for our finding concerning sex differences in the rate of change. One explanation is that boys are more likely to have unrealistically high expectations of their ability in the early elementary school years. Girls tend to be more sensitive to failure information at earlier ages, and consequently they may have already begun a shift to a more realistic self-appraisal by the first grade (Parsons & Ruble, 1977). Second, this finding may reflect a reduction in gender stereotyped socialization over the past decade due to interventions and legislations (Title 9 in sports) aimed at increasing girls' motivation and participation in math, science, and sports over the past decade. These results are consistent with the suggestion that these changes are having a positive effect on girls. In future research, it will be worthwhile to document if these patterns hold in other "male-typed" domains as well (i.e., engineering, computers, sciences). Further, we need to look more intensely at variations in girls' beliefs across domains to see if the predictions about positive socialization are supported. For example, we did not find a parent belief by sex of child interaction, highlighting that these findings are not limited to families in which parents have high expectations for their daughters.

Parents' beliefs

Parents' beliefs during the early elementary school years were related positively to mean differences in math competence, sports competence, sports interest, and sports importance, as well as differences in the rate of change in the sports model. Since children's aptitude was controlled for in these analyses, these effects are independent of early ability differences. Therefore, parent beliefs were associated more strongly with children's beliefs than one would have expected given children's ability level. However, given later maturation changes, it is still possible that there are individual differences in later ability that can account for the relation between parents' and children's beliefs. These results are consistent with prior work by Eccles and colleagues documenting parents' beliefs have a stronger impact on children's math competence beliefs than actual performance information like grades and teacher ratings (Eccles, 1993; Jacobs & Eccles, 1992; Parson et al., 1982). Our findings also expand the prior research on the effect of parent socialization on sports competence and value beliefs, an understudied area of work.

Our hypothesis about differences in the influence of parents' beliefs across the two domains was also supported. Parents' beliefs were more predictive in sports than in math. This finding highlights the important role that parents play in socializing children's athletic motivation (Brustad, 1992). The greater influence of parents in sports may reflect differences in parents' level of involvement in the two domains. Eccles and her colleagues (2001) have documented that parents spend more time helping their children with sports activities than they spend helping their children with math activities. In fact, parents report spending almost no time on math activities. As a consequence, there is more of an opportunity for parents to influence their children's beliefs about their ability and the value of participating in sports as compared to math.

Interestingly, fathers' beliefs were more strongly associated with children's sports competence and value beliefs. The importance of fathers in this domain may reflect fathers' greater involvement and investment in their children's athletic participation. In fact, fathers report spending significantly more time on athletics than do mothers (Eccles et al., 2001). Most of the research on socialization has focused on mothers; these results indicate that mothers and fathers may play differentially important roles in different domains. Future research on the influence of fathers in socializing competence and value beliefs can help to expand our knowledge base in crucial ways.

The results for the sports models support a launching model of development, in which the early experiences within the family set the stage for later experiences in achievement situations (Skinner et al., 1998). One explanation for these findings is that when parents have high perceptions of their children's athletic abilities in elementary school, children feel better about their competencies, which influences how children approach future sports situations. Another explanation is that these findings reflect that parents who hold high expectations provide more opportunities that positively influence children's competence and value beliefs. Further research is needed to test this hypothesis. These findings may also support the bi-directional relation between children's beliefs and parents' beliefs (a change-to-change model). Although we believe a change-to-change model is a plausible model of development, prior research has suggested that parents' beliefs are highly stable and the direction of influence is stronger from parents to children than vice-versa (Eccles et al., 2000; Yoon et al., 1993). Finally, these findings may reflect that parents of less motivated children incorporate the messages children's provide about their ability into their ratings of their children's competence and act to reinforce their children's low competence and value beliefs. Our analytic method attempts to account for this explanation by controlling for initial aptitude differences and examining net changes from these initial levels.

Limitations

The results of this study should be interpreted in light of the following limitations. First, this sample was purposely drawn from middle-class European-American families who have access to opportunities and resources. Most of the children in these families plan to go to college; they are likely to have experienced more success than a sample of children from a less advantaged group. Therefore, we hypothesize that the decline in competence and value beliefs would be even larger in a more diverse sample. A second limitation is that we used teachers' ratings as our measure of children's mathematics aptitude. Although it is possible that teachers' ratings of children's ability are sex stereotyped, overall the evidence indicates that teachers are very accurate raters of children's ability (Jussim, Eccles, & Madon, 1996). Nonetheless, in future work it will be important to include other measures of mathematics ability. Finally, we chose to use parents' initial reports of competence in order to focus attention on the launching power of parental beliefs (Skinner et al., 1998). This hypothesis underestimates the dynamic nature of the interaction between parent views and child views. A change-to-change model, in which changes in parents' beliefs influence changes in children's motivation over time, is more appropriate to study this interplay. In future research, it will be important to look at both of these models of development.

Conclusion

In conclusion, the results of this study illustrate declines in children's perceptions of ability, interest, and importance from childhood to adolescence in math and sports. These results support and extend prior cross-sectional and short-term longitudinal studies. Our data also provide important new information about sex differences in children's competence and value beliefs from childhood to adolescence in two traditionally "male-typed" domains. Interestingly, our data does not confirm prior research that suggests an increase in sex differences over time. Instead, we find support for egalitarian socialization theories. Finally, our findings show how both mothers' and fathers' early beliefs influence patterns of change in children's competence and value beliefs over time, supporting a launch model of development. When parents have high perceptions of children's ability, the decline in children's self and task beliefs are less dramatic over time.

