

*Selected papers presented at
the [2nd Network Gender &
STEM Conference](#), 3–5 July
2014, in Berlin, Germany*

In association with



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Gendered Socialization of STEM Interests in the Family

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ABSTRACT

In this perspectives paper, I describe families' influences on gender differences in STEM disciplines (science, technology, engineering, and mathematics). I introduce the Eccles et al. General Expectancy-Value Model of Achievement Choices as a theoretical framework that integrates both psychological and socio-cultural perspectives on human development. Focusing on gendered socialization within the family, I then outline how one gets from the child's biological sex to gender differences in children's achievement-related behaviors and decisions via gendered socialization processes. Empirical results of two longitudinal studies are presented that address the question of how parents' perceptions of their children's academic abilities predict the children's own confidence in their academic abilities; how parents' beliefs differ according to the sex of their child; and how these beliefs actually predict children's own beliefs and behaviors. The findings help us to understand how a gendered bias might emerge in STEM fields, despite the fact that girls and boys do equally well in math and science throughout their schooling.

KEYWORDS

Gender; socialization processes; family; Eccles et al. General Expectancy-Value Model of Achievement Choices; sciences; technology; engineering; mathematics, STEM



Gendered socialization of STEM interests in the family

This paper focuses on families' influences on STEM-related gender differences. Let me begin by describing how I became interested in gender and STEM. I did not start my career studying gender or STEM, but when I got to the University of Michigan in 1977 the National Institute of Education issued a call for proposals to investigate why women were less likely to go into math than men. Interestingly, we are still trying to answer this question. I became very interested in developing a theoretical model to guide my thinking about answering this question, partly in order to get funding. My colleagues and I decided that this question was really a sub-set of a much more basic question: why does anybody do anything? Because we were motivationally oriented developmental psychologists, we applied both a motivational and a developmental perspective to this more basic question and proposed the general socio-cultural and psychological model illustrated in Figure 1.

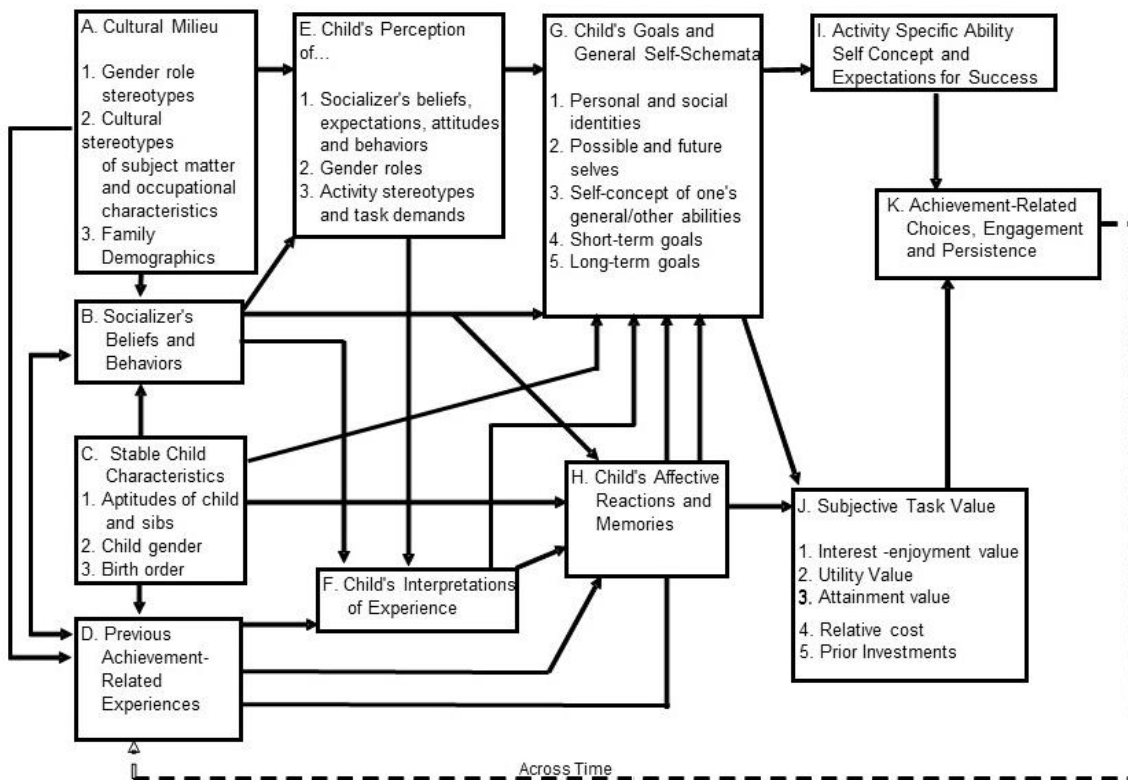


Figure 1. Eccles et al. General Expectancy-Value Model of Achievement Choices (based on model first presented in Eccles (Parsons), J. et al. (1983). Expectancies, values and academic behaviors. In J. Spence (Ed.), *Achievement and Achievement Motivation* (pp. 75–146). San Francisco: W. H. Freeman and Co.). (Copyright held by Jacquelynne Eccles)

We wanted to develop a theoretical framework that took seriously both psychological and socio-cultural perspectives on human development – a framework that would integrate notions of both personal agency and social structure. To do this we brought together two different literatures. The first focused

on the idea of personal agency in picking one's own path and the second focused on socialization. We asked how we could best understand something such as the decisions people make about what to study or what job to look for – with majoring in mathematics being just one example of such a choice. We believed that there were two important theoretical perspectives that one can draw on to answer that question. The first one is the classic expectancy–value model of rational choice used in social, personality, and organizational psychology, as well as in economics. We expanded on this perspective in two ways: (a) by more fully theorizing the value component, and (b) by more fully theorizing the link between gender-role socialization and the emergence of gender differences in individuals' hierarchies of expectancies and values across available options or choices. Thus we also tried to ground our work in the gender-identity development theories that were available at that time.

