Sex Differences in Achievement Patterns[1]

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Sex differences in achievement patterns have long interested social scientists. Many theories have been proposed to explain these presumed differences, often without solid evidence that they do in fact exist (see Frieze, Parsons, Johnson, Ruble, & Zellman, 1978, and Maccoby & Jacklin, 1974, for full discussion). Lest I succumb to the same temptation, I have set out three goals for this chapter: (1) To review these differences in a specific subset of achievement behaviors; (2) to summarize a comprehensive theory explaining these differences; and (3) to present the results of a longitudinal study designed to evaluate this theory.

Sex Differences in Achievement Patterns

Achievement has been operationalized in many ways. In laboratory studies it is often defined in terms of task choice, persistence in the face of failure, task performance, speed of performance, and scores on tests of motivation, anxiety, cognitive style, achievement, and aptitude. Field researchers and sociologists have defined it in terms of grades in school, scores on standardized tests of achievement and aptitude, course-enrollment patterns, activity choices, performance in competitive activities such as sports or spelling bees, persistence in

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the classroom or on the job, motivational style, occupational choice, income, and career advancement. Since sex differences occur on only some of these variables, we need to be specific about the achievement behaviors of interest when we discuss sex differences. Furthermore, we must avoid assuming that the sex differences on these various measures are determined by similar factors. Individual differences on these various indexes of achievement are shaped by different processes. Similar variations should exist for sex differences. Consequently, we should not expect simple explanations for sex differences in achievement patterns; many processes will be involved, and the relative importance of these processes will vary depending on the particular achievement behavior chosen for study.

My discussion is limited to a set of achievement behaviors that either reflect real-life achievement choices or are linked to these choices. These include scores on standardized tests of academic achievement and aptitude, grades in school courses, course-enrollment patterns, persistence on laboratory tasks, persistence on or single-minded devotion to occupational achievement activities, and college major and occupational choices.

TEST SCORES AND SCHOOL GRADES

Sex differences on tests of quantitative and verbal skills emerge with some regularity among adolescents and older subjects (see Eccles [Parsons], 1984; Hyde, 1981). For example, at 13 and 17, girls scored better than boys did on the National Assessment Tests of reading, literature, art, and music; in contrast, boys scored better than girls on the science and math tests (Grant & Eiden, 1982). The math and science differences (but not the verbal differences) also show up regularly on the Scholastic Achievement Tests administered nationally by the Educational Testing Service (1980). The quantitative differences (but again not the verbal differences) appear to emerge earlier among gifted populations (Benbow & Stanley, 1980, 1983). It is important to note, however, that even the math and science differences do not emerge with great consistency during the elementary school years. Furthermore, these differences are not very large (accounting for less than 4% of the variance; Hyde, 1981), are not found universally even in advanced high school populations, and are not evident in course grades at any level including college (see Eccles, [Parsons], 1984).

PERSISTENCE

There is a widespread belief in psychology that girls are less persistent in the face of failure on laboratory tasks than boys (see Eccles Parsons, 1983, Eccles [Parsons], Adler, & Meece, 1984). V. C. Crandall and E. Crandall (personal communication, 1983) and I have reviewed the developmental literature related to this hypothesis and find no consistent support for it. Although the nature of girls' responses to failure is affected by the sex and age of the evaluator (Dweck & Bush, 1976), girls' behavioral responses in terms of persistence and accuracy following failure on laboratory tasks are, by and large, similar to those of boys (e.g. Beck, 1977–1978; Crandall, 1969; Diener & Dweck, 1978; Dweck, 1975; Dweck & Reppucci, 1973; Eccles, 1983; Eccles Parsons, 1983; Eccles (Parsons), Adler, & Meece, 1984; Nicholls, 1975; Rholes, Blackwell, Jordan, & Walters, 1980; and Veroff, 1969). This is not to say that there are no gender effects on the behavioral measures used in these studies. Indeed, under some conditions boys and girls respond differently to both performance feedback and task manipulations. But in my opinion there is little evidence that girls are more likely than boys to give up after academic failures or to exhibit what might be labeled a learned helplessness response to challenge or failure.

But what about persistence in everyday achievement settings? It is difficult to define and measure persistence in these achievement settings primarily because it is difficult to define real-life achievement. It is even more difficult to assess sex differences in persistence in everyday achievement activities, primarily because males and females engage in different types of achievement activities. Consequently, it is also difficult to select a criterion activity without biasing the results in favor of males or females, depending on the activity chosen. For example, defining persistence in terms of occupational status and comparing males and females on this variable clearly biases our conclusion in favor of males. But while acknowledging this value bias, it is still instructive to compare males and females on a set of variables assumed to be indicators of achievement persistence by the culture at large. You are forewarned, however, that these indicators do favor males in part because they represent typical male achievement activities.

One such indicator is advancement through the educational system toward higher degrees. While males and females receive approximately equal numbers of bachelor's degrees, the number of males going on to obtain advanced degrees, even in traditionally female-stereotyped fields, exceeds the number of females. Furthermore, this discrepancy increases with the level of the degree being considered (National Center for Educational Statistics, 1980).

Another such indicator is advancement through the occupational system toward ever higher levels of responsibility and authority. Females are less likely than males to climb these achievement ladders; and when they do, they typically climb at a slower rate than males even in traditional female-stereotyped fields such as education (Frieze et al., 1978; Vetter, 1981). Although institutional barriers undoubtedly contribute to the sex difference on this indicator, psychological factors are also important (see Eccles & Hoffman, in press).

One final indicator of persistence is single-minded devotion to one's occupational role. This indicator can be assessed in a variety of ways, including the number of hours one puts into one's work, willingness to ask one's family to make sacrifices for one's career advancement, and concern over one's work to the exclusion of other concerns. Although we lack extensive data on these or similar variables, several studies suggest that males, on the average, exceed females on each (e.g., Baruch, Barnett, & Rivers, 1983; Bryson, Bryson, & Johnson, 1978; Eccles & Hoffman, in press; Goff-Timmer, Eccles, & O'Brien, 1984; Maines, 1983; Parsons & Goff, 1980).

COURSE AND OCCUPATIONAL CHOICE

Perhaps the most marked sex differences in achievement behavior are associated with the achievement activities males and females engage in. From early childhood, boys and girls select different achievement activities whenever they are given the choice (Huston, 1983). Although there have been some recent changes, these differences remain dramatic; boys still play football and baseball whereas girls do gymnastics and cheerleading. When they get to high school and have some choice about their courses, males and females still make predominantly sex-stereotyped selections (National Center for Educational Statistics, 1980), especially on career or vocationally relevant courses. This pattern holds up in college and in the occupational world (Eccles & Hoffman, in press) and may be one important cause of the persistence of sex differences in adult earnings.

SUMMARY

Although there are no consistent sex differences for course grades and indexes of persistence on laboratory tasks, there are small but consistent differences on tests of mathematical reasoning and scientific knowledge favoring males among older children, adolescents, and adults. The differences on tests of language skills and on tests of knowledge in literature, music, and art are less consistent but favor females when found. Finally, fairly consistent differences emerge on indicators of persistence and single-minded pursuit of high levels of adult occupational achievement, achievement-related activity choices in childhood and adulthood, high school course-enrollment patterns, college majors, and occupational choice.