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Appendix: Items for Math (comparable items were asked in sports)

Child Math Competence

1) How good at math are you? (1=not at all good, 7=very good)

2) If you were to list all of the students in your class from worst to best in math, where would you put yourself? (1=one of the worst, 7=one of the best)

3) Compared to most of your other school subjects, how good are you at math? (1=a lot worse, 7=a lot better)

4) How well do you expect to do in math this year? (1=not at all well, 7=very well)

5) How good would you be at learning something new in math? (1=not at all good, 7=very good)

Child Math Importance

1) In general, how useful is what you learn in math? (1=not at all useful, 7=very useful)

2) For me being good at math is? (1=not at all important, 7=very important)

3) Compared to most of your other activities, how useful is what you learn in math? (1=not at useful, 7=a lot more useful)

4) Compared to most of your other activities, how important is it you to be good at math? (1=not at all important, 7=a lot more important)

Child Math Interest

1) In general, I find working on math activities? (1=very boring, 7=very interesting)

2) How much do you like doing math? (1= a little, 7=a lot)

3) Compared to most of your other activities, how much do you like math? (1=not as much, 7=a lot more)

Parent Beliefs

1) How good is your child in [domain]? (1=not at all good, 7=very good)

2) How well do you think your child will do in [domain] next year? (1=not at all well, 7=very well)

3) In comparison to other children, how difficult is [domain] for child? (1=very difficult, 7=very easy)

4) Compared to other children, how much innate ability or talent does this child have in [domain]? (1=much less, 7=much more)

5) In comparison to other children, how would you evaluate this child's performance in math? [1=much worse, 7=much less].

Teacher Beliefs

1) Compared to other children, how much innate ability or talent does this child have in math? (1=much less than other children, 7=much more than other children)

2) How well do you expect this child to do next year in math (1=very poorly, and 7=very well)?

Appendix

Table 1: Initial Correlations – Math

Variable	1	2	3	4	5	6
1. Child math competence						
2. Child math interest	.36*					
3. Child math importance	.33*	.88*				
4. Mother ratings ability	.33*	.08	.07			
5. Father ratings ability	.34*	.17	.17	.66*		
6. Teacher ratings ability	.20* *	.10	.11	.51*	.49*	
7. Sex	-.14	.06	.07	-.08	-.16	-.06

Notes: *p<.001, Sex: 0-Male, 1-Female. Correlation at wave 1 (grades 1, 2, and 4).

Table 2: Initial Correlations-Sports

Variables	1	2	3	4	5	6
1. Child sport competence						
2. Child sport interest	.54*					
3. Child sport importance	.58 *	.82*				
4. Mother ratings ability	.30 *	.25*	.26*			
5. Father ratings ability	.32 *	.23*	.25*	.66*		
6. Sport aptitude	.10	.19*	.14*	.25*	.22*	
7. Sex	-.39 *	-.22*	-.21*	-.23*	-.24*	-.11*

Notes: *p<.001, Sex: 0-Male, 1-Female, Child belief at wave 1 (grades 1, 2, and 4)

Table 3: Correlations Math-Wave3

Variables	1	2	3	4	5	6
1. Child math competence						
2. Child math interest	.55*					
3. Child math importance	.54*	.88*				
4. Mother ratings ability	.43*	.18	.19*			
5. Father ratings ability	.46*	.19	.23*	.53*		
6. Teacher ratings ability	.34*	.10	.08	.52*	.42*	
7. Sex	-.20*	-.07	-.07	-.01	-.01	-.04

Notes: *p<.001, Sex: 0-Male, 1-Female. Correlation at wave 3 (grades 3, 4, and 6).

Table 4: Correlations Sports Wave 3

Variable	1	2	3	4	5	6
1. Child sport competence						
2. Child sport interest	.74 *					
3. Child sport importance	.78 *	.88 *				
4. Mother ratings ability	.50 *	.44 *	.45 *			
5. Father ratings ability	.52 *	.36 *	.41 *	.65 *		
6. Sport aptitude	.15 *	.12 *	.08	.18 *	.19	
7. Sex	-.43 *	-.33 *	-.38 *	-.14	-.12	-.11 *

Notes: *p<.001, Sex: 0-Male, 1-Female, Child belief at wave 1 (grades 1, 2, and 4)

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Footnotes

[1] Scores on this test provide an indicator of aptitude differences. However, since children were given this test at the beginning of elementary school, it is not possible to know how much these differences are a function of socialization in the first few years of life. In addition, while this is a good indicator of children's motor development in the early grades it is not clear from the available research whether this is a valid measure of motor skills in the later grades.

[2] The correlation of predictor variables at wave 6 (grades 9, 10, and 12) was .55-.67 in math, and .76-.86 in sports.

[3] For the full cohort based model, student grade was centered at the median for all three cohorts.

[4] These models are based on the findings for mothers' trajectories. These models control for sex.

[5] Although fathers' beliefs were a stronger predictor of children's sports competence beliefs, the difference in the strength of the coefficient between mothers' and fathers' beliefs was not significant.

[6] The difference in the strength of the coefficient between mothers' and fathers' beliefs was significant at $p<.01$.

[7] Students in this study made school transitions at different time points. Therefore, we do not see an abrupt change, because it is smoothed due to the spreading out of the transition point.

Table 1

Growth Curve Model- Child Math Competence

Fixed Effects	Mothers	Fathers
Intercept	5.229***	5.227***
Teacher ratings of ability	.176***	.152***
Dummy 1	.148**	.159*
Dummy 2	.080	.081*
Sex	-.260***	-.163*
Parent rating child ability	.240***	.273***
Linear	-.121***	-.121***
Teacher ratings of ability	.021*	.018^t
Dummy 1	.035**	.035*
Dummy 2	-.006	-.041^t
Sex	.038*	.040*
Parent ratings child ability	.013^t	.022*

Notes. N=514 (mothers), 368 (fathers), *p<.05 **p<.01 ***p<.001 ^{t}p<.10.