I was also interested in the structural forces that set up the opportunities and barriers to pursuing or picking one's path. More specifically, I was interested in the social forces that shape and restrict one's choices, in large part because I was very involved in the feminist movement of the 1960–1970s. Like Janet Hyde², I was there at the founding of the psychology of gender movement. It was a very exciting time to be thinking about things like gender-role socialization and the psychology of gender. This intellectual climate influenced how I thought about the issue of gendered occupational choices linked to STEM. Because I was a developmental psychologist, I wanted to understand how these external processes got under the skin to actually end up influencing people's life decisions.

Figure 1 shows the theoretical model that emerged from our thinking about the gender difference in taking math courses. In essence, the model has three major components. To the far right of the model you can see the basic principles of expectancy–value theory, namely that things such as behavioral engagement, effort, and choices are most proximally influenced by two sets of beliefs: how well you think you'll do and how important you think it is to do what you're doing. In the middle sections of the model are the less proximal psychological processes that link experience with the ontogeny of expectancies and subjective task values. These psychological processes are more distal from choice behavior in terms of time, physical space and closeness to the decision-making moment. These are the kinds of beliefs and processes that emerge slowly over time, based on each individual's social experiences as they mature. They include such beliefs and cognitive schema as short- and long-term goals, personal and social identities, affective memories that one has from prior experiences, and the ways in which one interprets the causes of one's prior experiences in similar achievement-related activities and tasks.

For example, the idea of mindset is very popular right now among motivational psychologists. I would put mindset in this set of psychological interpretive processes because mindset most likely influences achievement-related behaviors and both expectancies and values through its influence on how one interprets one's successes and "failures" in specific domains. If one has a growth mindset, one will ascribe failure or difficulty to the need to learn more so that one can get better.

Thus, difficulty or failure is good because it helps one to understand what one needs to work on in order to improve. In contrast, if one has a fixed mindset, one will interpret such difficulties as evidence that one doesn't have sufficient ability to master the material being taught. In this case, difficulty or failure is bad because one will conclude that there is little one can do to get better and do better in the future – leading initially to lower expectations of success and ultimately to the devaluing of mastery in this particular skill domain.

On the left-hand side of the model are all the experiences that individuals have as they grow up, as well as each individual's genetic endowments. These experiences are grounded in the cultural milieu in which the individual lives and matures. We have assumed that this cultural milieu influences the behaviors of all of the socializers to whom individuals are exposed as they mature. In this perspective paper I am going to write about one set of socializers – parents – and I shall focus on processes linked to gender-role socialization. Gender-role stereotypes are a central component of one's culture, as are gender-role-related beliefs about what beliefs, goals, and behaviors are appropriate and inappropriate for females and males. As children grow up, they have to make sense of the gendered world in which they live. This cognitive process will influence how they interpret everything that goes on around them. Gender-role-related beliefs also influence the behaviors of teachers, parents, and other individuals in children's lives. There is no doubt that children's gender influences the way individuals interact with them.

I am going to write in this paper primarily about gendered socialization within the family. Figure 2 illustrates more specifically the theoretical approach that guides this paper. I am going to consider how one gets from the child's biological sex in the far-left box to gender differences in children's achievement-related behaviors and decisions in the far-right boxes.

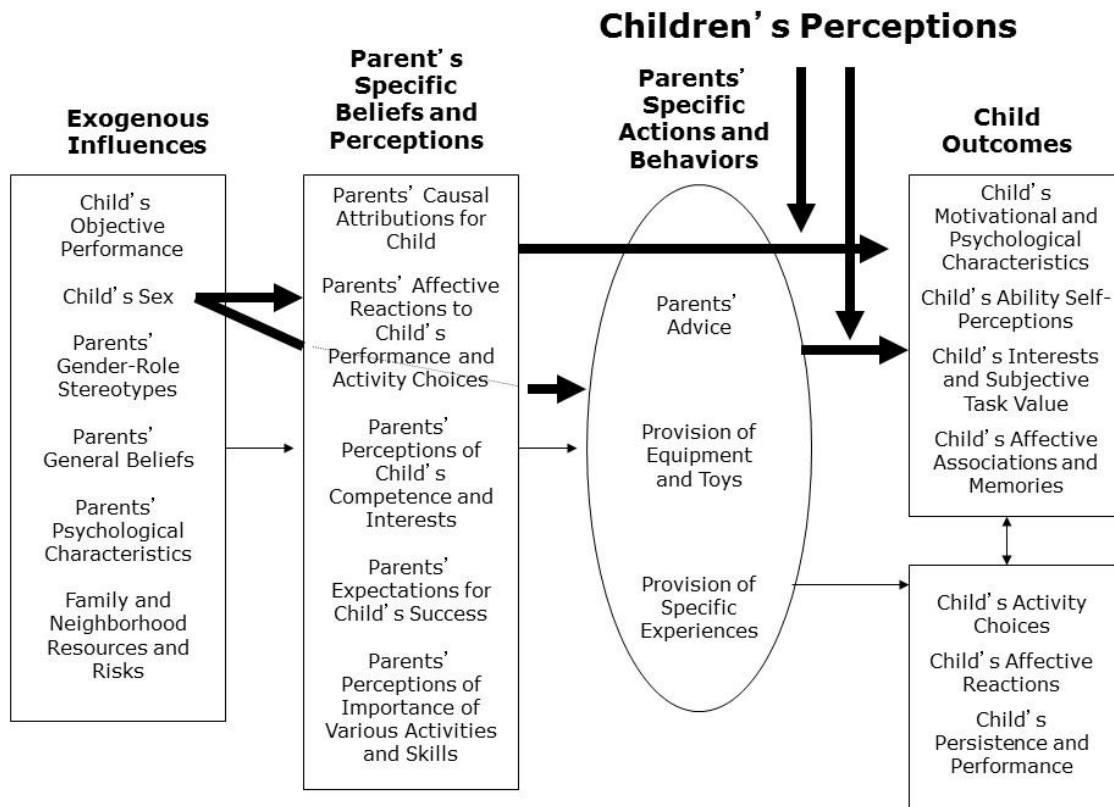


Figure 2. Conceptual model of parental influences on children. (Copyright held by Jacquelyne Eccles)