Although very important, institutional barriers and discrimination are not entirely responsible for these differences. There is ample evidence that psychological factors are also important. And in fact many psychological explanations have been proposed to account for sex differences in achievement patterns. For example, the underrepresentation of females in the professions has been attributed to low self-confidence (Barnett & Baruch, 1978; Crandall, 1969; Nicholls, 1975; Parsons, Ruble, Hodges, & Small, 1976), fear of success (Horner, 1972), fear of loss of femininity (Tangri, 1972), nonconscious sex-role ideology (Lipman-Blumen & Tickameyer, 1972), differential values and orientation (Parsons & Goff, 1980; Stein & Bailey, 1973; Tittle, 1981), and low independence (Hoffman 1972; Stein & Bailey, 1973). Reviewing and evaluating each of these theories is beyond the scope of this chapter (see Frieze et al., 1978; Parsons & Goff, 1980; and Eccles Parsons, 1983, for recent reviews). But it is clear that a more comprehensive, integrative theory is necessary if we are to advance our understanding of these complex phenomena. My colleagues and I have proposed such a model (see Eccles (Parsons), Adler, Futterman, Goff, Kaczala, Meece, & Midgley, 1983). It is summarized in the next section.

A Model of Achievement Choices

Over the past several years my colleagues and I have been interested in the motivational factors influencing long-range achievement goals such as career or occupational choice, major selection in college, and

the integration of work and family roles. Our interest in this area initially grew out of our concern over the underrepresentation of women in professional careers. Like many of our contemporaries, we set out to explain why bright, capable women were not achieving at the same levels as their male peers. We tried to identify the factors constraining women's efforts to attain these nontraditional, high-level achievement goals.

But troubled by the assumption that choosing a nontraditional career reflects maturity and enlightenment whereas choosing a traditional career reflects immaturity and sex-role rigidity, we have redirected our focus. This assumption inevitably leads the researcher to ask, "Why aren't women more like men?" A more appropriate, and less biased, question is, "Why do men and women make the choices they do?" To answer this latter question, we returned to basic motivational models and decided to treat long-range, life-defining achievement choices as analogous to task choices. Given this perspective, we have developed an expectancy/value model of achievement choice based on the expectancy × value models of Lewin (1938) and Atkinson (1964). This model, depicted in Figure 1, links achievement choices to expectancies for success and to the importance or value an individual attaches to the available achievement options. It also specifies the relation of these constructs to cultural norms, experience, aptitude, and a set of personal beliefs and attitudes associated with achievement activities. The model is built on the assumption that it is not reality itself (i.e., past successes and failures) that most directly influences choices, but rather one's interpretation of reality. The influence of reality on achievement beliefs, outcomes, and future goals is assumed to be mediated by causal attributional patterns, by the input of primary socializers, by one's needs and values, by one's self-schemata, and by one's perceptions of the various choices themselves. Each of these factors is assumed to contribute both to the expectations one holds for future success at the options available and to the subjective value one attaches to these options. Expectations and subjective value, in turn, are assumed to influence achievement-related behaviors, including the decision to engage in particular activities, the intensity of effort expended, and one's actual performance.

The model assumes that achievement decisions, such as the decision to enroll in an advanced mathematics class or to major in education rather than engineering, are made in the context of a variety of choices. Furthermore, it assumes that these choices, whether made

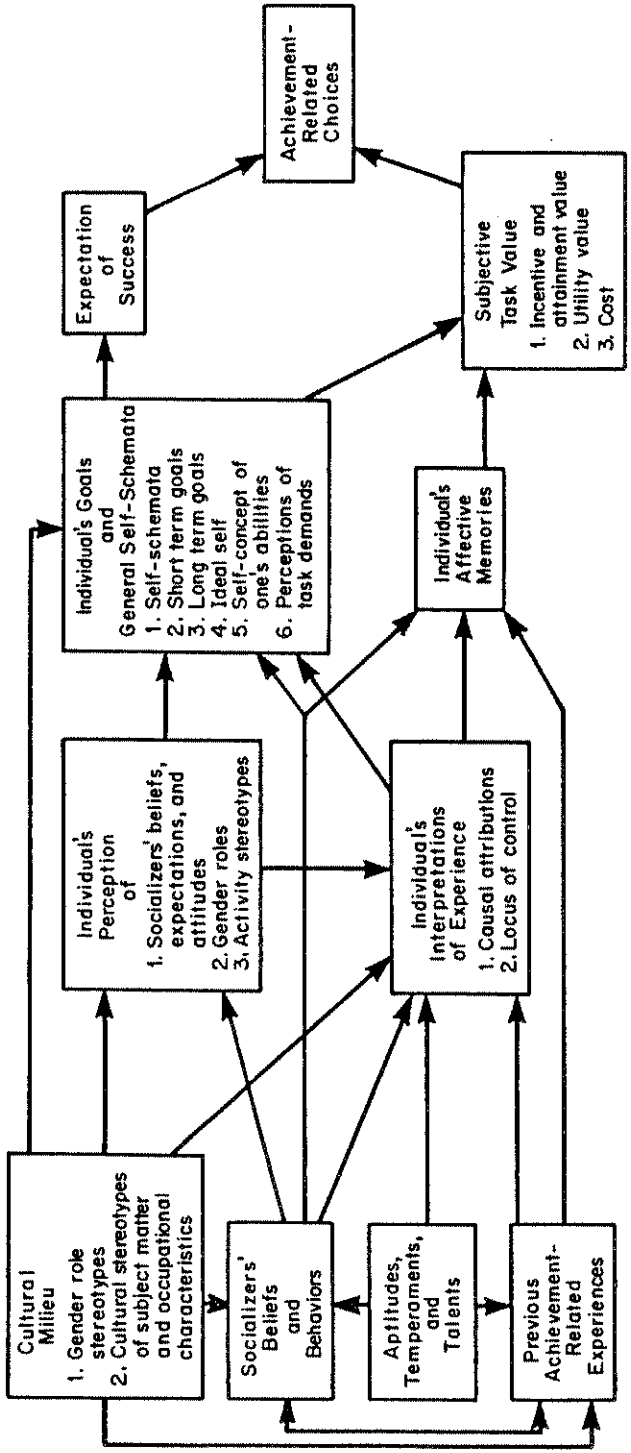

FIGURE 1. General model of achievement choices.

consciously or nonconsciously, are guided by one's expectations for success at the various options, by such core personal values as achievement needs, competency needs, and gender-role schemata, by more utilitarian values such as the importance of a particular course for one's future goals, and by the potential cost of investing time in one activity rather than another. Thus, if a female likes math but feels the effort it will take to do well is not worthwhile because it decreases the time she will have available for some other preferred activity, she will be less likely to continue taking math than the female who both likes math and thinks her efforts at mastering it are worthwhile and important.

Because expectancies and the variables linked to self-concept have received so much attention, I will not discuss them further here (see Eccles (Parsons) et al., 1983, for a more complete discussion). Suffice it to say that expectations, confidence in one's ability to succeed, and personal efficacy are critical mediators of achievement behaviors. Their role as mediators of sex differences in achievement behaviors is less clear (see Eccles (Parsons), et al., 1984, for more discussion). Since the role of values as mediators both of general achievement behaviors and of sex differences in achievement choices has received less attention, and since I believe it is one primary mediator of sex-differentiated achievement choices, I will discuss values in more detail here.