Mothers: results when mothers' perceptions of initial ability entered into model.

Fathers: results when fathers' perceptions of initial ability entered into model.

Sex: 0-Male, 1-Female. Intercept coded at middle of sixth grade.

Reliabilities: Intercept = .64 (.64), Slope= .46 (.48).

Dummy 1: comparison between the youngest cohort and the two older cohorts.

Dummy 2: comparison between the middle cohort and the oldest cohort.

Table 2

Growth Curve Model- Child Sport Competence

Fixed Effects	Mothers	Fathers
Intercept	5.670***	5.544***
Initial ability	.013***	.017**
Dummy 1	-.162*	.100
Dummy 2	.121	.070
Sex	-.681***	-.508***
Parent rating child ability	.340***	.434***
Linear	-.150***	-.177***
Initial ability	.001	.001
Sex	.025	.070**
Parent ratings child ability	.031***	.044*
Quadratic	-.014***	-.014***

Notes. N=477 (mothers), 332 (fathers), *p<.05 **p<.01 ***p<.001 ᵗp<.10.

Mothers: results when mothers' perceptions of initial ability entered into model.

Fathers: results when fathers' perceptions of initial ability entered into model.

Sex: 0-Male, 1-Female. Intercept coded at middle of sixth grade.

Reliabilities: Intercept = .72 (.71), Slope= .47 (.50).

Dummy 1: comparison between the youngest cohort and the two older cohorts.

Dummy 2: comparison between the middle cohort and the oldest cohort.

Table 3

Growth Curve Model- Math Interest

Fixed Effects	Mothers	Fathers
Intercept	3.813***	3.946***
Teacher ratings ability	.090	.151*
Sex	-.022	-.057
Parent rating child ability	.208***	.170**
Linear	-.204***	-.218***
Teacher rating ability	-.011	.006
Sex	.052[t]	.056
Parent ratings child ability	.002	-.007

Notes. N=504 (mothers), 360 (fathers), *p<.05 **p<.01 ***p<.001 [t]p<.10.

Mothers: results when mothers' perceptions of initial ability entered into model.

Fathers: results when fathers' perceptions of initial ability entered into model.

Sex: 0-Male, 1-Female. Intercept coded at middle of seventh grade.

Reliabilities: Intercept = .66 (.67), Slope= .43 (.46).

Dummy 1: comparison between the youngest cohort and the two older cohorts.

Dummy 2: comparison between the middle cohort and the oldest cohort.

Table 4

Growth Curve Model- Math Importance

Fixed Effects	Mothers	Fathers
Intercept	4.372***	4.334***
Teacher ratings ability	.027	.046
Sex	-.028	-.079
Parent rating child ability	.135***	.163***
Linear	-.104***	-.115***
Teacher rating ability	-.008	.001
Dummy 1	-.071***	-.069**
Dummy2	-.105***	-.132***
Sex	.025	.044[t]
Parent ratings child ability	.011	.001
Quadratic	.034***	.029***

Notes. N=504 (mothers), 360 (fathers), $*p<.05$ $**p<.01$ $***p<.001$ $^{t}p<.10$.

Mothers: results when mothers' perceptions of initial ability entered into model.

Fathers: results when fathers' perceptions of initial ability entered into model.

Sex: 0-Male, 1-Female. Intercept coded at middle of seventh grade.

Reliabilities: Intercept = .65 (.65), Slope= .44 (.46).

Dummy 1: comparison between the youngest cohort and the two older cohorts.

Dummy 2: comparison between the middle cohort and the oldest cohort.

Table 5

Growth Curve Model- Sport Interest

Fixed Effects	Mothers	Fathers
Intercept	6.041***	5.834***
Initial ability	.010	.016[t]
Dummy 1	-.196*	-.083
Dummy2	.088	-.351*
Sex	-.423***	-.160
Parent rating child ability	.345***	.491**
Linear	-.114***	-.134***
Initial ability	.002	.003
Dummy 1	-.085***	-.090*
Dummy2	-.065[t]	-.148***
Sex	.022	.079*
Parent ratings child ability	.015	.047***

Notes. N=464 (mothers), 322 (fathers), *p<.05 **p<.01 ***p<.001 [t]p<.10.

Mothers: results when mothers' perceptions of initial ability entered into model.

Fathers: results when fathers' perceptions of initial ability entered into model.

Sex: 0-Male, 1-Female. Intercept coded at middle of seventh grade.

Reliabilities: Intercept = .75 (.73), Slope= .50 (.51).

Dummy 1: comparison between the youngest cohort and the two older cohorts.

Dummy 2: comparison between the middle cohort and the oldest cohort.

Table 6

Growth Curve Model- Sport Importance

Fixed Effects	Mothers	Fathers
Intercept	5.260***	5.176***
Initial ability	.013*	.016*
Dummy 1	-.107	.038
Dummy 2	.281*	.025
Sex	-.499***	-.311*
Parent rating child ability	.395***	.486***
Linear	-.229***	-.264***
Initial ability	-.003	.005
Sex	.038	.097**
Parent ratings child ability	.017^{t}	.031*
Quadratic	-.030***	-.034***

Notes. N=464 (mothers), 322 (fathers), *p<.05 **p<.01 ***p<.001 ^{t}p<.10.

Mothers: results when mothers' perceptions of initial ability entered into model.

Fathers: results when fathers' perceptions of initial ability entered into model.

Sex: 0-Male, 1-Female. Intercept coded at middle of seventh grade.

Reliabilities: Intercept = .71 (.71), Slope= .44 (.44).

Dummy 1: comparison between the youngest cohort and the two older cohorts.

Dummy 2: comparison between the middle cohort and the oldest cohort.