Beginning in the far-left box, we see those characteristics and processes most distal from the child's STEM-related behaviors. These include the child's objective performances (e.g., how they are doing in math and science and other things), the child's sex, the parents' gender-role stereotypes, the parents' general beliefs, their own psychological characteristics, and family and neighborhood resources. We assume that these characteristics influence parents' specific beliefs and perceptions as they relate to their own children, as illustrated in the middle box. This box includes such beliefs and processes as parents' causal attributions for their child, parents' affective reactions to the child's performances and activity choices, parents' perceptions of their children's competencies and interests, parents' performance expectations for their children's success, and parents' perceptions of important activities and skills. We predict that these specific beliefs influence parents' behaviors (see middle oval), such as the advice they will give their children about what to do and their provision of specific equipment, toys, and experiences, which, in turn, influence exactly what skills the children get to learn and master, as well as to come to enjoy or dread. Finally, we predict that these parental behaviors influence the ontogeny of children's own beliefs, goals, and identities, as well as the hierarchy of their domain-specific expectancies and values. Most importantly, we also predict that it is critical to take into account both the parents' behaviors themselves and the children's perceptions of their parents' beliefs and behaviors.

So this is basically a model of how external structural features of the world one lives in end up influencing the choices one makes for oneself as one moves through life. In this paper I will focus on ways in which gender-role systems influence a child's development through their influence on the beliefs and behaviors of the child's parents. I am going to provide selected examples from our own studies on various aspects of the model shown in Figure 2.

Empirical Studies: Parents' Beliefs and Perceptions

Do parents' perceptions of their children's academic abilities predict the children's own confidence in their academic abilities? Do parents' beliefs differ with the sex of their child, and do we have any evidence to show that these beliefs actually end up predicting what the children think? The bottom line is yes.

I am going to introduce two longitudinal studies. The first is the Michigan Study of Adolescent Life Transitions (MSALT), which is an ongoing study of one birth cohort. They were sixth-graders when the study began; they are now (2014) approximately 45. We followed these kids from the time they were in the sixth grade. We have just finished gathering the most recent wave of data on them, so we now know exactly what they did with their lives, what occupations they went into, what their college majors were, whether they are married, etc. We collected four waves of data during their sixth and seventh grade school years (between the ages of 12 and 14), two waves when they were in high school, and four waves after they graduated from high school. They were a school-based sample of predominantly European-American young people growing up in working- and middle- class families in Southeastern Michigan. Approximately 50% of the young people went on to college.

We collected a variety of measures. The analyses I summarize in this paper include the sixth-grade teachers' rating of each child's mathematical and English abilities, their parents' rating of their own children's math, English, and sport abilities, the parents' causal attributions for their children's math and English performance, the importance the parents attached to their child's being good at math and English, and the children's ratings of their own math abilities and English abilities (Eccles et al., 1993). Figure 3 illustrates one of our major findings.

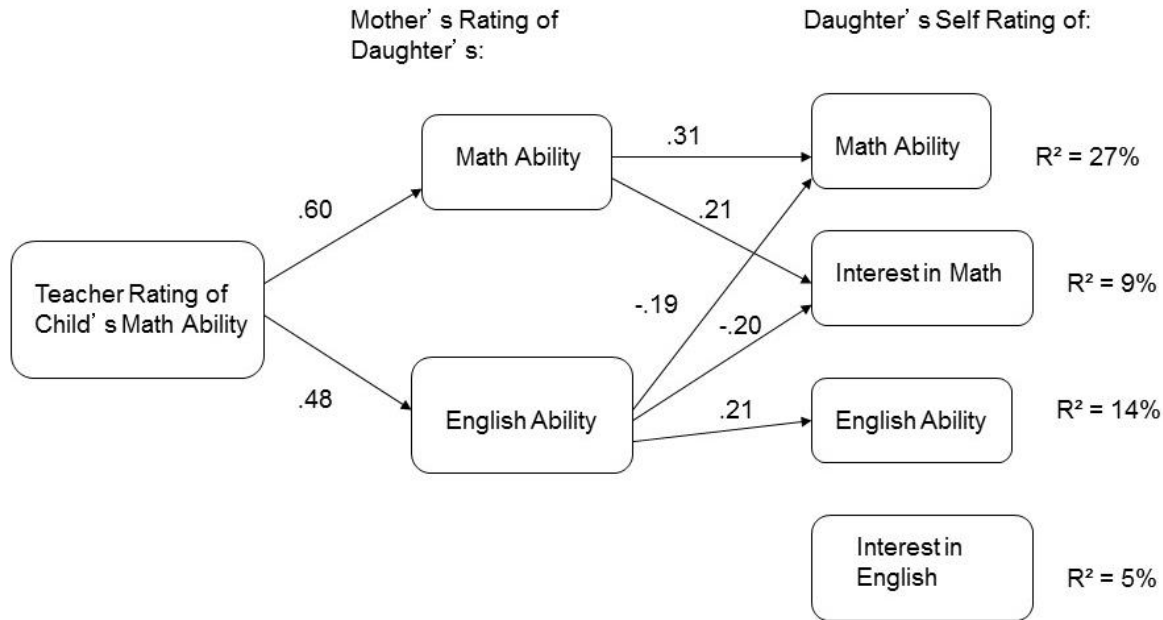


Figure 3. *Mother's influence on daughter's self-perceptions.* (Copyright held by Jacquelynne Eccles)

