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Contents

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2 Expectancies, Values, and Academic Behaviors

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EDITOR'S OVERVIEW

The beliefs that men and women ought to be accorded equal educational and vocational opportunities and that it is acceptable even for married women with children to work have gained increasing acceptance over the past decade. Despite these attitudinal changes and the substantial percentage of women who have paid employment, the labor force continues to exhibit marked segregation by sex. Prestigious, well-paying positions tend to be male-dominated, whereas female-dominated jobs tend to be relatively low in prestige and pay. These discrepancies in the vocational attainments of men and women and the factors that determine them have become a matter of social concern.

The proportion of women who enter careers in science, engineering, and related professions is particularly low. One contributory factor is insufficient training in mathematics. Although the genders perform equally well in mathematics during their grade-school years, females are less likely than males to elect courses in mathematics in high school and college. This, in turn, limits women's access to a variety of jobs that require a strong background in the subject matter.

In this chapter, Jacquelynne Eccles (Parsons) and her associates report the results of a cross-sectional and longitudinal study of students in the fifth through twelfth grades, their parents, and their teachers. The major purpose of the study was to discover the factors that contribute to these sex differences in math achievement. On a more theoretical level, the study was designed to test the investigators' general model of achievement behavior. This model, which is most directly influenced by theories in which the constructs of expectancy and value are prominent, focuses on the role of cognitive rather than motivational factors in determining achievement behaviors.

The model has two components: the first is a psychological component in which the interactions of various cognitive factors at one point in time are specified; the second is a developmental component. In the first component, the most immediate precursors of such performance variables as task choice and persistence are individuals' expectancies or subjective probabilities of success and the value they place on successful attainment. These expectancies and values, as they relate to children's school performance, are determined by such variables as the individuals' goals and self-concepts, their perceptions of parents' and teachers' expectations, their interpretations of the reasons for their past performance (e.g., their attribution of past success or failure to their own ability or lack thereof), and their perception of the difficulty of the task. The developmental component specifies the origins of individual differences in these psychological factors.

Past research has indicated that females are less likely than males to attribute their past successes to their ability and to have somewhat lower expectancy for future success, particularly on new tasks. The investigators' model thus has obvious implications for sex differences in math attainment. The model also incorporates sex differences in the value that males and females place on training in mathematics, females being hypothesized to perceive math as less important to their future plans than do males and as being a "masculine" activity and thus noncongruent with feminine roles.

Using path analyses and cross-lagged panel analyses as their statistical techniques, the investigators tested the interrelationships among the cognitive factors specified in their model and the contribution of these psychological variables to a measure with implications for actual achievement behavior: the students' intention to take additional math courses. These analyses confirmed the importance of children's self-concepts of ability, attributions for past performance, and perceptions of the beliefs of parents and teachers as determinants of expectancies, values, and course plans. Relatively few sex differences were found, but those that did appear confirmed the results of past investigations: females, in comparison with males, had lower confidence in their ability and perceived math as more difficult and less valuable. Such sex differences appeared to be related to parents' beliefs in the difficulty of math for their child.

Why, given equivalent past histories of success and failure in a particular subject area, does one child approach the opportunity to take a new, more advanced course with enthusiasm and confidence, while another child approaches the same opportunity filled with self-doubt and anxiety, and yet another child avoids the opportunity altogether?

Why does one competent student fall apart in the face of failure, while another responds with renewed vigor?

Why do some good students conclude that they are able, while others doubt their abilities?

These questions and others like them have been the focus of my interests over the last decade. My colleagues and I have spent the last several years developing and refining a model for approaching these questions. We set ourselves the task of identifying the critical motivational/attitudinal mediators of achievement behaviors, of proposing causal relations among these beliefs, and of outlining the developmental origins of individual differences in these beliefs. In the spring of 1977, a project proposed by the National Institute of Education (NIE) was brought to our attention. The NIE wanted to fund research on sex differences in advanced mathematics course enrollment. Several reviews of the literature (Fennema, 1977; Fox, 1977; Sherman, 1977) had ruled out an innate ability difference as the primary causal determinant of the discrepancy in participation rates. Consequently, the NIE was particularly interested in studies of what were loosely called "math attitudes." Here was a golden opportunity to test our model of achievement behavior: a genuine achievement behavior (math course taking) showing fairly consistent individual differences that could not be explained by ability differences alone. Females, on the average, do not perform any more poorly in math than do males, and yet they are less likely to enroll in advanced high

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school math courses. Why? Needless to say, we set about translating our model into a field study of the determinants of math course plans and the developmental origins of individual differences in these determinants.

In this chapter, we outline the model and report the results of the study conducted to assess its predictive validity. The model presented in Figure 2-1 has two basic components: one psychological, and one developmental. We tested major portions of both components. In the first portion of the chapter, we discuss the psychological component and present the relevant findings from our study. The developmental component and its empirical test are discussed subsequently. Since the empirical study was conducted in the area of mathematics and since it focused on sex-differentiated achievement behaviors, particular attention is paid in this review to the relevant literature on mathematics achievement and sex differences.