Figure Captions

Figure 1: Changes in children's math competence beliefs by sex

Figure 2: Changes in children's math competence beliefs by mothers' ratings of ability

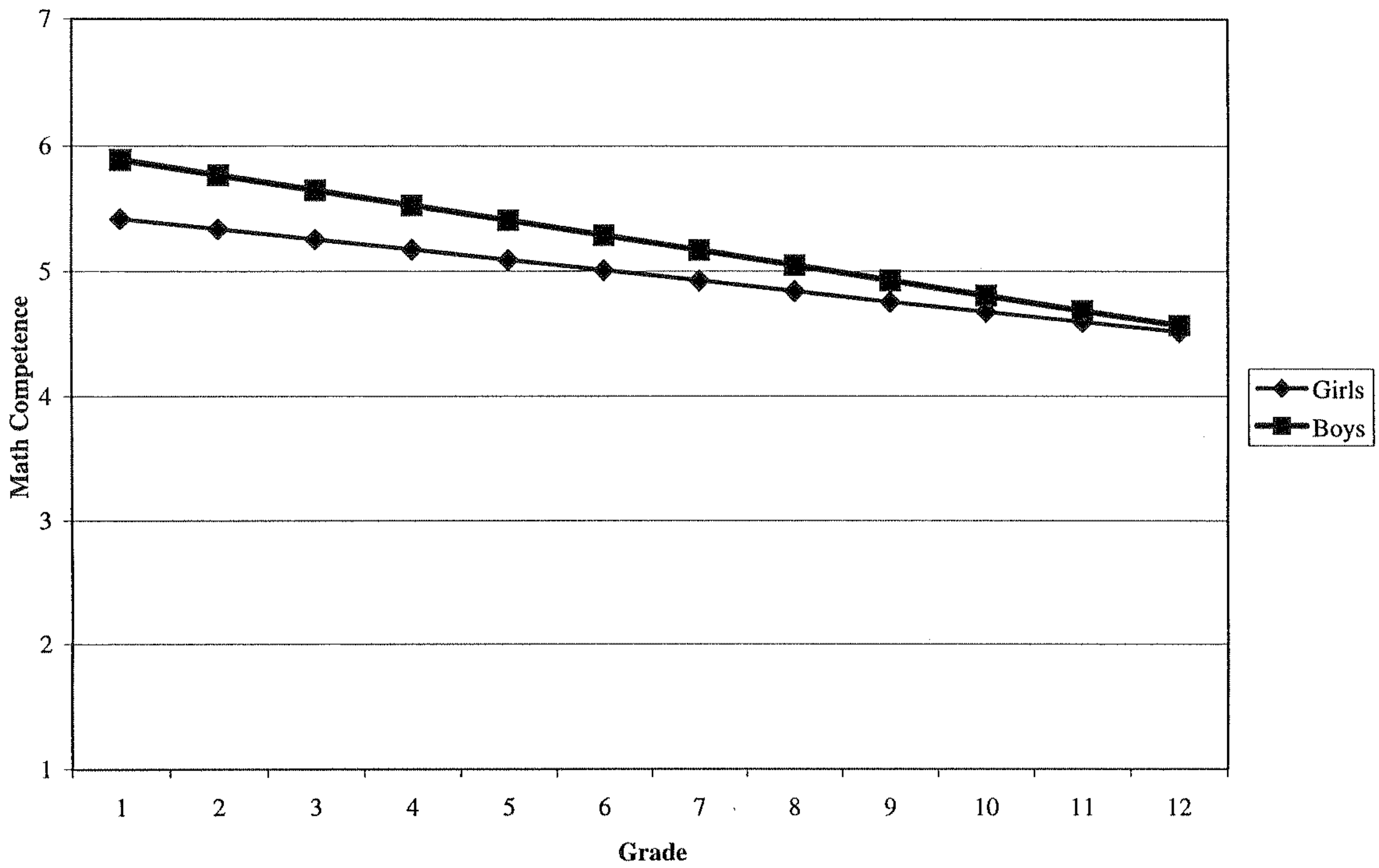
Figure 3: Changes in children's sport competence beliefs by sex

Figure 4: Changes in children's sport competence beliefs by mothers' and fathers' ratings of ability