This is a path analysis that shows the paths from teachers' estimates of each child's math ability to mothers' estimates of their female child's math and English abilities and then to the daughter's ratings of her own abilities and interest in math and English. This analysis lets us see the association of mothers' perceptions of their daughters' abilities with their daughters' own expectancies and values, controlling for an independent (in this case the teacher's) rating of the child's actual math ability. Thus it provides an estimate of a biasing effect of mothers' perceptions on their children's own self-perceptions. It also lets us see the crossover impact of mothers' perceptions of their children's relative abilities in math versus English so that we can look at the gendered bias across these two gender-stereotyped abilities areas. The effects shown here are also true for mothers of sons and the coefficients are approximately the same for mothers of sons.

First, we can see that mothers have pretty accurate perceptions of their children's math abilities and that mothers' beliefs fully mediate the association of actual abilities (as assessed by the teacher) with their children's own self-perceptions at this age. Second, we see that the teachers' ratings of the child's math ability also predict mothers' ratings of their daughters' English ability, probably because there is a high correlation between how these children do in math and English. Third, as we expected, mothers' ratings of their daughters' math ability predict the girls' ratings of their own math ability and interest; furthermore, as we expected, mothers' ratings of their daughters' English ability also predict the children's own rating of their English ability but not their interest in English. But, even more interestingly, mothers' ratings of their daughters' English ability predict their daughters having lower ratings of their math ability and lower ratings of interest in math. Thus, to the extent that her mother thinks that she is really good at English,

an individual will lower her estimates of her own ability and interest in math, independent of how well she is actually doing in math. This set of findings suggest that parents can influence their daughters' interest in, and expectations of success in, math by two routes: (a) through the direct positive association of their perceptions of their children's math abilities, and (b) through a direct but negative association of their perceptions of their daughters' English ability on their children's math self-perceptions. I will reveal evidence later in this paper that parents' gender stereotypes about which sex is better in math and English influence the extent to which parents think their children are better at English or math, again independent of how well their children are actually doing in math according to their teachers. Because parents are more likely to think daughters (compared to sons) are better at English than math, this is a good example of one way in which parents of daughters may be inadvertently pushing their daughters away from math and towards English.

Another possible path of influence is through how hard parents think their sons as opposed to their daughters have to work in order to do well in math. If parents of daughters think that their child has to work harder to do well in math than do parents of sons, they may underestimate their daughters' math abilities and overestimate those of their sons (Eccles et al., 1993; Eccles & Jacobs, 1986; Yee & Eccles, 1988). Figure 4 illustrates our findings with the MSALT data.

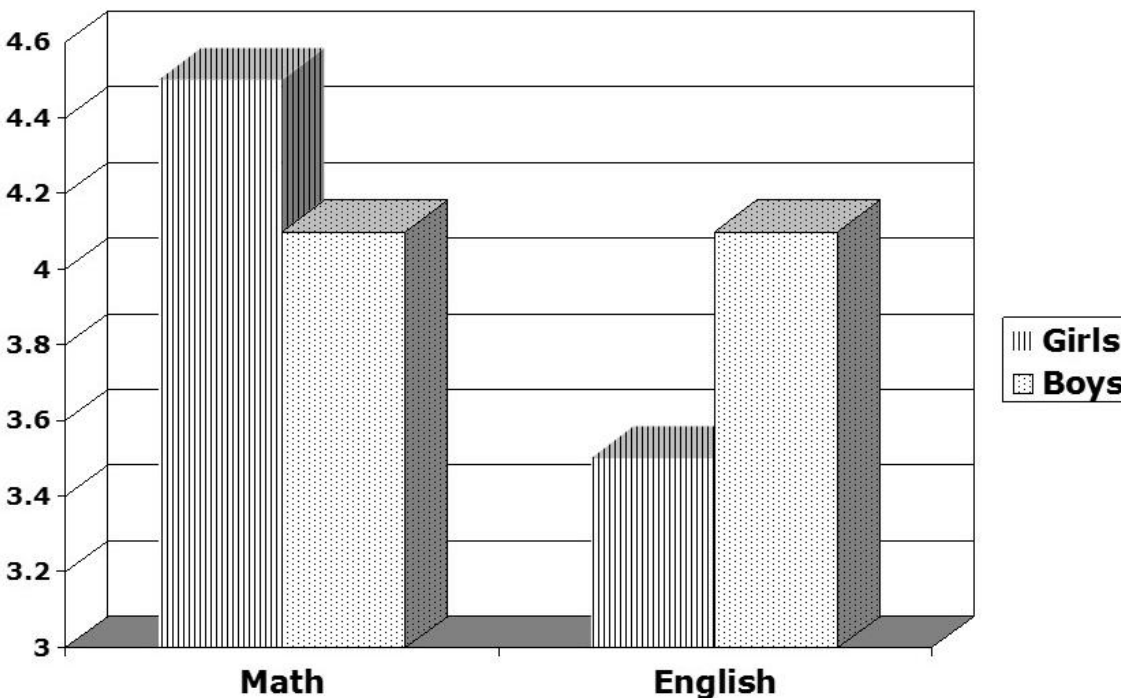


Figure 4. *Parents' rating of child's effort in math and English: MSALT Study.* (Copyright held by Jacquelynne Eccles)

Even though girls actually get better grades than boys in math, these parents felt their daughters were working harder to do well in math than their sons and that the reverse was true for English. But, even more importantly, parents thought their girls were working harder to do well in math than in English. Not surprisingly, these parents also thought their daughters had more ability in English than in math. This was not true for sons. They also thought that their daughters would do less well in careers that required math skills than their sons would.