VALUES AS MEDIATORS OF ACHIEVEMENT CHOICES

Like others (e.g., Crandall, 1969; Crandall, Katkovsky, & Preston, 1962; Raynor, 1974; Spenner & Featherman, 1978; Stein & Bailey, 1973), we assume that task value is a quality of the task that contributes to the increasing or declining probability that an individual will select it. We have defined this quality in terms of three components: the utility value of the task in promoting the achievement of one's long-range goals; the incentive value of engaging in the task in terms of more immediate rewards and pleasure one gets from the activity; and the cost of engaging in the activity.

Incentive and attainment values. Incentive value can be conceptualized in several ways, two of which are of particular interest to me. On the one hand, incentive value can be conceptualized in terms of the immediate rewards, intrinsic or extrinsic, that performing a task will

provide. For example, playing tennis could be intrinsically rewarding because it makes one feel healthy, or extrinsically rewarding because one is paid for the performance.

Incentive value can also be conceptualized in terms of the needs and personal values an activity fulfills. As they grow up, people develop an image of who and what they are. This image is made up of many component parts, including conceptions of one's personality and capabilities, long-range goals and plans, schemata regarding the proper roles of men and women, instrumental and terminal values (Rokeach, 1973), motivational sets, self-schemata, and social scripts regarding proper behavior in a variety of situations. Some parts of an individual's image are central or critical to his or her self-definition and should exert the most influence on behavior (see also Markus, 1980). For example, if being a good athlete is a central part of one's self-image, then one should work at continuing to be a good athlete. Since personal needs and values are part of one's self-image, the degree of influence wielded by these values and needs should also be determined by their centrality to an individual's self-definition (see also Parsons & Goff, 1980). Consequently, personal needs and values should operate in ways that both reduce the probability of engaging in those activities or roles perceived as inconsistent with one's central values and increase the probability of engaging in roles or activities perceived as consistent with one's definition of self.

But what links personal needs, values, and self-schemata to task selection? We believe people perceive tasks in terms of certain characteristics that can be related to needs, values, and self-schemata. For example, a difficult task requiring great effort for mastery may be perceived as an achievement task; if it also involves pitting one's performance against others', it may be perceived as a competitive task. Other tasks may be perceived in terms of nurturance, power, asthetic pleasure, and so on. The decision to engage in one of these tasks may require one to demonstrate or exercise the characteristics associated with the task. Whether this requirement is seen as an opportunity or a burden will depend on the individual's needs, motives, self-schemata, and personal values and his or her desire to demonstrate these characteristics to both the self and others. Essentially, I am arguing (1) that individuals seek to confirm their possession of those characteristics central to their self-images, and (2) that various tasks provide the opportunity to do exactly this. If one values the characteristics assumed to be inherent in a task, one will regard task involvement as an opportunity to confirm one's self-image and will be more

likely to engage in the task than someone who does not value the characteristics associated with the task. For example, tennis should be especially attractive (have high incentive value) to someone who values competitive, athletic competence, precisely because playing tennis provides the opportunity to demonstrate athletic competence to both the self and others.

This analysis implies that the incentive value of any particular task will be influenced by three sets of beliefs. First, it will depend on the individual's perception of the characteristics of the task or, more specifically, on the needs and characteristics he or she believes the task will fulfill or demonstrate. Second, it will depend on the individual's own hierarchy of values, needs, motives, and self-schemata. And finally, it will depend on the extent to which the individual believes that participating in the task will fulfill his or her central needs or affirm his or her self image.

We have labeled this third belief attainment value. And since gender-role socialization influences both the development of one's self-schemata and personal values as well as our stereotypes of the characteristics associated with various achievement activities, gender-role socialization will affect the attainment value each individual attaches to various achievement options.

Perceived cost. The value of a task will also depend on a set of beliefs that can best be characterized as the cost of participating in the activity. This cost is influenced by many factors, such as anticipated anxiety, anticipated negative responses from one's peers, friends, parents, colleagues, or neighbors, fear of failure, and the negative affective memories one has associated with similar activities in the past. Gender-role socialization can influence each of these negative affective variables (see Eccles [Parsons], 1984, for a full discussion).

The cost of any given activity or life-defining achievement choice can also be conceptualized in terms of the loss of time and energy for other activities and life-defining roles. People have limited time and energy, so they cannot do everything they would like. They must choose among activities. To the extent that one loses time for Activity *B* by engaging in Activity *A*, and to the extent that Activity *B* is high in one's hierarchy of importance, then the subjective cost of engaging in *A* increases. Alternatively, even if the attainment value of *A* is high, the value of engaging in *A* will be reduced to the extent that the attainment value of *B* is higher and to the extent that engaging in *A* jeopardizes the probability of successfully engaging in *B*.

GENDER-ROLES AND TASK VALUE

The implications of this analysis for our understanding of sex differences in achievement choices are clear. Since socialization shapes individuals' goals and values, men and women undoubtedly acquire different values and goals through the process of gender-role socialization. In terms of task value, gender differences in value structure can manifest themselves in several ways. For one, gender-role socialization can create a gender-differentiated hierarchy of core personal values (such as their terminal and instrumental values; Rokeach, 1973). Consequently, tasks embodying various characteristics should have different attainment values for men and women. For example, men may be more likely to engage in athletic activities because they place more importance on demonstrating their athletic competence than do women. Differences in career choice may reflect similar processes. For example, Dunteman, Wisenbaker, and Taylor (1978) found that being thing-oriented rather than person-oriented predicted becoming a math or science major. Similarly, Fox and Denham (1974) found that mathematically talented children are relatively low on social value and high on theoretical, political, and economic values. In both of these studies, the females were less likely to hold the math- and science-related values than were males. Not surprisingly, then, the females were also less likely to aspire to math- and science-related careers than the males in both studies.

Alternatively, the structure of men's and women's hierarchies of values might differ. If so, then women ought to rank order the importance of various activities differently than men do. For example, if women see the parenting role as more important than a professional career role while men rate these roles as equally important, then women should be more likely than men to resolve life's decisions in favor of the parenting role. This differential would be especially marked if women see the career options not only as of lower importance but also as detrimental to the successful completion of their parenting goals.

Similarly, men and women could differ in the density of their goals and values. As noted earlier, men seem more likely than women to exhibit a single-minded devotion to one particular goal. In contrast, women seem more likely than men to be involved in several activities simultaneously. This difference could reflect differing density patterns for the hierarchy of goals and personal values. That is, women

may place high attainment value on several goals and activities, while men may differentiate more among the options open to them. If this is true, then the cost of engaging in their primary goal in terms of other important goals will be less for men than for women.

Finally, a gender-differentiated hierarchy of task values could result from gender differences in people's perceptions of various tasks and in the very definition of success and failure on these tasks (see also Frieze, Frances, & Hanusa, 1983). One of the primary characteristics of gender roles is that they define the activities that are central to one's occupancy of the role. In essence, gender roles define what one should do with one's life in order to be successful in that role. To the extent that one holds success in one's gender role as a central component of one's identity, then activities that fulfill this role will have high value and activities that detract from one's successful fulfillment of this role will have lower, and perhaps even negative, subjective value. If staying home with one's children and being psychologically available to them most of the time is a central component of one's gender-role schema, then involvement in a demanding, high-level career will have reduced value because it conflicts with a more central component of one's identity.