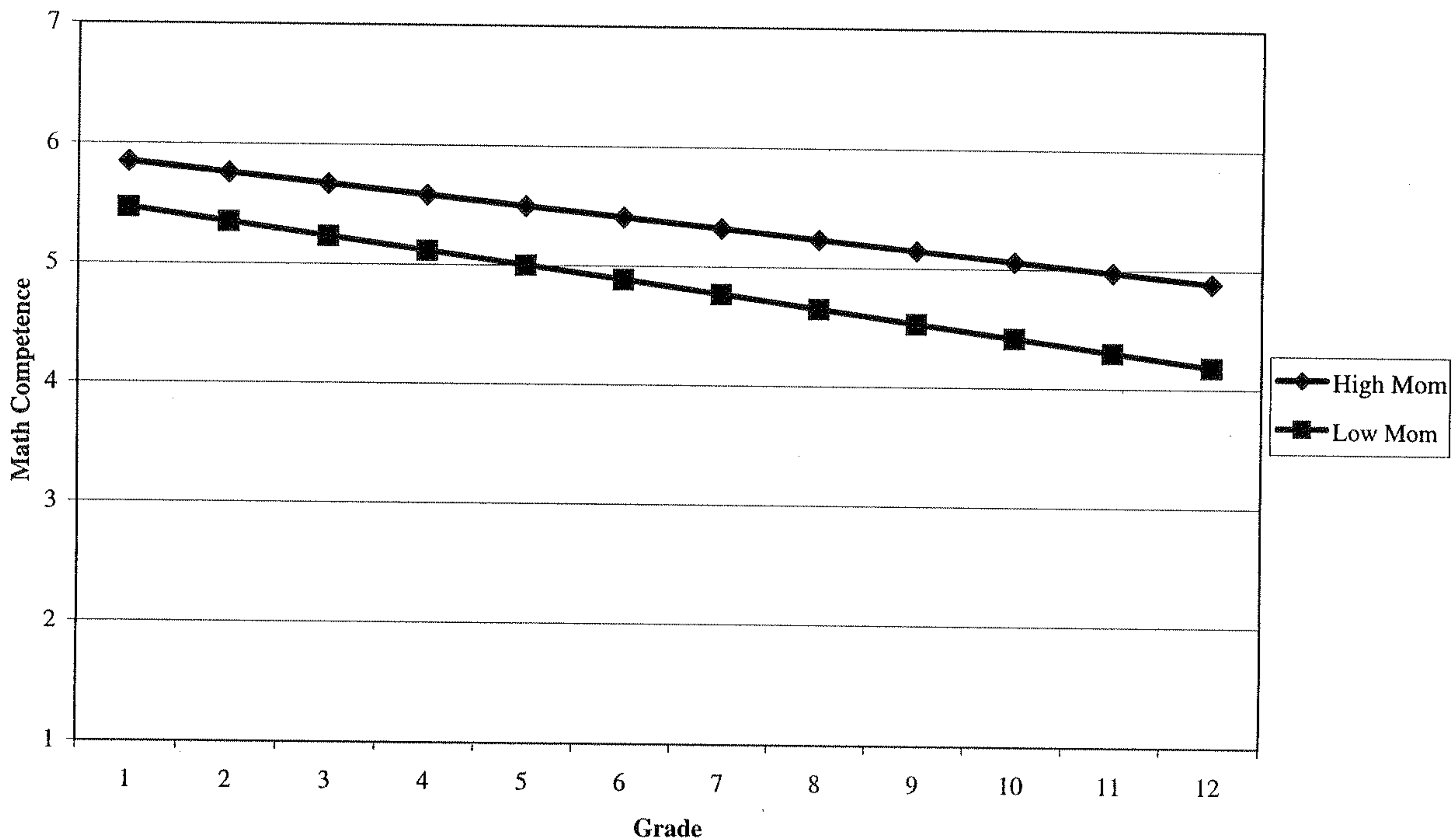
Figure 5: Changes in children's perceptions of math interest and math importance

Figure 6: Changes in children's perceptions of sports interest and sports importance

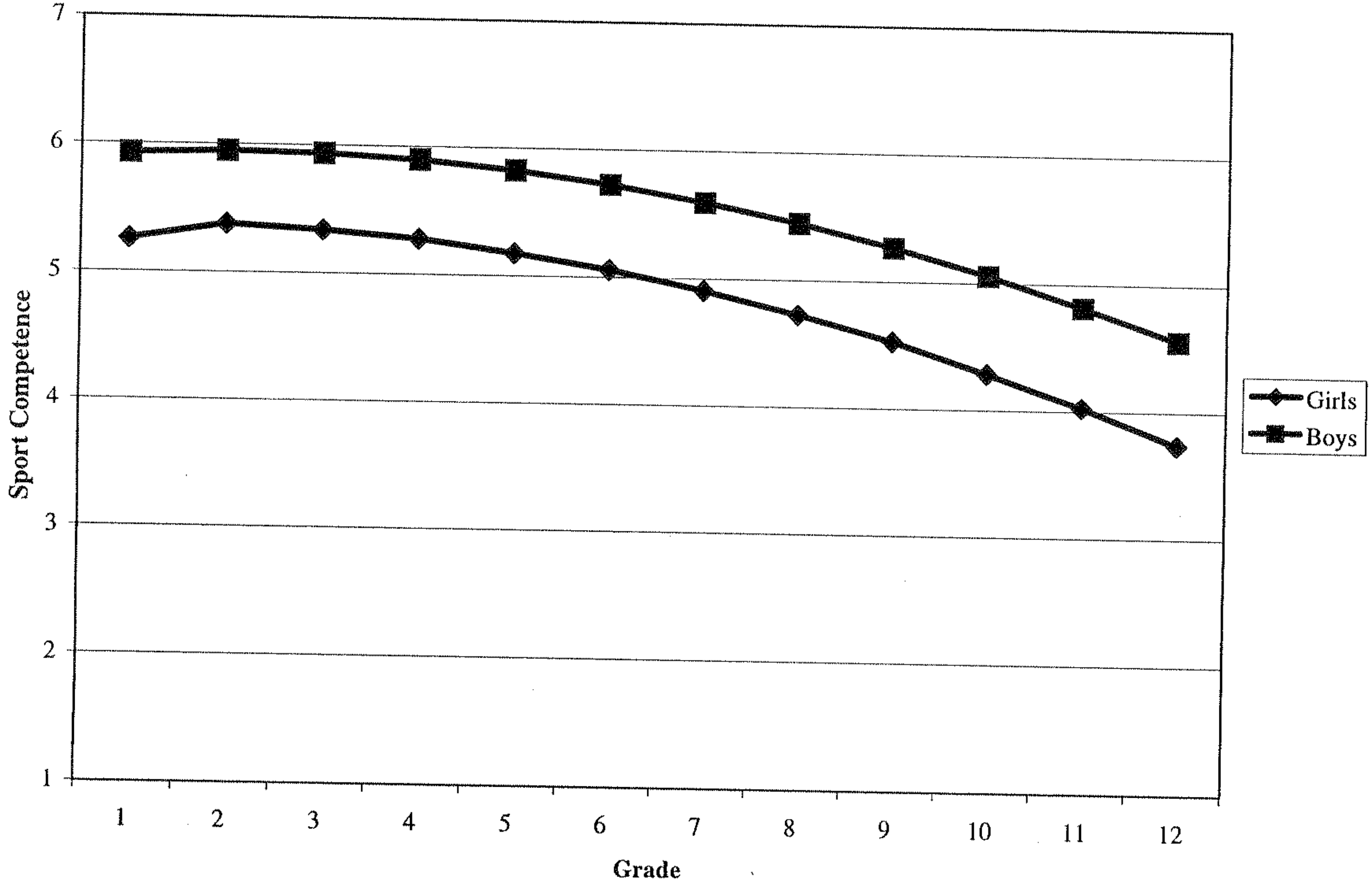
Figure 7: Changes in children's sport interest by mothers' and fathers' ratings of ability