We found a similar pattern in another study with elementary-school-aged children. In this study (the Childhood and Beyond Study – CAB), we asked the parents how much natural talent their child had for math and English. Parents of daughters believed that their child was more talented in English than parents of sons and less talented in math than parents of sons, despite the fact that their daughters had performed better in math and English class and in standardized math and English tests than their sons.

Thus middle-class American parents do have gender-stereotypic beliefs about their children's math and English abilities/talents even though their daughters gain better grades in both math and English than their sons. Why might that be? We have no evidence that these girls were performing more poorly or working harder in math than their male peers. We asked the girls how hard they worked in each subject and we asked their teachers how hard each child worked in each subject. There were no gender differences on these measures for math. Furthermore, the teachers rated boys as having to work harder and as having less talent than girls in reading. So these gendered parental beliefs persist despite evidence to the contrary. Why?

Perhaps it has to do with parents' making different causal explanations for their sons' versus their daughters' performance in math. We asked these parents to imagine the last time their child came home with a very good grade in mathematics and then to rate the extent to which that success was due to the child's natural talent, the child's effort, the quality of the teacher they had, or just luck. Figure 5 shows the results for the ratings of natural talent and effort.

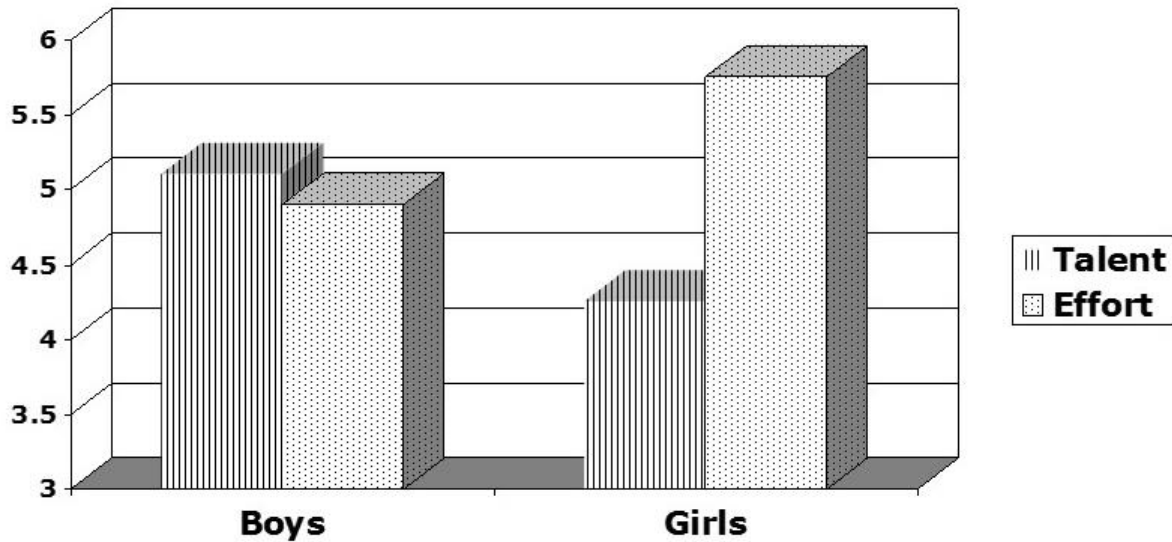


Figure 5. MSALT parents' causal attributions for their child's math successes. (Copyright held by Jacquelynne Eccles)

As you can see, the parents of girls believed that their child's math success was more due to how hard their daughter had worked than to how much talent she had. In contrast, parents of sons felt their child's math success was equally due to talent and effort. As a result, parents of sons thought their child's math success was more due to natural talent than did parents of daughters.

Next we looked across time at the relationship between these causal patterns and changes in the parents' perceptions of their children's effort and talent (Yee & Eccles, 1988). As shown in Figure 6, the more parents attributed their child's math success to hard work at time 1, the lower they rated their child's natural talent in math at time 2. In contrast, the more they attributed their child's math performance at time 1 to talent, the higher they rated their child's natural talent in math at time 2. We see here evidence of a self-fulfilling gender-stereotypic prophecy: if at time 1 parents believe their child is doing well in math because they work hard, a year later they think their child has less math talent independent of how well their child actually did on their math course, and vice versa if they attribute their child's math success to natural talent.