PSYCHOLOGICAL COMPONENT OF ACHIEVEMENT MODEL

The search for an understanding of the motivational/attitudinal determinants of achievement-related behaviors is not new to psychology. Much of the work in the 1950s and 1960s was stimulated by the expectancy–value theory of Atkinson and his colleagues (e.g., Atkinson, 1958). This theory, the central tenets of which are outlined in Chapter 1 of this volume, focuses on individual differences in the motive to achieve and on the effects of subjective expectancy on both this motive and the incentive value of success. Some investigators, using new techniques to measure achievement motives, have continued to explore the implications of motivational mediators for achievement behaviors (e.g., Chapter 1, this volume). Much of the work of the last decade, however, has shifted attention away from motivational constructs to cognitive constructs, such as causal attributions, subjective expectancies, self-concepts of abilities, perceptions of task difficulty, and subjective task value. The theoretical and empirical work presented in this chapter fits into this tradition. Building on the seminal works of John Atkinson, Vaughn and Virginia Crandall, and Bernard Weiner, we have elaborated a model specifying the developmental and causal links among cultural factors, historical events, and one's expectancies, values, and achievement behaviors. We have proposed a detailed conceptualization of the mediators of expectancies and values. A general summary of these mediators and their relation to expectancies, values, and achievement behaviors is depicted in Figure 2-1. The model itself is built on the assumption that it is not reality itself (i.e., past successes or failures) that most

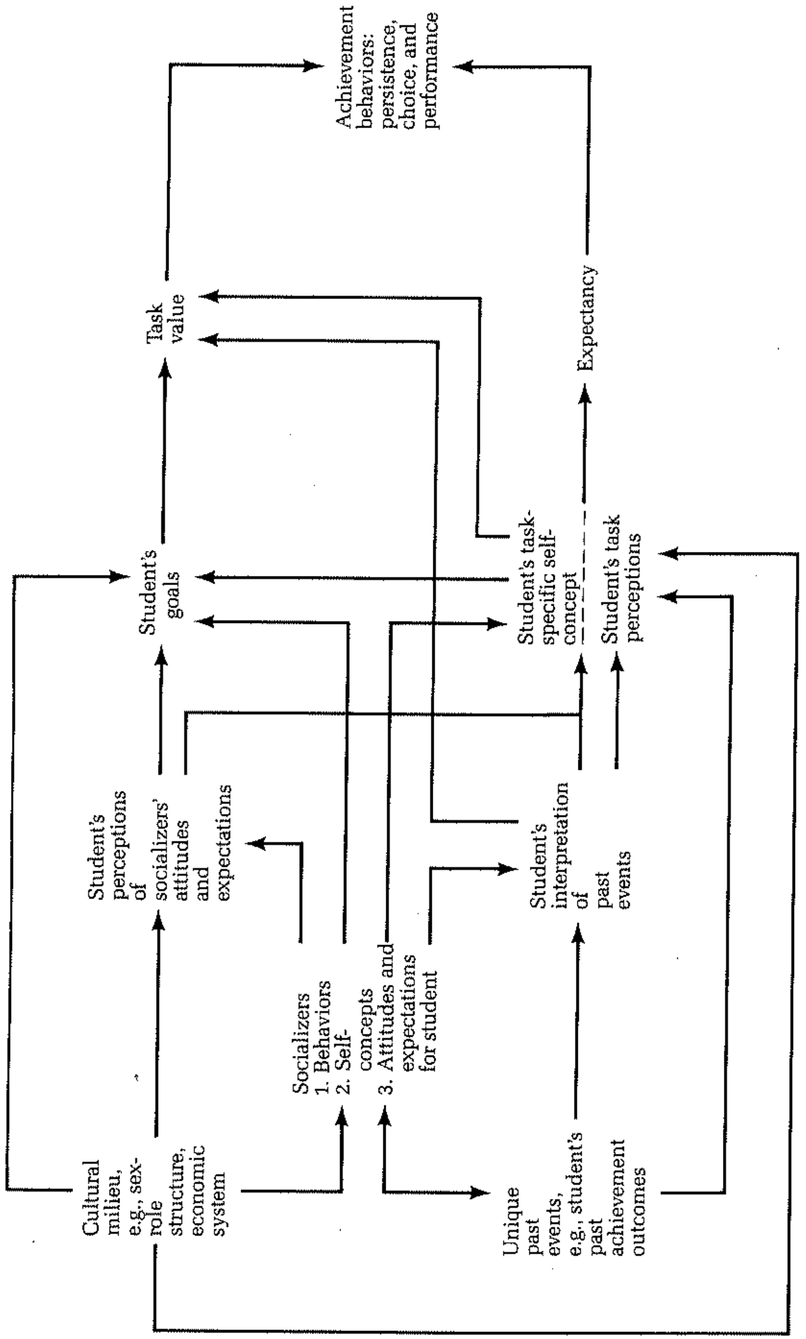

Figure 2-1
General expectancy–value and developmental model of achievement behaviors.

directly determines children's expectancies, values, and behavior, but rather the interpretation of that reality. The influence of reality on achievement outcomes and future goals is assumed to be mediated by causal attributional patterns for success and failure, the input of socializers, perceptions of one's own needs, values, and sex-role identity, as well as perceptions of the characteristics of the task. Each of these factors plays a role in determining the expectancy and value associated with a particular task. Expectancy and value, in turn, influence a whole range of achievement-related behaviors, e.g., choice of the activity, intensity of the effort expended, and actual performance.