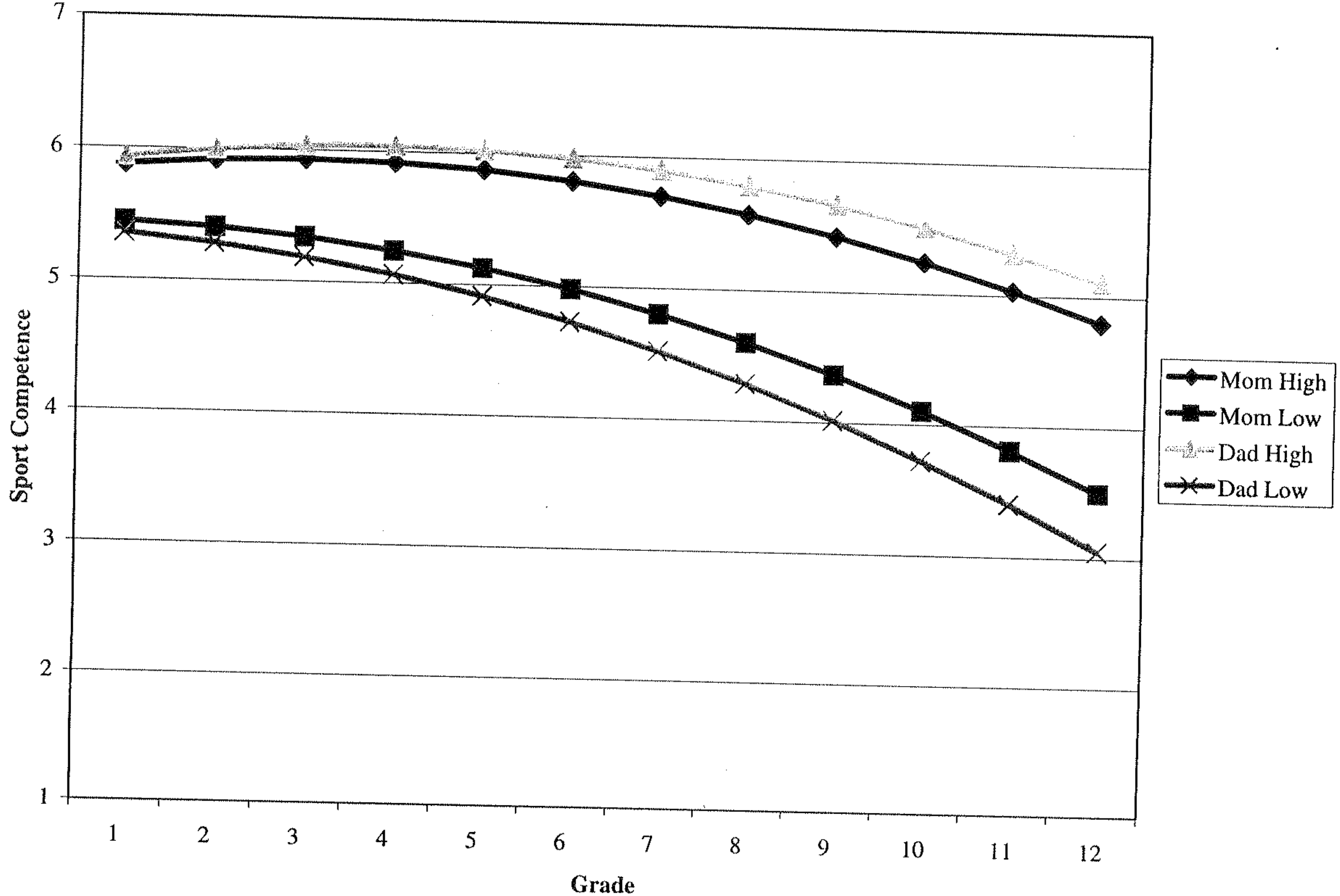


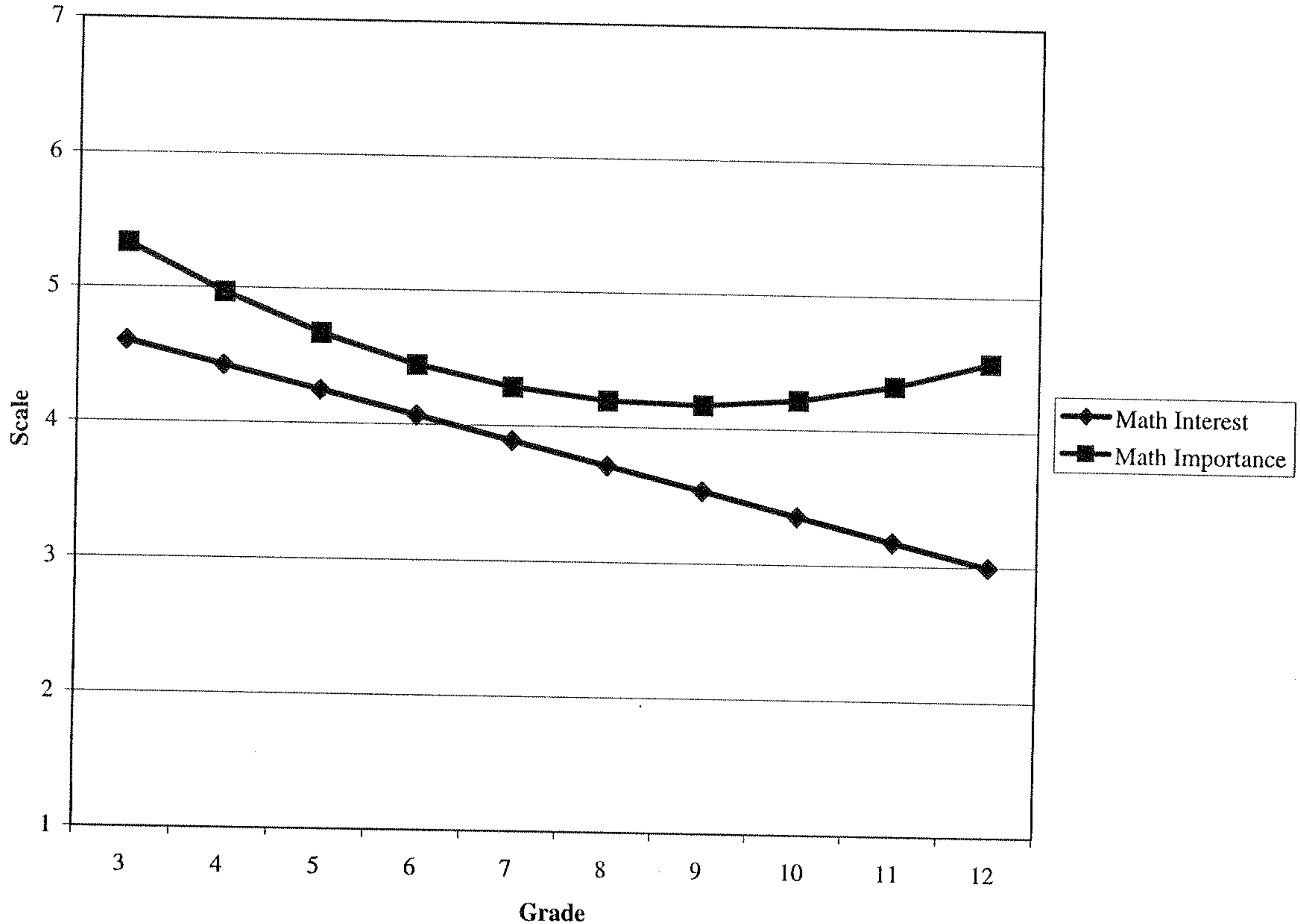
Math Competence
7
6
5
4
3
2
1
1
2
3
4
5
6
7
8
9
10
11
12
Grade
Girls
Boys