Adherence to one's gender role may be so central to an individual that merely knowing, even at a subconscious level, that a particular activity is stereotypically part of the opposite gender's role will be sufficient to prevent further consideration of engaging in that activity. Consequently, gender-role schemata (beliefs regarding the composition of both male and female gender roles) can effectively limit the range of options one even considers as well as affecting the subjective value one attaches to the various options considered.

Gender roles can also influence one's very definition of successful performance of activities considered central to one's identity. Consequently, men and women may differ in their conceptualization of the requirements for successful task participation and completion. If so, then men and women should approach and structure their task involvement differently. The parenting role provides an excellent example of this process. If males define success in the parenting role as an extension of their occupational role, they may respond to parenthood with increased commitment to their career goals and with emphasis on encouraging competitive drive in their children. In contrast, if women define success in the parenting role as a high level of involvement in their children's lives, they may respond to parenthood with decreased commitment to their career goals.

Differences in approach to various careers can be interpreted similarly. For example, it is a common finding that academic women publish less than academic men. One possible explanation relies on the reasoning outlined here. Females may define the faculty role equally in terms of teaching, service, and publications; in contrast, males may define the faculty role more in terms of research and publications. If so, then male and female faculty members should approach their professional role quite differently, and as a consequence females should have weaker publication records than men.

SUMMARY

In summary, the model depicted in Figure 1 builds on the theoretical base of expectancy/value models of task choice. In addition, by elaborating on the construct of value, it has provided a link between expectancy/value models and the growing literature on the self.

What distinguishes this model from other models of achievement behavior is its attention to the issue of *choice*. Whether done consciously or not, people make choices among a variety of activities all the time. For example, they decide whether to work hard at school or just to get by; they decide which intellectual skills to develop or whether to develop any at all; they decide how much time to spend doing homework; they decide whether to take difficult courses or to spend their extra time with their friends; and they decide which occupations to prepare themselves for. We have tried to address the issue of choice directly and to develop a model that allows us to predict the type of choices being made. Furthermore, we have tried to specify the kinds of socialization experiences that shape individual differences on the mediators of these choices, especially in the academic achievement domain (see Eccles (Parsons) et al., 1983).

Furthermore, because we have focused on choice rather than avoidance, we believe this model provides a more positive perspective on women's achievement behavior than is common in some popular psychological explanations for sex differences in achievement patterns. Beginning with the work associated with need achievement and continuing to current work in attribution theory, a variety of scholars have considered the origin of sex differences in achievement. Many of these scholars have looked for the origin either in motivational differences or in expectancy/attributional differences. For example, in the fifties and sixties, several studies focused

on sex differences in need achievement. In 1966 Horner introduced the concept of fear of success and suggested that sex differences in achievement reflected high levels of fear of success in women.

In the early seventies, Weiner and his colleagues (see Weiner, 1972) introduced an attributional model of achievement motivation and paved the way for a new set of hypotheses regarding sex differences in achievement, a set focusing on cognitive-mediational variables. Within this new framework, sex differences in achievement have been attributed variously to differences in expectations, self-confidence, causal attribution patterns, and learned helplessness. So, for example, it has been argued that women have lower expectations for success, are less confident in their achievement-related abilities, are more likely to attribute their failure to lack of ability, are less likely to attribute their success to ability, and are more likely to exhibit a learned helplessness response to failure. Furthermore, it has been argued that these differences mediate the sex differences we observe in achievement patterns.

There are several problems with this body of work. First, because they assumed a deficit model of female achievement, researchers have focused their attention on the question "How are women different from men?" rather than "What influences men's and women's achievement behavior?" Second, the assumption that the differences uncovered in most studies actually mediate sex differences in achievement behavior has rarely been tested. Instead, many studies simply demonstrate a statistically significant difference between males and females and conclude that this difference accounts for sex differences in achievement behavior. Third, and most important, the deficit perspective has limited the range of variables studied. Researchers have focused most of their attention on variables linked to self-confidence and expectancies, since high self-confidence is one of those "good" things that facilitates men's competitive achievement.

The dominance of this deficit perspective in sex-difference research has been especially marked in the past decade. Our model provides a very different perspective. By assigning a central role to the construct of subjective task value, we have offered an alternative explanation for sex differences in achievement patterns. This alternative explanation puts male and female achievement choices on a more equal footing. Our model makes salient the hypothesis that differences in male and female achievement patterns result from the fact that males and females have different but equally important and valuable goals for their lives. This view differs markedly from explana-

tions that attribute sex differences in achievement patterns to females' lack of confidence, low expectations, or debilitating attributional biases. Instead of characterizing females as deficient males, our perspective, outlined in more detail in Parsons and Goff (1980) and Eccles (Parsons) (1984), legitimizes females' choices as valuable on their own terms rather than as a reflection or distortion of male choices and male values. Gilligan (1982) has made a similar point regarding males' and females' moral judgments.

But how well does this model do in generating important research questions and in explaining sex differences in achievement choices? To answer this question, we have studied the origin of sex differences in a "real-life" achievement activity—enrollment in advanced high-school mathematics. Some major components of this research program are described in the next section.

Sex Differences in Course-Enrollment Patterns

As I noted earlier, two areas of cognitive functioning reveal fairly consistent patterns of sex differences (see Eccles Parsons, 1984; Wittig & Petersen, 1979). Girls typically perform better than boys on verbal tasks, whereas boys perform better than girls on quantitative tasks. Sex differences in high school course enrollment, college majors, and adult careers reflect a similar pattern. For example, among the B.A. degrees awarded in 1978, women received only 6% of those awarded in engineering, 23% in architecture, 26% in computer and informational science, 22% in physical science, and 41% in mathematics. In contrast, 57% of B.A.s in letters, 73% of B.A.s in education, 76% of B.A.s in foreign languages, and 88% of B.A.s in library science went to women (National Center for Educational Statistics, 1979, 1980). Clearly, these sex differences are larger than one would expect based on the achievement test score differences alone. This is especially true for the math-related achievement domains. For example, in 1978 37% of the pool of first-year students eligible to major in engineering were women.[2] In contrast, only 13% of those actually planning to major in

2. We estimated the proportion of women eligible to enter these fields by calculating the number of women scoring above 500 on the math SAT (Educational Testing Service, 1979); 500 is approximately the mean score on the math SAT of students expressing an interest in majoring in math or the physical sciences. Hyde (1981), using a different method of estimating the available pool of female potential scientists and engineers, arrived at a comparable figure of 37%.

engineering were women, and only 6% of the bachelor's degrees in engineering in 1978 went to women. Similar though less dramatic results characterize the population planning to major in the physical sciences. Clearly, the proportion of female participation in quantitative fields is much lower than the available pool would predict.[3]

Sex Differences in Math Participation: Recent Explanations

Recent attention has focused on the origin of this underrepresentation of females in math-related fields. While some researchers still argue that this difference primarily reflects biologically based gender differences, the magnitude of the occupational differences outlined above casts doubt on this perspective (see Meece, Parsons, Kaczala, Goff, & Futterman, 1982, and Eccles [Parsons], 1984, for reviews). Attitudinal and motivational factors clearly play a substantial role in shaping this sex-differentiated achievement pattern. Research has yielded four basic explanations for this problem:

1. Males outperform females on spatial problem-solving tasks and on other mathematics aptitude measures. Consequently, they are more able to continue in math (Aiken, 1976; Wittig & Pedersen, 1979).
2. Males receive more encouragement than females from parents, teachers, and counselors to enroll in advanced mathematics courses or to pursue math-oriented careers (Casserly, 1980; Fox, Tobin, & Brody, 1979; Luchins & Luchins, 1980; Parsons, Adler, & Kaczala, 1982; Parsons, Kaczala, & Meece, 1982).
3. Mathematics is commonly perceived as a male achievement domain. Consequently, because of its potential conflict with their gender-role identity, females are more likely to avoid mathematics (Fen-

3. This underrepresentation of females in math and science is very costly both for females and for society at large. In almost all occupational fields, females can expect to earn less than their male peers. But the mean income for both males and females is particularly low in nonscientific, female-dominated occupations. Both males and females earn more in math-related occupations than in nonscientific occupations. In addition, among recent graduates, females are most likely to earn salaries commensurate with those of their male peers in scientific and technical fields (Grant & Eiden, 1982). Also, society is in need of as many mathematically trained and scientifically literate college graduates as it can get to fill jobs in a wide range of industries and service professions.

nema & Sherman, 1977; Nash, 1979; Sherman & Fennema, 1977; Stein & Smithells, 1969).

4. Males perceive themselves as more competent and report greater confidence in learning mathematics than females (Eccles Parsons, 1984; Fennema & Sherman, 1977; Fox et al., 1979).

The research traditions associated with each of these explanations have provided insights into the mechanisms contributing to students' math achievement behaviors. However, because researchers have approached this area of study from a variety of theoretical perspectives, each has tended to focus on a limited subset of possible causes. What has been missing is a comprehensive, theoretical framework that acknowledges the complex interplay of these many factors, takes into account the sociocultural context in which course-enrollment decisions take place, and provides a more comprehensive approach to the problem. Our model provides such a comprehensive approach.

EMPIRICAL TEST: OVERVIEW

To test the utility of our model for explaining sex differences in math participation, we conducted a large-scale cross-sectional/longitudinal study of the ontogeny of students' achievement beliefs, attitudes, and behaviors. Given our conceptualization of math participation as a task choice construct, we felt it was important to include measures of the students' attitudes toward at least one other subject area. The decision not to take math might seem very logical in the face of evidence that a student really likes another subject better. Since English is the other major achievement domain that evidences consistent sex differences, we assessed students' attitudes toward English as well as toward math. We also assessed the students' achievement plans and outcomes in both math and English.

We began our study with a cross section of 300 students in Grades 6–9, their parents, and their math teachers. One year later, 94% of these same students were retested. During the second year, an additional control group of 329 students in Grades 5–12 was recruited. We used this sample to assess test-retest effects and to rule out the possibility that our longitudinal findings reflected the effect of unique historical events rather than more general developmental change. These analyses indicated that test-retest effects were minimal and the

changes in the students' attitudes from Year 1 to Year 2 did not reflect the effect of unique historical events. Based on these results and on the fact that we had modified our questionnaire slightly from Year 1 to Year 2, the control and Year 2 samples were merged, making a total Year 2 sample of 668 children. The cross-sectional data presented here are based on this expanded Year 2 sample.

Data were collected in several forms: student record data, a student questionnaire, a parent questionnaire, a teacher questionnaire, and classroom observations. Information taken from each student's school record included final grades in mathematics and English for the four years (1975–1979) before the study, the two years of the study, and each year following the study until the students graduated from high school. Any standardized achievement test scores in the student's file were also recorded. Thus we have comprehensive data on each of our students' participation and achievement in both math and English throughout their secondary school careers. Only a small portion of these data are summarized in this chapter. I will focus primarily on the student questionnaire data that are most directly related to the issue of sex differences in math and English achievement patterns. The parent and classroom observational data have been reported elsewhere (see Parsons, Adler, & Kaczala, 1982; Parsons, Kaczala, & Meece, 1982).

According to our model, general beliefs influence task-specific beliefs, which in turn influence achievement behaviors. To operationalize this model, we created variables to coincide with each of these three levels of the psychological variables. Given our concern with sex differences, we were especially interested the following general beliefs: gender-role schemata, stereotyping of math as a male domain, and perceptions of encouragement to continue taking math by parents, teachers, and peers. We developed measures of these general beliefs and of the following specific beliefs: expectancy of success, perceived ability, perceived task difficulty, perceived amount of effort necessary to succeed, perceived importance of the subject, perceived cost of success, perceived worth of the effort necessary to succeed, perceived utility value of the subject, and reasons one would take advanced-level math courses. For achievement outcome measures, we asked the students whether they planned to continue taking math and English and, if so, how much; we asked their proposed college major and their career goals; we collected their grades in their math and English courses; and we recorded their actual course-enrollment patterns.

The attitudinal variables were factor analyzed using the maximum likelihood factor analytic procedure developed by Joreskog and Sorbom (1978). Three identical factors emerged for both the math and the English items: Self-Concept of Ability, Perceived Task Difficulty, and Subjective Task Value. The Self-Concept factor included all items tapping perceived ability, perceived performance, and expectations for success in current and future courses. The Task Difficulty factor included items tapping perceived task difficulty, perceived effort needed to do well, and estimates of actual level of effort. The Subjective Task Value factor included all items related to perceived utility value, enjoyment of the subject, and perceived importance of doing well. Confirmatory factor analysis supported the reliability of this factor structure. The data reported in this chapter concern these three factors and focus on the relation of these specific beliefs to achievement choice patterns. All effects reported are significant at the $p < .05$ level or better.

FIRST-ORDER EFFECTS

Relatively few sex differences merged, but those that did formed a fairly consistent pattern. Across both years, boys, compared with girls, rated their math ability higher, felt they had to exert less effort to do well in math, and held higher expectancies for future successes in math, even though there were no sex differences on any of the objective measures of math performance. In addition, boys in Year 1 rated both their current math courses and advanced math courses as easier than did the girls; boys in Year 2 had higher expectancies for success in current (as well as future) math courses; and boys in Year 2 rated math as more useful than the girls. Finally, both boys and girls rated math as more useful for males than for females.[4] Thus, to the extent that there are sex differences on these self- and task-perception variables, boys had a more positive view both of themselves as math learners and of math itself.

These differences are even more dramatic when one compares the students' attitudes toward both math and English from a developmental perspective. To assess developmental differences we looked at both the age effects within the cross-sectional sample and the

4. However, male students endorsed this stereotype to a much greater extent than female students.

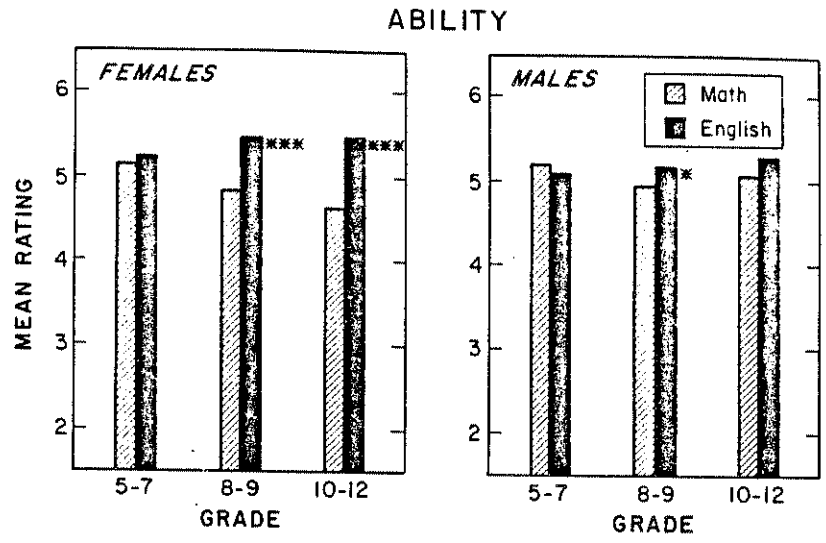

FIGURE 2. Grade × sex × content area effects: Self-Concept of Ability (* $p < .05$, *** $p < .001$).