In this section of the chapter, the psychological determinants of expectancies and values are discussed. In addition, specific hypotheses growing out of the psychological component of our model are presented, methodological procedures for the test of those hypotheses are outlined, and the findings of a longitudinal/cross-sectional study designed to test these hypotheses are summarized. The origins of expectancies are considered first.

Expectancies

The concept of expectancy or probability of success has long been recognized by decision and achievement theorists as an important variable in determining behavioral choice (Atkinson, 1964; Edwards, 1954; Lewin, 1938). Numerous studies have demonstrated the importance of expectancies for a variety of achievement behaviors including academic performance, task persistence, and task choice (e.g., Covington and Omelich, 1979a; Crandall, 1969; Diggory, 1966; Feather, 1966; Parsons, 1978; Veroff, 1969). Developmental studies indicate that the influence of expectancy on performance increases with age and may emerge earlier and more strongly in males than females (Crandall, 1969; Parsons and Ruble, 1977; Stein, 1971). By adolescence, however, expectancies are clearly related both to general achievement performance (e.g., Stein and Bailey, 1973) and to math achievement and course enrollment in particular (Armstrong and Kahl, 1978; Battle, 1966; Fennema and Sherman, 1978; Pedersen, Elmore, and Bleyer, 1979; Sherman, 1977; Sherman and Fennema, 1977). Not surprisingly, these studies have shown that students are more likely to enroll in advanced mathematics courses when they are confident of their performance.

Inconsistent findings, however, have been reported in studies examining sex differences in achievement expectancies. Laboratory studies, using somewhat novel tasks, generally have found females 8 years and older to have lower initial expectancies than males (Crandall, 1969; Dweck and Bush, 1976; Dweck and Gilliard, 1975; Montanelli and Hill, 1969; Parsons and Ruble, 1977). But when familiar tasks or actual school subjects are used, the findings have been less consistent (e.g., Parsons and Ruble, 1977; Stein, 1971). Inconsistent results have also been found in studies using measures of expectancies for math tests versus expectancies for future math courses (Fox, 1975; Fox, Brody, and Tobin, 1979; Heller, Futterman, Kaczala, Karabenick, and Parsons, 1978; Stein, 1971). Frieze, McHugh, Fisher, and Valle (1978) have interpreted this pattern of results as reflecting the difference between specific expectancies and generalized expectancies. They have argued that females' generalized expectances are lower than males', but that their specific expectancies, like those of males', are largely determined by performance history. Consequently, when males and females participate in a given achievement activity, one can expect their expectancies to be similar. It is generalized expectancies, however, that influence many decisions regarding future achievement behavior and, on these, females have lower expectancies than do males, in spite of similar past histories of achievement.

Since achievement expectancies play a significant role in students' academic choices, it is important to identify the factors shaping these expectancies. We propose that expectancies are influenced most directly by self-concept of ability and by the student's estimate of task difficulty. Historical events, past experiences of success and failure, and cultural factors are proposed to have indirect effects that are mediated through the individual's interpretations of these past events, perceptions of the expectancies of others, and identification with the goals and values of existing cultural role structures. Each of these influences is described briefly below.

Self-Concept of Ability The importance of individuals' concepts of their abilities for their achievement behaviors has been discussed by several researchers (e.g., Brookover and Erickson, 1975; Covington and Beery, 1976; Covington and Omelich, 1979a, 1979b; Kukla, 1972, 1978; Meyer, Folkes, and Weiner, 1976; Nicholls, 1976; Purkey, 1970). Formed through a process of observing and interpreting one's own behaviors and the behaviors of others, self-concept of ability is defined as the assessment of one's own competency to perform specific tasks or to carry out role-appropriate behaviors. In the view of most authors, self-concepts of ability are key causal determinants of a variety of achievement behaviors.

Research assessing this view has yielded somewhat mixed results. Although several studies have demonstrated that those with higher estimates of their abilities to master a task in fact do better on the task, few have actually tested the causal direction of the relations. In a field study, Calsyn and Kenny (1977) found that academic achievement determines self-concept of ability rather than the reverse. In

contrast, intervention procedures designed to raise students' confidence in their abilities in particular subject areas have been shown to induce gains in the students' subsequent achievement behaviors (e.g., deCharms, 1976; Dweck, 1975). These intervention studies suggest that, for some students at least, increases in self-confidence can produce increases in achievement.

Research specific to math achievement has yielded a consistent and positive relation between perception of mathematical ability and plans to enroll in advanced mathematics courses. For example, Kaminski, Erickson, Ross, and Bradfield (1976) and Armstrong and Kahl (1978) have demonstrated that students' ratings of their mathematical abilities predict the amount of math they plan to take in high school.

Furthermore, when sex differences emerge in measures of self-concept of math ability, females report lower estimates of their abilities than do males. These differences do not emerge with any consistency prior to junior high school but are frequently found at and beyond junior high, despite the fact that, during elementary school and junior high school, females perform just as well as males in math (e.g., Ernest, 1976; Fennema, 1974; Fennema and Sherman, 1977; Fox, 1975; Heller, Futterman, Kaczala, Karabenick, and Parsons, 1978; Kaminski, Erickson, Ross, and Bradfield, 1976).