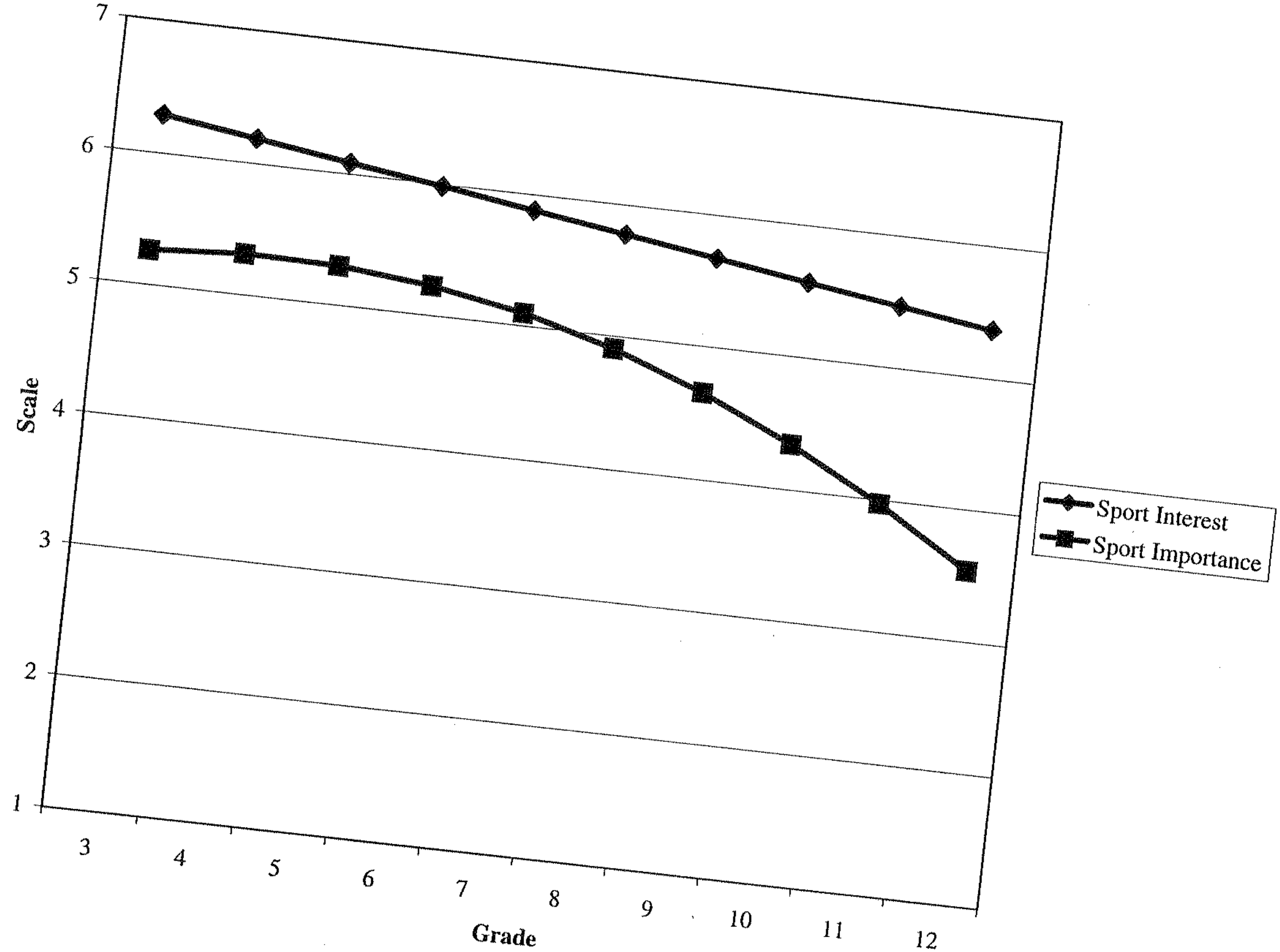


7
6
5
4
3
2
1
Math Competence
1
2
3
4
5
6
7
8
9
10
11
12
Grade
High Mom
Low Mom


7
6
5
4
3
2
1
Sport Competence
1
2
3
4
5
6
7
8
9
10
11
12
Grade
Girls
Boys


Sport Competence
7
6
5
4
3
2
1
1
2
3
4
5
6
7
8
9
10
11
12
Grade
Mom High
Mom Low
Dad High
Dad Low


7
6
5
4
3
2
1
Scale
3
4
5
6
7
8
9
10
11
12
Grade
Math Interest
Math Importance



Scale
7
6