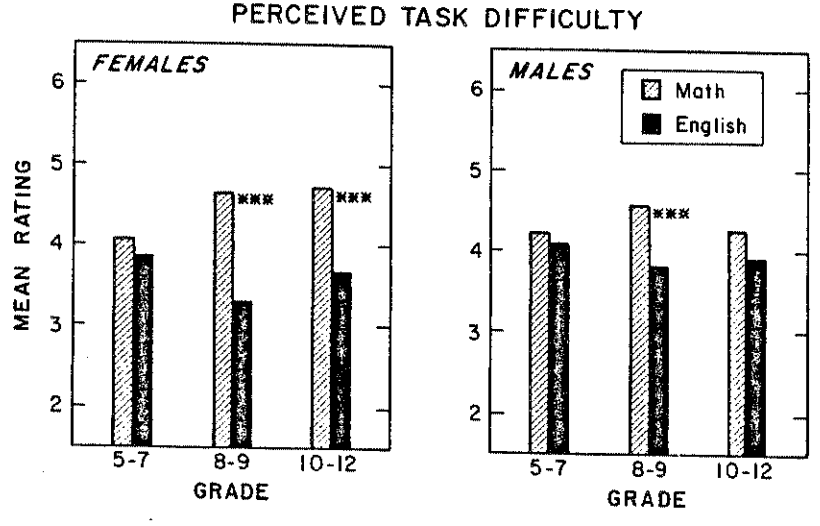

FIGURE 3. Grade × sex × content area effects: Perceived Task Difficulty (*** $p < .001$).

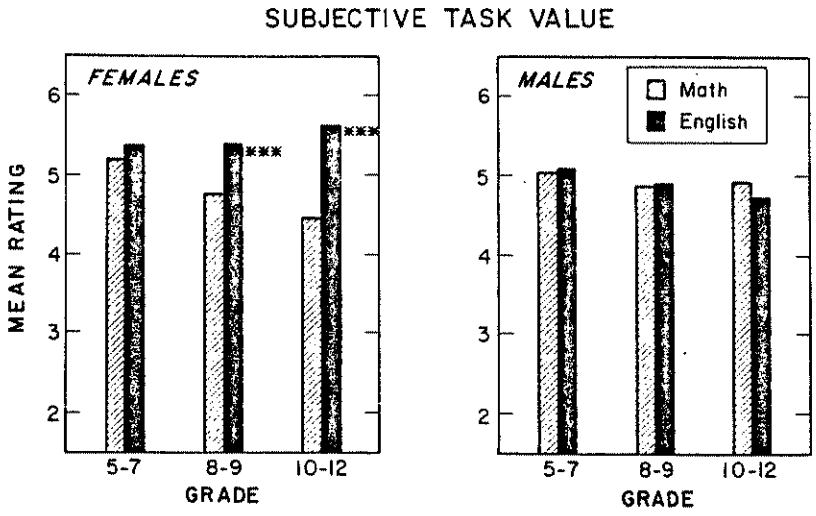

FIGURE 4. Grade × sex × content area effects: Subjective Task Value (*** $p < .001$).

test-retest effects in the longitudinal sample. Comparable developmental conclusions emerged in both sets of analyses. In general, the females became more positive toward English and more negative toward math as they grew older. In contrast, boys attitudes toward both subjects remained fairly stable over time and across grade levels. These effects are best illustrated with the three major attitudinal factors. First, consider Self-Concept of Ability. As is apparent from Figure 2, female students' estimates of their math ability declined linearly with age. Two additional comparisons are important. By 8th grade the females rated their English ability higher than their math ability, and by 10th grade they rated their math ability lower than the boys rated theirs. Neither of these effects are present in the earlier grades. Comparable effects emerge for Perceived Task Difficulty (see Figure 3), and for Subjective Task Value (see Figure 4). The sex differences are especially marked for Subjective Task Value. By 10th grade the females rated English as more valuable than math. Furthermore, they rated math as less valuable and English as more valuable than did the males.

These changes in the females' attitudes toward both math and English are especially interesting given the nature of our sample. First of all, we have no indication that there is a measurable difference in the math performance between the males and females in this

sample on either their course grades or their scores on standardized achievement tests. Second, the male and female students also had comparable test scores on standardized achievement tests in English at each grade level. Third, the female students earned higher grades than the male students in their English courses beginning at about the 8th grade. Fourth, when one compares the students' standardized test scores across years, the older females in this sample had higher scores than the younger females. Consequently, the older female students, if anything, had higher math ability, on the average, than the younger female students. They also scored higher on tests of English ability than did the younger female students. Thus, despite the fact that the female population became more select in terms of both English and math achievement scores with advancing grade level, and despite the fact that there were no apparent sex differences on math performance measures, the attitudes of the female students toward math declined with age whereas their grades did not. In contrast, both their attitudes and their actual performance in English increased with age.

Given our perspective that choice is the critical mediator of achievement differences, these results certainly lead to the prediction that female students will elect less math than English and male students will continue to take courses in both subject areas. This is, in fact, what has happened in this sample. The females were less likely to take 12th grade advanced math course than the males, but their English enrollment patterns did not differ. There were no sex differences in math enrollment before the 12th grade.

The analyses described thus far suggest several important sex differences in students' attitudes. Females in general have a more negative attitude than boys toward math learning and toward themselves as math learners. Furthermore, females also have a more negative view of math than of English. These differences certainly could mediate sex differences in achievement patterns, but the mere existence of these differences does not support their importance as variables mediating sex differences in achievement patterns. The critical question is whether these differences, in fact, make a difference. To answer this, we ran a series of correlational and multivariate regression analyses. Several important results emerged.

RELATIONAL ANALYSES

First we ran a series of analyses relating our gender-role constructs to student attitudes. Several researchers have suggested that the stereotype of math as a male domain inhibits female participation in math. To evaluate this hypothesis and its many variations, we correlated the students' rating of the usefulness of advanced math for both males and females, their perception of math as being more useful to males, their gender stereotyping of math ability, and their ratings of themselves on a simplified version of the Personal Attributes Questionnaire (PAQ; Spence, Helmreich, & Stapp, 1975) with the other student measures. Femininity (or more appropriately Expressivity) as measured by the PAQ was not related to either student attitudes or their achievement patterns. Masculinity (or Instrumentality), however, was related positively to measures of both expectancy and Self-Concept of Math Ability for both males and females.