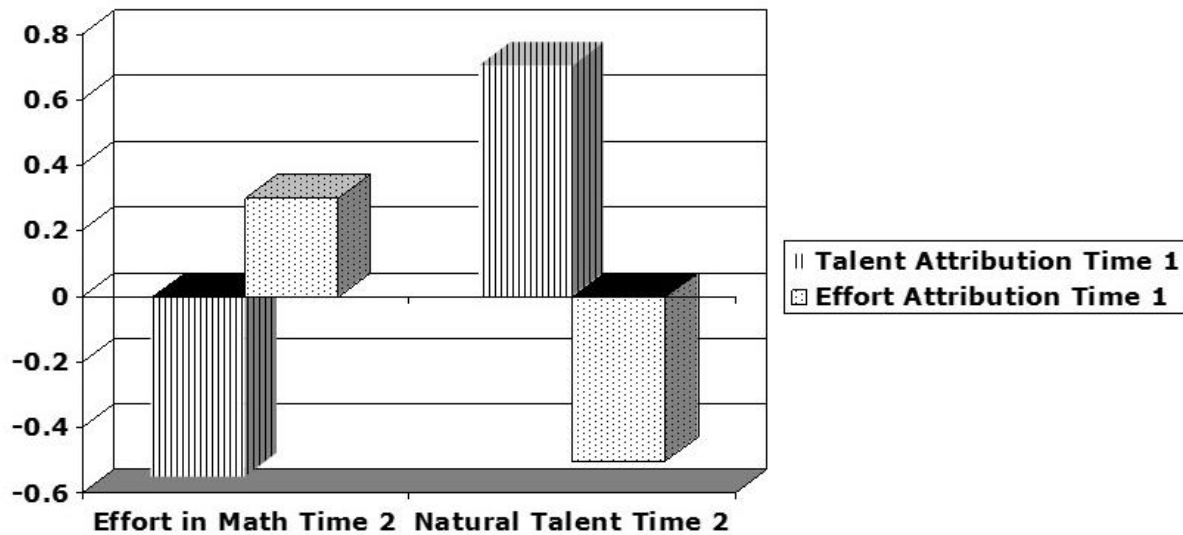


Figure 6. *Relation of MSALT parents' causal attribution for child's math success to changes over time in parents' ratings of child's effort and talent in math. (Copyright held by Jacquelynne Eccles)*

Given the gender difference in the parents' average attributions for both math and English, this pattern will, over time, lead parents to believe that their daughters have more natural talent for languages and arts than for math, and vice versa for sons. Using path analyses with the MSALT data, we found that attributing one's child's math success to talent predicts increases in mothers' perceptions of their child's current math competency, their expectations for their child's future math-course performance, their expectations for the child's likely success in a math-related career and their child's natural talent for mathematics, and decreases in their perceptions of the difficulty of math for their child. We found similar patterns for the CAB study. In each study, this gendered causal attribution pattern created a disadvantage for girls because their parents were less likely than parents of sons to attribute their child's math successes to talent rather than to hard work.

So, parents do make gender-stereotypic causal attributions and these differences help to explain changes over time in parents' ratings of their children's abilities and interests. These findings support the conclusion that causal attributions are one important source of gender-typed socialization. What about gender-role stereotypes themselves as another possible explanation? Do parents' gender-role stereotypes influence their perceptions of their children's abilities? To answer this question, Jan Jacobs and I developed the model shown in Figure 7 (Jacobs & Eccles, 1992).

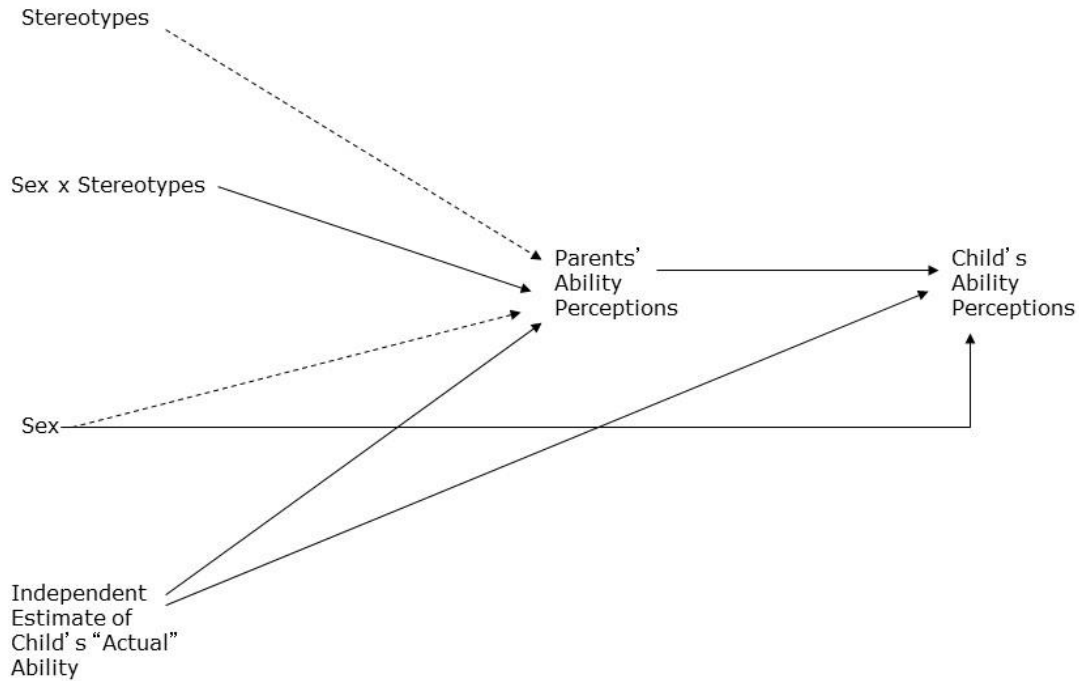


Figure 7. *Parents' gender-role stereotypes predicting parents' perceptions of their children's abilities.* (Copyright held by Jacquelynne Eccles)

We wanted to investigate whether parents' general gender-role stereotypes about the gendered distribution of math talent would influence their views on their own children's math abilities independent of how well the child was actually doing at school in math. If they do, then parents of sons should overestimate their child's math ability and underestimate their daughters' math ability after controlling for the teachers' estimates of each child's math ability. Did we find evidence to back this hypothesis? Yes (Jacobs & Eccles, 1992)! The results are illustrated in Figure 8. We found that the child-gender association with parents' perceptions of their child's math ability becomes non-significant when one includes the interaction term for child's gender by parents' gender-role stereotype in the path analysis. This gender by parents' gender-role stereotype interaction term estimates the biasing impact of parents' stereotypes on their perceptions of their children's math ability because we controlled for the teachers' ratings of each child's math ability. This coefficient is significant. Furthermore, the association between the teachers' estimate of the child's math ability and the child's own rating of their math ability is substantially mediated by its association with the parents' estimates of their children's math ability. Thus parents can influence their children's developing math ability self-concepts in two ways: a positive mediational effect reflecting the accuracy of their perception of their children's math ability (estimated by the association between the parents' perceptions and the teachers' rating) and a stereotypic biasing effect that results from their endorsement of the culturally shared gender stereotype that males are naturally more talented in math than females. As we predicted, this bias leads to parents' slightly overestimating their son's math abilities and slightly underestimating their daughters' math abilities.