While these studies indicate that self-concept of ability is related to such achievement behaviors as course plans and actual performance, its causal significance in explaining various forms of achievement behaviors is not clear. The one study that attempted to address this issue using path-analytic techniques found self-concept of ability to have only a small direct effect on course enrollment plans (Kaminski et al., 1976). Similarly, the causal role of self-concept in accounting for the sex differences in expectancies has received little direct attention. While adolescent females appear to have lower estimates of their math abilities than do adolescent males, the causal relation of this difference to sex differences in either expectancies, course plans, or actual course enrollment has yet to be tested. Researchers are often content to demonstrate a sex difference on a variable that is assumed to be causally related to achievement and then to conclude that the obtained sex difference is the cause of the sex difference in achievement. Such a conclusion is neither logically nor scientifically sound. Through the use of causal modeling procedures, we assessed the causal direction of the relation between confidence in ability and course plans. The results are summarized in a later section.

Perception of Task Difficulty Intuitively, it seems that expectancies for success should be inversely related to perceived task difficulty. While little research has addressed this prediction directly, there is ample evidence that task choice in experimental settings is related to perceived task difficulty (e.g., Atkinson and Birch, 1970; Meyer, Folkes, and Weiner, 1976; Stallings and Robertson, 1979; Weiner, 1972, 1974). However, the relation between these two variables is not straightforward. In some situations and for some individuals, there is a curvilinear relationship between increasing task difficulty and the likelihood of both choice and persistence (Atkinson, 1958, 1964; Kukla, 1978; Meyer, Folkes, and Weiner, 1976; Weiner, 1972). Other investigators have suggested that these results may be generalizable to only a limited range of activities, namely, those that might be considered recreational or of limited long-range importance. For inherently difficult tasks with important future implications, such as school achievement, perceived task difficulty should be negatively related to enrollment plans. That is, the harder one judges a course to be, the less likely one will be to enroll in that course. The discrepancy between these two points of view may be a consequence of the variations in perceived difficulty levels of naturally occurring versus simulated achievement tasks. Most nontrivial, naturally occurring achievement tasks are probably perceived to be at the difficult end of the probability-of-success curve, while laboratory-simulated achievement tasks can be designed to span the full range of perceived difficulty. Furthermore, the very definition of success may differ markedly between these two domains, making comparison of results difficult. Raynor (1974) has made a similar point, suggesting that the discrepancy between these two viewpoints may be a function of how finely one divides up the sequence of events in naturally occurring achievement tasks. Nonetheless, we are left with two competing hypotheses regarding the nature of the relation between perceived task difficulty and naturally occurring achievement behaviors.

The few studies testing these predictions with regard to math in particular have not shed much light on this debate and have, in fact, yielded conflicting results. For example, a cross-cultural study of math achievement (Husen, 1967) did not find any relation between perceived task difficulty and math achievement. Stallings and Robertson (1979), in contrast, found perceived difficulty to be the most important variable in discriminating between females who planned to continue in math and those not planning to continue.

Few studies have tested for sex differences in perceived task difficulty. In our own studies, adolescent females rated future courses in mathematics as more difficult than did males (Heller, Futterman, Kaczala, Karabenick, and Parsons, 1978), suggesting that females' perceptions of task difficulty might work in conjunction with their lower self-concepts of math ability to lower their expectancies for success in future courses and to decrease the likelihood of their enrolling in

advanced math courses. While there has been very little research directly testing this hypothesis, there are data suggesting that females more frequently than males select tasks that have been designated as easy by the experimenter (e.g., Crandall, 1969; Stein and Bailey, 1973; Veroff, 1969). Perhaps these results reflect a difference between males and females in their subjective assessments of task difficulty, coupled with a difference in their subjective assessments of their abilities. In support of this suggestion, females have been found to rate objectively similar tasks as more difficult than males (Foersterling, 1980). Consequently, females may actually be selecting tasks for themselves that they judge to be more difficult than the tasks the males are selecting for themselves.

The evidence reviewed is not especially encouraging for investigators hoping to predict achievement expectancies, plans, or other achievement behaviors exclusively from students' perceptions of the difficulty of the task. Findings from the few existing studies suggest that the effects of this variable are consistent but small. Of the two major mediators of expectancies discussed thus far, self-concept of ability appears to be the more critical construct. Perceptions of task difficulty, however, may influence self-concept of ability such that, over time, students who see a subject or task as more difficult develop lower estimates of their own abilities for that subject or task. For this reason, perceived task difficulty is included in our model of achievement behaviors as an important mediator of achievement expectancies, and its impact on math course plans and expectancies for success was assessed in our study.

Perception of Others' Expectations The achievement literature has documented the importance of parents' and teachers' expectations and attitudes in shaping students' self-concepts and general expectancies of success (Brookover and Erickson, 1975; Brophy and Good, 1974; Parsons, Frieze, and Ruble, 1976; Rosenthal and Rosnow, 1969; Webster and Sobicozek, 1974). Studies investigating this relationship have yielded consistent results. Students for whom teachers and parents have high expectations also have high expectations for themselves and in fact do better in their course work. It seems only reasonable that this effect is mediated, in part, by students' perceptions of their parents' and teachers' expectations. In support of this suggestion, Poffenberger and Norton (1959) and Kaminski, Erickson, Ross, and Bradfield (1976) have found a significant positive relation between perceived parental evaluations and students' self-concepts and perceptions of task ease. However, the causal direction of this relation is unclear. While it is commonly assumed that the perceptions of the expectancies of others influence a student's self-concept of ability, Calsyn and Kenny (1977) have found the reverse relationship to be stronger. Our study provides an additional test of the causal direction of this relationship.