Several investigators (e.g., Nash, 1979) have suggested that it is the interaction of gender-role identity with gender stereotypes regarding the nature of the task that influences students' attitudes toward a subject. We used multivariate contingency tables to assess the effect of personality type on math attitudes and achievement and to test whether gender-role identity, as measured by a personality inventory, interacts with gender-role stereotypes of math in influencing students' attitudes toward math. Gender-role classification had no significant influence on any of the student attitude or achievement measures, either as a main effect or in interaction with the gender-role stereotyping of math as a masculine domain. Gender-role stereotyping of math did, however, influence Subjective Task Value. The extent to which a female judged math to be useful for women did not relate to its subjective value for her. Instead, it was the perceived usefulness of math for males that predicted positively math's subjective value for both males and females. One might conclude from these data that the stereotype of math as a male domain has a positive effect for everyone and ought to be encouraged; but results from other studies suggest that this conclusion is oversimplified. Instead, what it suggests is that perceiving math as more useful for males than for females does not necessarily have a negative consequence for girls, perhaps especially when the stereotype reflects an awareness of the high-status jobs that are both male dominated and math related. We need to know the subjective

meaning of these stereotypes for the individual before we can predict their effect on Subjective Task Value. In this case it may be the status of the job rather than its male domination that elevates the perceived usefulness of advanced math courses for these high-ability boys and girls.

We next assessed the relations of the student attitudinal variables to achievement plans, performance,and actual enrollment patterns. As predicted, for both males and females, Self-Concept of Ability and Subjective Task Value correlated positively with students' plans to continue taking math and English, with the students' grades in both math and English one year later, and with the students' actual course-enrollment decisions in math measured one to three years later (see Table 1). These results provide initial support for the predicted influence of attitudinal variables on achievement behaviors. But these attitudinal variables are intercorrelated and are correlated with past grades. Before we can understand the effect of attitudes on achievement, we need to answer two additional ques-

Table 1
Correlations Between Attitudes and Achievement Outcomes for Math and English

Variable	*1*	*2*	*3*	*4*	*5*	*6*
1 Past Performance	—	.50**	.30**	-.10	.14	.25**
2 Grade Year 1	.44**	—	.36**	-.19*	.11	.23**
3 Self-Concept of Ability	.35**	.27**	—	-.49**	.50**	.46**
4 Perceived Task Demands	-.15	-.05	-.54**	—	-.09	-.21**
5 Subjective Task Value	.12	.16	.59**	-.13	—	.60**
6 Plans to Continue Taking Subject	.17*	.16	.35**	-.04	.44**	—
7 Course Enrollment: Grade 12, math only	.39**	.42**	.17	.15	.36**	.17

Note: Correlations are based on Year 2 data base. Results for English items are in upper triangle; results for math items are in lower triangle.

* $p < .05$.

** $p < .01$.

Table 2
Stepwise Multiple Regression: Predictors of Subjective Educational Plans

English			*Math*		
Step	Multiple R^2	Predictor	Step	Multiple R^2	Predictor
1	.51	Subjective Value of English	1	.22	Subjective Value of math
2	.54	Self-Concept of English Ability	2	.29	Self-Concept of Math Ability
			3	.33	Subjective Value of English

tions: Which of these attitudes are most critical? and Are any of the attitudes as critical as past performance in shaping subsequent achievement behaviors? To answer these questions we used stepwise multiple regression procedures. Subjective Value of Math, Subjective Value of English, Self-Concept of Math Ability, and Self-Concept of English Ability were regressed on Subjective English Educational Plans and on Subjective Math Educational Plans in two stepwise (hierarchical) regression analyses. In both analyses, Subjective Task Value emerged as the most powerful predictor of educational plans (see Table 2). These results suggest that Subjective Task Value is the attitude that mediates sex differences in achievement choice patterns.

To test for the hypothesized mediating role of Subjective Task Value in explaining actual sex differences in achievement choices, we tested for sex differences in course-enrollment patterns for mathematics. We were unable to run a comparable test for English because English is required for all three years of high school in the school districts we sampled. Since there was a significant sex difference in course enrollment in the 12th grade, we were able to test the mediating role of task value on course enrollment in math. These results, depicted in Figure 5, are consistent with the hypothesis that sex difference in math course enrollment are mediated by the sex

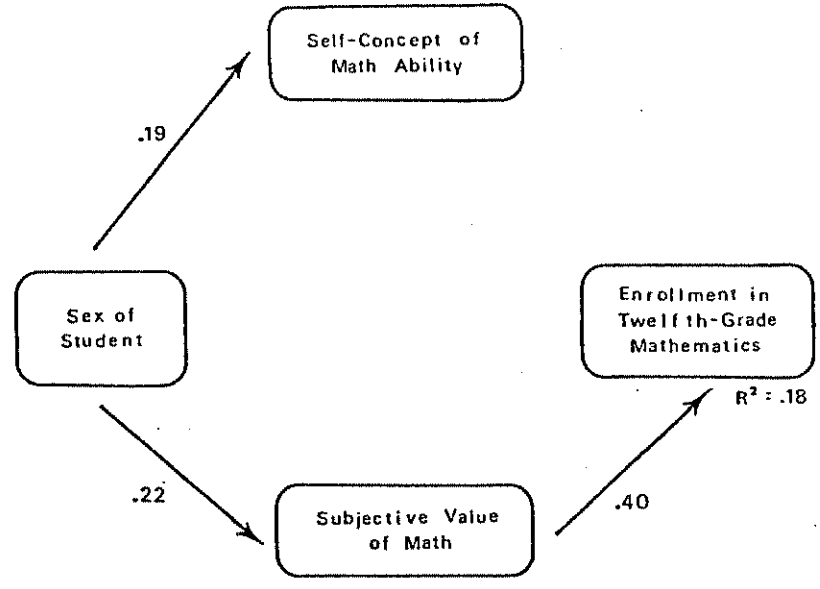

FIGURE 5. Path analysis of math variables. (Columnwise multiple repression equation procedures were used to estimate the path coefficients. The standardized path coefficients, which are regression coefficients, reflect the relative predictive power of each variable. All paths are significant at the $p < .05$ level or better.)

difference in Subjective Task Value, not by the sex difference in Self-Concept of Math Ability.

Thus, as predicted, Subjective Task Value emerged as the most powerful predictor of students' Subjective Educational Plans. Furthermore, the significant sex × age × subject area interaction yielded results consistent with the developmental predictions of our model. High school females had a more positive attitude toward English and a less positive attitude toward math than did the junior high school females, especially in terms of Subjective Task Value. Projecting these developmental patterns into the late adolescent years should produce a marked sex difference in attitudes toward the value of math and English and in actual course enrollment decisions, and in fact this happened; the females were more likely to drop math before high school graduation than were the males. Finally, our data suggest that it is Subjective Task Value rather than Self-Concept of Math Ability that mediates this sex difference in course-enrollment patterns.

EMPIRICAL TEST: MALES VERSUS FEMALES

The data discussed thus far were drawn from the entire sample, based on the assumption that comparable relations would hold for both males and females. The zero-order correlations calculated for each sex separately support this assumption for the variables we have discussed thus far (see Table 1), but this is not the case for the correlations of these attitudes with past performance. A very important sex difference emerged when we compared the correlations of students' attitudes with their past grades and with a composite score reflecting their relative position within their grade level on their course grades and standardized achievement test scores. These results are illustrated in Figure 6. The males' attitudes, across the board, were more directly related to their performance history than were females' attitudes. This is true for both math and English. Furthermore, it is especially interesting to note, given the importance of Subjective Task Value, that the value females placed on both math and English was unrelated to their history of performance in either subject.