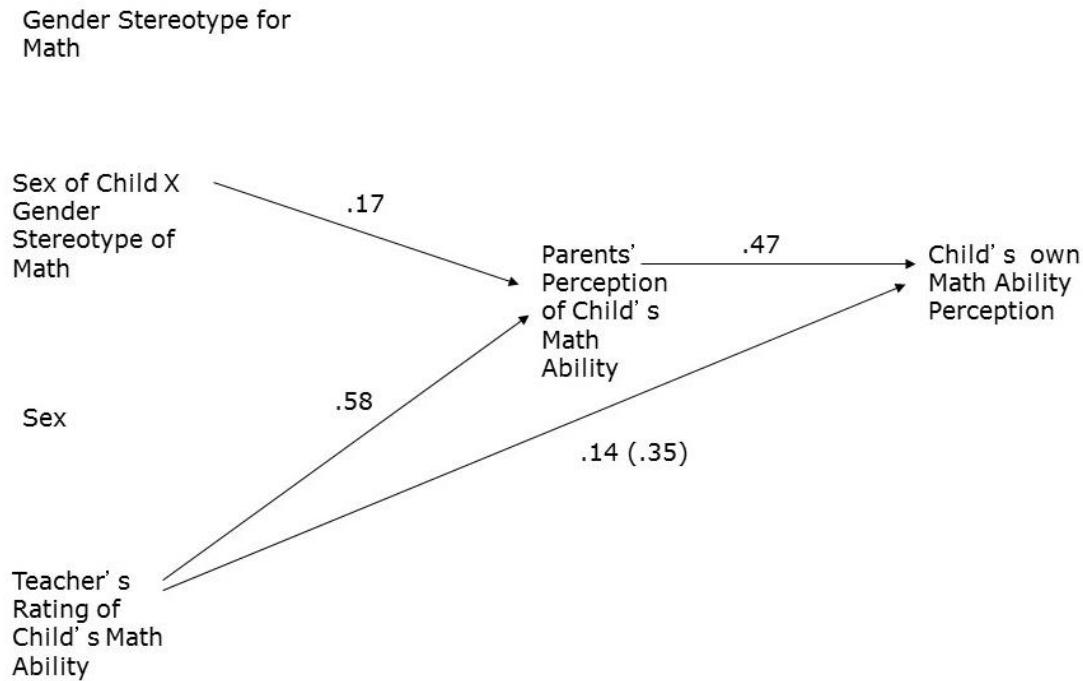


Figure 8. Path analysis for parents' gender-role stereotypes predicting parents' perceptions of their children's abilities: MSALT. (Copyright held by Jacquelynne Eccles)

Empirical Studies: Parent Behaviors and Provisions of Experience

Do parents also provide their daughters and sons with different STEM-related experiences and do these differences support the model presented in Figure 2? To address these questions, we conducted a second longitudinal study – CAB. This study was based on MSALT but we looked at elementary-school children and we gathered much more information about parents' behaviors (see Eccles, Wigfield, Harold & Blumenfeld, 1993 for more details). The families also came from Southeastern Michigan. They were predominantly middle-class families, so all had the financial means to provide their boys and girls with equivalent experiences of activities that are gender-stereotyped in the wider community. We know what gifts they gave their children for birthdays and holidays, we know what camps they sent their children to in the summer months, we know how much time they spent helping their children with all types of homework, we know how much they encouraged them to be engaged in math, science, computers, sports, reading, and the arts. We wanted to investigate exactly what parents were doing to communicate their beliefs to their children. Our initial results for parents of children in the early elementary-school grades are summarized in Figure 9.

Activity	Girls	Boys
Have child read to you	3.10	2.90
Play sports with child	2.63	3.36
Do active, outdoor activities with child	3.20	3.56
Take a child to paid sporting event	1.71	1.91
Encourage child to do math or science-related activities at home	4.01	4.35
Encourage child to work on or play with a computer outside of school	3.70	4.04
Encourage child to read	6.04	5.69
Encourage child to play competitive sports	3.58	4.43
Encourage child to play noncompetitive sports	4.54	4.94
Encourage child to take dance lessons	3.56	2.15
Encourage child to take dancing for fun	3.85	2.53
Encourage child to watch sports on TV	2.61	3.07
Encourage child to take music lessons	4.26	3.52
Encourage child to play musical instrument	4.32	3.67
Encourage child to build, make, or fix things	3.83	4.67
Encourage child to learn cooking and other homemaking	4.01	3.59

Figure 9. *Parents' provision of experiences for daughters and sons (Childhood and Beyond Study – Grades 2, 3, and 5). (Copyright held by Jacquelynne Eccles)*

As you can see, parents' behaviors differed markedly according to the sex of their child. Parents are more likely to have their daughters rather than their sons read to them, and to encourage their daughters to read. They are more likely to take their daughters to dance lessons and to dance with their daughters than with their sons. They are also more likely enroll their daughters in music lessons, buy them musical instruments, and involve them in indoor household chores and tasks such as cooking. Thus, even in the early elementary-school years, girls were getting a heavier dose of the things that are characteristic for females than boys were. In contrast, compared to daughters, these parents were more likely to play sports and do outdoor activities with their sons, to take their sons to a sporting event, to encourage their child to do math and science activities at home, to encourage their child to work on the computer, and to provide their sons with computer-based opportunities. They were also more likely to involve their child in building and making things if it was a son than if it was a daughter. These data suggest that the generation of Americans now in their mid-thirties were very likely to have been socialized into gender-stereotypical activity preferences. We then looked more closely at the parents' provision of math and science materials and experiences. Boys were more likely to get such experiences at every grade level.