Few studies have tested for sex differences in perceived parental expectations for achievement in mathematics. In general, when sex differences are evident, female students perceive their parents as having lower estimates of the females' math abilities than do male students (Fennema and Sherman, 1977; Fox, 1975; Kaminski et al., 1976). These differential perceptions of parental expectancies have been found to be related to students' intentions to take advanced mathematics courses. The relation of these perceptions to sex differences in expectancies has not been tested.

Perhaps the critical variable is the perception and internalization of the cultural stereotype of general female incompetence, rather than (or in addition to) the perceptions of the expectations of specific individuals. Several studies have documented the fact that women are viewed as less competent and are expected to do less well than men on a variety of different tasks (Broverman, Vogel, Broverman, Clarkson, and Rosenkrantz, 1972; Deaux and Emswiller, 1974; Feldman-Summers and Kiesler, 1974). Acceptance of these cultural stereotypes may be reponsible for females' lower expectancies.

Causal Attributions Attribution theorists have suggested another set of variables as important mediators of individual differences in expectancies and perceptions of both one's ability and the difficulty of the task (Frieze, Fisher, Hanusa, McHugh, and Valle, 1978; Heider, 1958; Weiner, 1974). According to these theorists, it is not success or failure per se, but the causal attributions made for either of these outcomes that influence future expectancies. For example, if people attribute success to a stable factor such as ability, then they should expect continued success. If, on the other hand, they attribute success to an unstable factor such as effort or good luck, they should be uncertain about future outcomes. Similarly, attributing failure to stable factors should produce expectations of continued failure, while attributing failure to unstable factors should not. Consequently, individuals who attribute their success to an unstable factor such as task ease and their failure to a stable factor such as lack of ability should have lower expectancies than do individuals exhibiting the reverse attributional pattern, even if their performance histories have been identical.

Several studies have provided indirect support for these general hypotheses (e.g., Dweck, 1975; Dweck and Reppucci, 1973; Jackaway, 1974). The causal nature of these relations, however, has come under recent scrutiny (Covington and Omelich, 1979a, 1979b). Using path-

analytic techniques, Covington and Omelich (1979a) tested the hypothesis that attributions for a failure experience on a college test mediate individual variations on both expectancies and retest performance. In comparing the effects of need-achievement motivation and attributions on subsequent expectancies and performances, they found that attributions added little predictive power and did not mediate the influence of need achievement on either expectancy or performance. Based on their findings, Covington and Omelich proposed that expectancy shifts are caused by students' initial self-concept of ability rather than by their causal attributions.

While in basic agreement with Covington and Omelich's conclusion regarding the importance of one's self-concept of ability, we maintain that attributions have a causal role in achievement expectancies. Extending the argument originally advanced by Weiner, Frieze, Kukla, Reed, Rest, and Rosenbaum (1971) into a developmental time frame, we hypothesize that attributions play a critical role in the formation of one's self-concept of ability and one's perceptions of task difficulty when confronted with novel tasks. Once individuals have formed a stable self-concept of ability at any particular task, however, attributions may well become an epiphenomenon rather than a causal influence on subsequent expectations and performance. In line with this developmental view, Kukla (1978) has suggested that it is primarily attributions to ability that influence subsequent achievement behavior. One could argue that the ability attribution plays a critical role during the period when an individual's self-concept of ability is forming. Once the self-concept has formed, however, attributions to ability may simply mirror one's self-concept.

Unfortunately, few studies have assessed this hypothesis. In a study in our laboratory, we compared the influence of attributions on expectancies for a familiar task (performance in one's current math course) with their influence for a novel task (an experimental task involving number sequences). Consistent with the findings of Covington and Omelich (1979a), we found that attributions were related minimally to expectations for performance in math class. In contrast, however, variations in the students' attributions of their math failures to lack of ability were critical mediators of their responses to the experimentally induced failure on the number-sequence task (Parsons, 1980). While only in its initial stages, this research provides encouraging support for our predictions.

Given our concern with sex-differentiated academic choices, examination of the studies assessing attributional differences between males and females is also in order. To the extent that males and females differ in their attributional patterns, females are more likely to exhibit low expectancy patterns, and in some studies their achievement behaviors are affected accordingly (e.g., Crandall, Katkovsky, and Crandall, 1965; Dweck, 1975; Dweck and Reppucci, 1973; Feather and Simon, 1973; Jackaway, 1974; McMahan, 1973; Nicholls, 1975). The pattern of results, however, is not as consistent as one might expect, given reviews of the field (e.g., Bar-tal, 1978; Dweck and Goetz, 1978; Parsons, Ruble, Hodges, and Small, 1976). For example, while some studies have reported that females attribute their failures more to lack of ability than do males (e.g., Dornbusch, 1974; Fennema, 1981; Nicholls, 1975; Parsons, 1980, 1981), other studies either have not found or have not reported sex differences (e.g., Beck, 1977–1978; Diener and Dweck, 1978; Dweck, Davidson, Nelson, and Enna, 1978; Dweck and Reppucci, 1973; Parsons, 1980). Still other studies have found that the nature of the sex differences varies depending on a variety of related variables such as the student's achievement level (Fennema, 1981), the point in the task at which the attribution is taken (Nicholls, 1975), the wording of the question, and the sex and age of the evaluator (Dweck and Bush, 1976). Thus, whether sex differences in attributions mediate sex differences in achievement behaviors remains an open question.