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4
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2
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3
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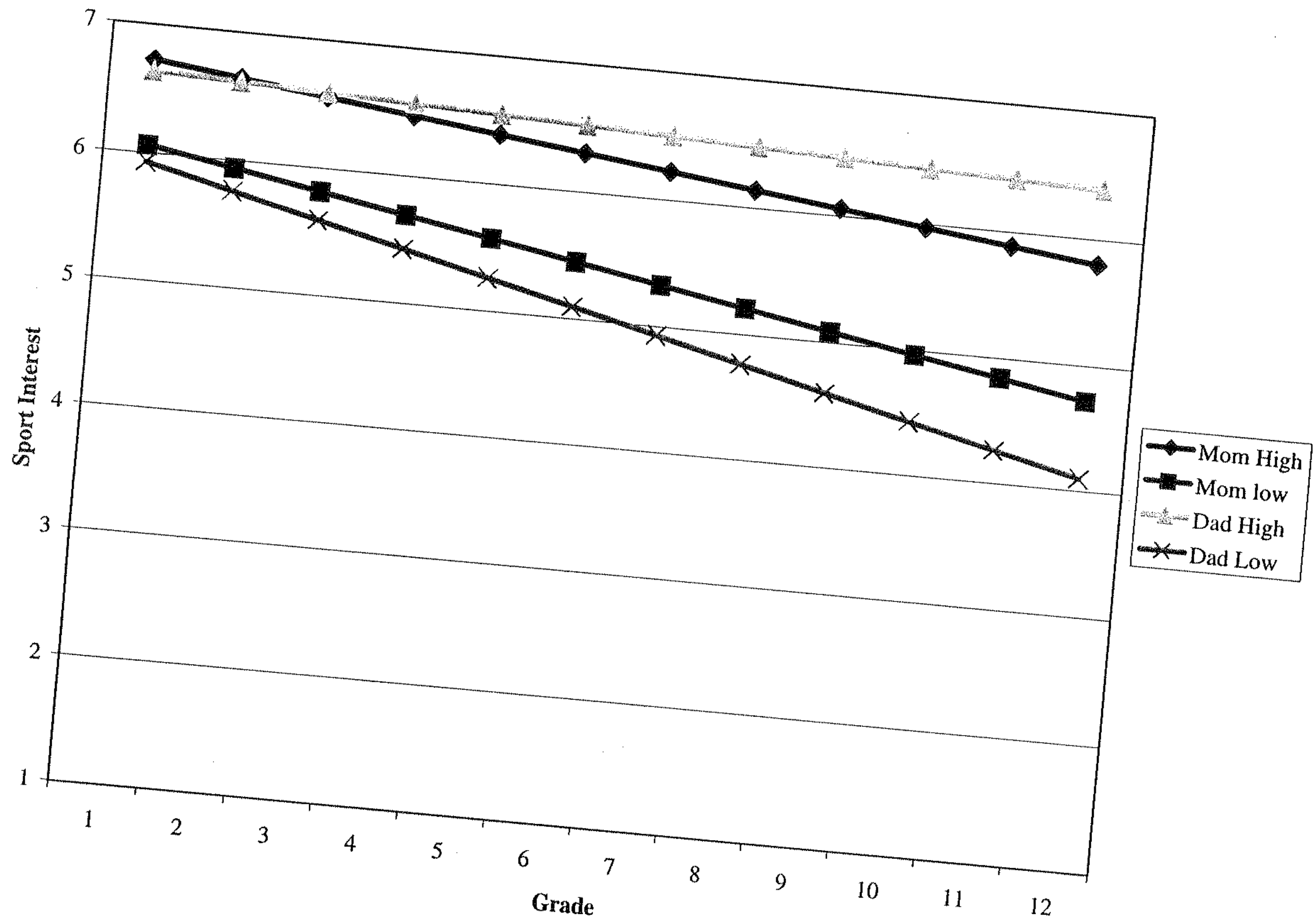
5
6
7
8
9
10
11
12
Grade
Sport Interest
Sport Importance



Sport Interest
1
2
3
4
5
6
7
Grade
1
2
3
4
5
6
7
8
9
10
11
12
Mom High
Mom low
Dad High
Dad Low