Do such differences predict gender differences in the ontogeny of children's own math ability self-perceptions, interest in math, and amount of free time spent on math and STEM-related activities? Yes. Jennifer Fredricks and I used a person-

centered approach similar to that being used in the risk and protection literature to answer this question (Fredricks & Eccles, 2005). We looked at all of the ways in which parents might socialize their children’s interest and engagement in math and science, including the parents’ confidence in their children’s math ability, the parents’ reports of actively encouraging their children’s participation and interest in STEM-related activities, the value the parents said they placed on their children’s doing well in math class, the parents’ doing STEM-related activities with their children, and the parents’ provision of experiences with STEM-related objects and experiences. We gave the family one point for each time their score fell in the top 25% of the distribution of scores across all families. Their final score represents the cumulative amount of encouragement they are providing their child with to participate in STEM. Our findings for math are summarized in Figure 10. As you can see, the boys are more likely than the girls to get either no support or lots of support from their parents. Thus boys are more likely than girls to receive a great deal of support for their interest in math.

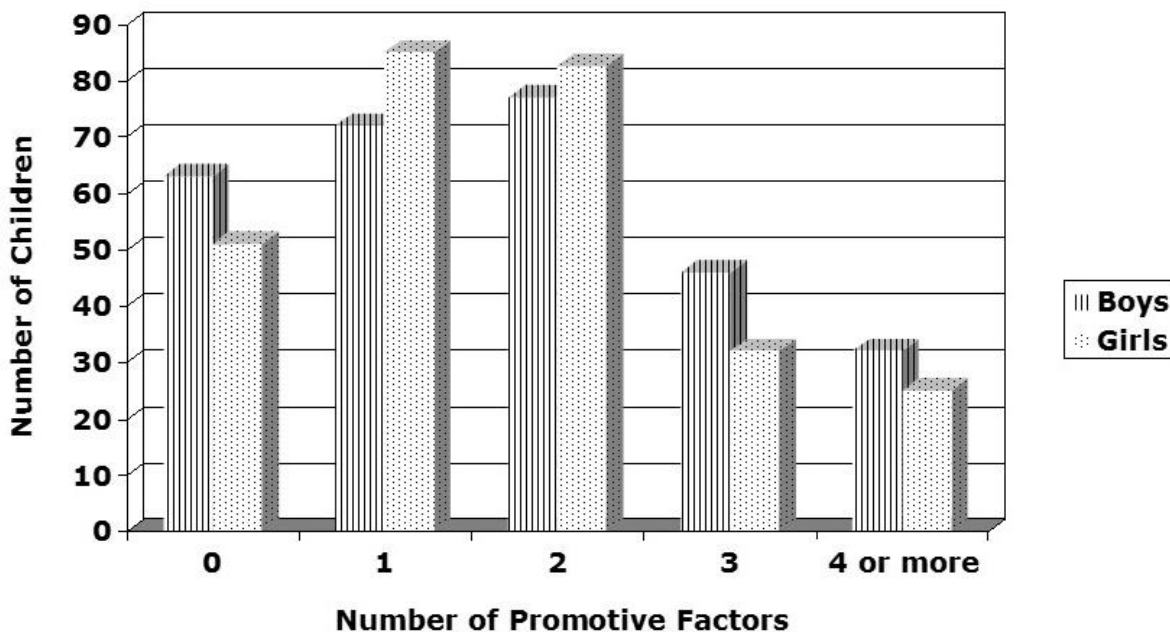


Figure 10. *Number of math-promoting factors by gender of child.* (Copyright held by Jacquelynne Eccles)

Does this score predict children’s own self-perceptions and interests? Yes. As we predicted, there is a significant positive regression coefficient linking the amount of family support for math interest and children’s reports of the math ability self-concept, liking of math, and importance attached to doing well in math for both the same year in which the parent data were collected and one year later (Fredricks & Eccles, 2005, see also Simpkins, Fredricks & Eccles, 2012).

CONCLUSION

These analyses show some of the ways in which parents' beliefs and practices might lead to variations in their children's expectancies in and values for mathematics and science. They also help us to understand the emergence of gender differences in children's and adolescents' confidence in their math ability and interest in math more generally. Our other research has documented the importance of these gender differences in explaining gender differences in STEM-related course taking, occupational aspirations, and actual job choices. Thus our findings suggest that these family-based beliefs and practices can help us to understand the gender differences that emerge in the children's own self-beliefs regarding mathematics, independent of how well they are actually doing. More specifically, gender differences in these parents' beliefs and practices help us understand how a gendered bias might emerge in STEM fields, despite the fact that girls and boys do equally well in math and science throughout their schooling.

ENDNOTES

¹ This perspectives paper is based on the Opening Speech of Jacquelynne S. Eccles at the conference: Gender and STEM: What schools, families, and workplaces can do?, 3–5 July 2014, Technische Universität Berlin, Germany, Gender and STEM Conference 2014 in Berlin, Germany

² Professor Janet Hyde, Department of Psychology, University of Wisconsin-Madison

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