Locus of Control Closely related to attribution theory is the work on locus of control. Based on the work of Rotter (1954), Virginia and Vaughn Crandall developed the construct of intellectual-achievement responsibility, arguing that the belief that one is responsible for or in control of achievement outcomes is both important and beneficial. Taking this construct one step further and building on the work of Seligman (1975), Dweck (1975) introduced the concept of academic learned helplessness to describe students who assume that they cannot control their failures. Attributional analysis of these concepts (Dweck and Goetz, 1978) has suggested the similarity of both of these constructs to the high and low attributional pattern analysis discussed earlier. Consequently, no further discussion of these constructs is included here except to note that:

1. Empirical evidence has demonstrated the important mediating role of locus of control and learned helplessness for achievement-related behaviors.
2. Sex differences have not been found consistently on either locus of control or learned helplessness.
3. The mediating role of learned helplessness in accounting for sex differences in achievement has yet to be established (Parsons, 1981).

Task Value

Consistent with the manner in which the causal pathways related to the expectancy component of our model were traced, the proposed causal pathways related to the value of an achievement task for the individual are now traced. In Atkinson's theory (1964), the value that an individual attaches to success or failure on a task is assumed to be a critical determinant of achievement motivation. Atkinson's definition of the concept (reviewed in more detail in Chapter 1, this volume) was narrow and based on objective task characteristics. Other theorists have used a broader, more individualistic concept of task value (Crandall, Katkovsky, and Preston, 1962; Parsons and Goff, 1978, 1980; Raynor, 1974; Spenner and Featherman, 1978). According to these theorists, the value of a task is determined both by the characteristics of the task and by the needs, goals, and values of the person. The degree to which the task is able to fulfill needs, facilitate reaching goals, or affirm personal values determines the value a person attaches to engaging in that task.

Elaborating on this more recent work, we suggest that the overall value of any specific task is a function of three major components: (1) the attainment value of the task, (2) the intrinsic or interest value of the task, and (3) the utility value of the task for future goals. Each of these components is discussed below.

Attainment value is the importance of doing well on the task. In its most basic form, this component coincides with the conceptualization of attainment value advanced by the Crandalls (e.g., Crandall, 1969; Crandall, Katkovsky, and Preston, 1962). In its broader form, it incorporates a variety of dimensions, including perceptions of the task's ability to confirm salient and valued characteristics of the self (e.g., masculinity, femininity, competence), to provide a challenge, and to offer a forum for fulfilling achievement, power, and social needs. The perceived qualities of the task determine its attainment value through their interaction with an individual's needs and self-perceptions. Consider, for example, a student who thinks of herself as "smart" and defines a certain course (e.g., advanced math) as both intellectually challenging and "the" course for "smart" students to take. The attainment value of such a course for this particular student should be high, precisely because doing well in it would affirm a critical component of her self-concept.

Intrinsic or interest value is the inherent, immediate enjoyment one gets from engaging in an activity. *Utility value*, on the other hand, is determined by the importance of the task for some future goal that might itself be somewhat unrelated to the process nature of the task at hand. For example, a high school student may want to be a veterinarian and may need to take a particular course (e.g., math) in order to gain entry into the appropriate graduate training program. Consequently, she may take advanced mathematics classes, even though she has little or no interest in math itself. In this case, the desirability of her career goal and the instrumentality of mathematics in helping her to achieve that goal would outweigh the student's neutral or even negative attitude toward the subject matter. The value of math in this case is high precisely because of its long-range utility.[1] This distinction between the intrinsic-value component and utility-value component coincides most closely to the distinction made between intrinsic and extrinsic motivation (Deci, 1975; Kruglanski, 1975; Lepper and Greene, 1978; Nicholls, 1979), namely, the distinction between "means" versus "ends" motivation. (This distinction is discussed in more detail in Chapter 1, this volume.)

In the literature specifically relevant to mathematics participation, there is some evidence to support the influence of *utility value* on course selection. Several researchers, for example, have reported that students' perceptions of the usefulness of mathematics are strongly related to their intentions to continue or discontinue their mathematical studies (e.g., Armstrong and Kahl, 1978; Brush, 1980; Fennema and Sherman, 1977; Sherman, 1980). Sex differences in students' math achievement values have also been uncovered. Males, as early as seventh and eighth grade, are more likely than females to perceive math as important to future career goals (Dornbusch, 1974; Fennema and Sherman, 1977, 1978; Fox, 1975; Hilton and Berglund, 1974; Wise, Steel, and MacDonald, 1979)—a belief that coincides nicely with reality. Professions demanding math are, in fact, dominated by males and, until recently, few women aspired to participate in them. High school males also place a higher importance on their grades in mathematics than do females (Dornbusch, 1974).

In sum, we are proposing that the value of a particular task to a particular person is a function of both the perceived qualities of the task and the individual's needs, goals, and self-perceptions. Individual differences on these variables are created by differential past experiences with that task or with similar tasks, by social stereotypes (e.g., the perception of math as a male domain), and by differential information from parents, teachers, or peers about the importance of or difficulty involved in doing well. Intuitively, three clusters of variables seem to be particularly important mediators: (1) sex roles, (2) perceptions of the cost of success, and (3) previous affective experiences with similar tasks. Each of these is discussed below.