These results suggest that different factors influence the achievement decisions of males and females. To test this hypothesis directly, we ran stepwise regressions separately for males and females.

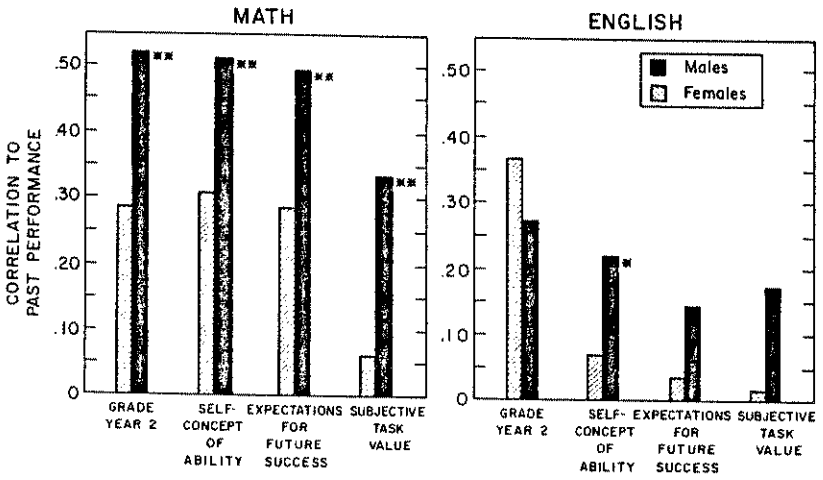

FIGURE 6. Correlations of beliefs and performance with past performance (sex effects, * $p < .05$, ** $p < .01$).

Table 3
Stepwise Regressions: Math Enrollment

		Female		
Step	R^2	Variable	Partial R	Significance
0	.18	Past Performance	.43	.0005
1	.25	Subjective Task Value	.37	.004

Since past performance is such an important predictor of course enrollment for both males and females, we entered it at the first step. This procedure allows us to assess whether attitudinal variables have any independent influence on achievement patterns beyond what they share with past performance. The results are illustrated in Table 3. As expected, past performance emerged as a strong predictor of course enrollment for both males and females. However, it was a stronger predictor for males; and for males, attitudes made little independent contribution to their course-enrollment decisions. In contrast, Subjective Task Value is an important independent predictor for females. Independent of how well or how poorly they were doing in math, women who enjoy math and think it is important were more likely to enroll in advanced math courses than were women who either did not enjoy math or did not think that advanced math courses were particularly important or useful.

Taken as a package, these results suggest that sex differences in achievement choice patterns are a function primarily of two processes. First, they are a function of the sex difference in Subjective Task Value; second, they are a function of the fact that academic achievement values seem to be shaped differently in males and females. Males' enrollment decisions appear to be influenced primarily by their performance history. In contrast, females' decisions appear to be influenced by both their performance history and the value they attach to the subject. This discrepancy, however, probably reflects the fact that the value the males attached to both math

Table 3 *continued*

Male				
Step	R^2	Variable	Partial R	Significance
0	.26	Past Performance	.51	.0004

and English was related to their performance history in the subject. Consequently, the value they attached to the subject did not emerge as a strong independent predictor of course choice for the males. In contrast, the value females attached to academic subjects was more independent of their performance history. Consequently, for females value could, and did, enter into the regression equation as a significant independent predictor of their enrollment decisions.

These results raise two important questions: (1) What factors influence the value individuals attach to various achievement options? and (2) Why does the effect of performance history on Subjective Task Value differ for males and females? We are now exploring the variables that shape the value males and females attach to various achievement activities in an effort to broaden our understanding of the ontogeny of sex differences in achievement choice patterns. We are focusing on two sets of variables. The first set relates to the effect of gender-role stereotyping on beliefs and attitudes. We now believe that gender roles influence achievement patterns primarily through their effect on the value individuals attach to the many achievement options available to them. To test this hypothesis, we are evaluating the relation between gender-role salience, gender-role stereotypes of various activities, and achievement beliefs and choices.

The second set of variables we are exploring relates to the socialization of achievement values. Parental beliefs and attitudes appear to be particularly important. Parents, more than teachers, have sex-differentiated perceptions of their children's math aptitude, despite the similarity in the actual performance of their sons and daughters. Parents also believe that advanced math is more important for boys than for girls. Finally, our initial work suggests that parents' beliefs regarding their children's math aptitude are stronger predictors of the students' attitudes toward math than are indicators of the students' actual performance in math (see Parsons, Adler, & Kaczala, 1982).

Conclusion

In this chapter I have summarized a comprehensive model explaining achievement choices, have applied this model to the question of sex differences in achievement choices, and have summarized the results of a developmental study of sex differences in achievement choices generated by this model. The model differs from other explanations of sex differences in achievement behavior primarily in its focus on choice and its stress on the importance of task value as a critical mediator of sex differences in patterns of achievement choices. The results reported support this perspective. Sex differences in the decision to enroll in 12th-grade advanced math courses were mediated by the sex differences in the perceived value of advanced math courses. Furthermore, subjective task value was the most influential attitudinal variable in the course decisions of both boys and girls. However, since the subjective value of math was related positively to performance history in math for boys, enrollment in 12th-grade math was predicted primarily by performance history. Subjective task value played a larger predictive role in girls' enrollment decisions.

We find these results encouraging for two reasons. First, we believe they suggest a more positive view of women's achievement motivation than is inherent in other theories. Many popular explanations of sex differences in achievement choices are based on deficit models of female achievement orientation. For example, sex differences in achievement patterns have been attributed to females' learned helplessness, low self-concepts, low-expectancy attributional patterns, and fear of success. Each of these theories suggests that females are deficient in some critical component of achievement motivation. They imply that if only females had as much of this component as males they would make the same

achievement choices as males. While we did find some sex differences that might be interpreted as reflecting these types of deficits, we found little support for the suggestion that females' achievement patterns were being driven by these variables to any greater extent than were males' achievement patterns. Instead, our data suggest that sex differences in achievement choices reflect these differences: (a) Females and males attach different subjective task values to various achievement options (in this case math and English courses); (b) females weight the subjective value of the activity more heavily in their achievement decisions than males; and (c) the value females attach to various achievement activities is influenced by different factors than is the value males attach to the same activities.

Second, we find these results encouraging because they highlight the importance of modifiable factors in both male and female achievement patterns. Studies of intervention programs (see Eccles & Hoffman, in press) clearly demonstrate that the value students attach to various school subjects can be modified with appropriate role models, information, and career guidance. Further, studies of effective teachers (e.g., Casserly, 1980) also demonstrate that students' achievement values and goals are affected by their classroom experiences. Despite these findings, junior and senior high school students receive little career guidance and little active encouragement to develop their talents to the fullest and to consider the full range of occupational choices available to them. Our results suggest that boys and girls make different achievement decisions because they attach different values to course options. This difference may well result from the stereotypes boys and girls hold of math-related occupations (see Boswell, 1979; Eccles Parsons, 1984) and from the fact that girls seem to be ignoring information about their own talents and skills in deriving the values they attach to various achievement activities. Both of these potential mediating systems can be influenced by better career guidance and by the active involvement of teachers and parents in helping young women identify their talents and consider occupations that take advantage of these talents.

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