[1]Raynor's (1974) work on future orientation has provided one example of the incorporation of utility value into the general need-achievement model.

Sex-Role Identity and Personal Values A sizable portion of both the empirical and the theoretical literature related to the processes of socialization has suggested that a variety of needs and values influence the form of an individual's achievement behavior (Hoffman, 1972; Mortimer and Simmons, 1978; Parsons and Goff, 1978, 1980; Spenner and Featherman, 1978; Stein and Bailey, 1973; Veroff, 1969, 1977). The importance of the centrality of values and needs to one's self-definition has been a recurring theme. Personal needs and values, it has been argued, operate in ways that both reduce the probability of engaging in roles that are perceived as inconsistent with these central values (Spenner and Featherman, 1978) and increase the probability of engaging in roles perceived as consistent with one's definition of self (Parsons and Goff, 1980).

One need, in particular, has received a great deal of attention: the need to behave according to a set of social prescriptions for sex-appropriate conduct, or sex-role identity. Proponents of the cognitive-developmental model of sex-role acquisition (e.g., Kohlberg, 1969; Parsons, 1977; Parsons, Frieze, and Ruble, 1976) have suggested that sex roles influence achievement behavior through their impact on perceived task value. Specific tasks are identified as either consistent or inconsistent with one's sex-role identity. The extent to which a task is consistent with one's sex-role identity influences the value of that task. In partial support of this view, several studies have documented the influence of sex labeling of tasks on students' performance and choice (e.g., Liebert, McCall, and Hanratty, 1971; Montemayor, 1974; Sherman, 1979). Studies of adolescent values have suggested that males become more oriented toward achievement in school with age, while females become more concerned with the potential conflict between their academic goals and their social goals (Beech and Schoeppe, 1974; Douvan and Adelson, 1966; Sherman, 1979; Stein and Bailey, 1973). Taken together, these studies have suggested a growing sensitivity to the congruence between anticipated adult sex-related roles and the current task demands that may influence the value of various tasks for the individual and, in turn, influence achievement-related behaviors.

Central to this line of argument is the assumption that sex-role identity and the sex stereotyping of particular achievement activities interact in influencing task value. That is, we are suggesting that the sex typing of the task will affect its perceived value only to the extent that one's sex role identity is a *critical* and *salient* component of one's self-concept. Conversely, sex-role identity should influence task value only to the extent the task is sex-typed by the individual. For example, the value of math should be low for a female who both sees math as a masculine activity and avoids masculine activities as one way to affirm her "femininity." Among those females who do not see mathematical competence as a masculine characteristic, sex-role identity should not be related to the perceived value of enrolling in a mathematics course. Similarly, for those females whose sex-role identity is not a central component of their self-identity ("sex-role aschematics," Markus, 1980), variations in the perception of mathematics as a masculine subject should not be related to variations in perceived task value. It is clear in these examples that effects of sex typing on task value are complex, depending not only on the subjective sex typing of the activity but also on the salience of sex-role identity to one's self-concept. Unfortunately, good measures of sex-role identity are not available. In addition, it may well be that sex-role identity is not a unitary concept, making measurement even more problematic.

The implications of sex typing on achievement behaviors has, nonetheless, received considerable attention in the area of math achievement. The results of these studies are mixed but, when math is stereotyped, it is seen as a male achievement domain by both male and female students. Males, however, typically consider math to be more of a male achievement domain than do females, and females, when asked, do not characterize greater participation in mathematics courses or competence in mathematics as unfeminine (Armstrong and Kahl, 1980; Boswell, 1979; Dwyer, 1974; Ernest, 1976; Fennema and Sherman, 1977; Fox, Brody, and Tobin, 1979; Nash, 1979; Stein and Smithells, 1969). For example, Fennema and Sherman (1977) have reported that the high school females in their studies stereotyped math as less of a male achievement domain than did males and did not show great concern about success in mathematics. Thus, it is not clear that females are stereotyping math as inappropriate for them, and it is even less clear that the sex stereotyping of math is lowering its attainment value for females.

Yet the hypothesized impact of the sex typing of math continues to be a favored explanation of sex-differentiated math course taking (e.g., Nash, 1979). If it is not the sex typing of high school math courses themselves that is responsible for this hypothesized link, how else might sex roles be influencing student decisions regarding math enrollment? While females may not be stereotyping mathematics as exclusively masculine, they may be stereotyping math-related careers as either masculine or unfeminine. In support of this suggestion, Boswell (1979) has found that career mathematicians are perceived as being decidedly unfeminine. It is not surprising, then, that

females might not aspire to masculine-typed occupations and consequently would perceive advanced math courses as having low utility value, especially given the consistent view that advanced mathematics courses are difficult (e.g., Brush, 1980; Heller, Futterman, Kaczala, Karabenick, and Parsons, 1978). A number of articles have either reported or summarized distinct differences in the career interests of males and females, with females preferring occupations that require little math (Astin, 1969; Astin, Harway, and McNamara, 1976; Fox and Denham, 1974; Goff, 1978; Hawley, 1971, 1972; Lipman-Blumen and Tickameyer, 1975; Parsons, 1977; Parsons and Goff, 1980). Even in a study of high school math participation, Wise (1979) has found that a large proportion of the sex differences in participation could be accounted for by career interests in the ninth grade. Thus, it seems probable that it is the sex difference in career goals rather than the sex typing of math courses per se that is the major mediator of the sex difference in the perceived value of advanced math courses.

Sex differences in the perceived value of math could also result from sex differences in personal values and life goals. As noted earlier, several theoreticians have argued that one's values and life goals can influence the value one attaches to various activities such that activities consistent with these beliefs are seen as more valuable than activities that are inconsistent with or unrelated to one's personal value structure. In support of this argument, several recent studies have documented a relation between mathematics/science involvement and personal values. For example, Dunteman, Wisenbaker, and Taylor (1979) have 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 students are relatively low on social values and high on theoretical, political, and economic values. Furthermore, in both of these studies, females were less likely to hold the math- and science-related values than were males. Thus, it seems quite plausible that the sex difference in the perceived value of math is a function in part of the sex difference in personal value structure. The strength and causal direction of this prediction have yet to be tested.

Cost of Success or Failure The value of a task to an individual is also affected by a set of variables that can be conceptualized best as the cost of success or failure. Borrowing from exchange theorists (e.g., Thibaut and Kelley, 1959), we conceptualize the influence of cost on the value of an activity in terms of a cost/benefit ratio. Assuming that individuals have a conception of both the costs and the benefits of engaging in a variety of activities, then the value of each activity ought to be inversely related to this cost/benefit ratio. Variables influencing the benefit of an activity were discussed in previous sections. Variables influencing the cost of an activity include (1) the amount of effort needed to succeed, (2) the loss of time that could be used to engage in other valued activities, and (3) the psychological meaning of failure. Each of these is discussed briefly below.

1. *Effort*. Kukla (1972) has suggested that perceived effort needed for success may be a key determinant of achievement behavior. He has argued that a person calculates the minimal amount of effort needed to succeed on a task (i.e., to do as well as one considers essential), given the person's estimate of her or his ability and the difficulty of the task. The individual then exerts that minimal effort. If we assume that individuals have a sense of how much effort they think is worthwhile for various activities, then we could extend Kukla's argument to the following prediction: as the anticipated amount of effort increases in relation to the amount of effort considered worthwhile, then the value of the task to the individual should decrease. That is, as the cost/benefit ratio in terms of amount of effort needed to do well increases, the value of the task to the individual should decrease.

2. *Loss of valued alternatives*. Closely related conceptually to the cost of effort involved is the cost of a task in terms of the time lost for other valued activities. Students have limited time and energy. If they spend one hour on Task *A*, they have one hour less available for Task *B*. They must make choices among various activities. For example, imagine a female who likes math, knows it's hard, but also wants a boyfriend. To do as well in math as she feels she should, she thinks she'll have to do homework every night. She also believes that she can optimize her chance of getting a boyfriend by staying after school to watch the boy-of-her-dreams play basketball. Her parents, however, will not allow her to watch basketball practice unless her homework is finished, and she thinks she won't be able to finish her math homework in time. Despite its high incentive value, math poses an obstacle to success in her social goal. Consequently, the value of math for this female is decreased by its high cost in terms of the satisfaction of other important goals.

This analysis highlights the necessity of thinking about various achievement-related behaviors within the broad social array of behavioral options available to people. For example, the decision to try hard in math or not go to medical school, is not made in isolation of other salient life decisions that directly affect the perceived value of all of the available options.

3. *Psychological cost of failure*. Both the cost of success and the loss of valued alternatives are based on the assumption of anticipated

success. But what if a student is unsure of success or is certain of failure? How might that uncertainty affect the perceived value of the task? The common practice of avoiding courses that might lower one's grade-point average is a prime example of what can happen. Because students planning to attend college or graduate school know that they need high GPA's in order to compete, they often avoid courses that will add even a B to their academic records.

As another example, consider those students who view themselves as competent, have strong achievement needs, yet are unsure of their mathematical abilities and feel that they will have to try exceptionally hard to do well in their next math course. For these students, the cost of failure is high because failing to do well has important implications for their self-concept. In addition, these students would also be unsure of success and would believe that the amount of effort needed to do well was very high. Consequently, the perceived value of math should be lower for these students than for students who are either certain of success or do not find the prospect of failing as costly.

What does a student do when faced with these negative beliefs? If the option is available, he or she can avoid the activity altogether. But what if the student must engage in the activity, as is often the case in American schools? This is the situation given theoretical and empirical attention by Nicholls (1976), Covington and Beery (1976), and Covington and Omelich (1979a, 1979b). These theorists have suggested, and empirically demonstrated, that such a student would adapt by exerting the minimal effort necessary to get by. This strategy has two advantages. First, it prevents out-and-out failure; second, it provides the student with a face-saving attribution for lack of success; namely, "I didn't do better because I didn't try as hard as I could have." These theorists have argued that this attribution is psychologically less costly than the attribution to lack of ability that one would have to make if one had tried as hard as one could have and had still not "succeeded."

This analysis emphasizes the importance of the interaction among subjective definitions of success and failure (minimum standards), psychological cost of failure, perceptions of task demands, and expectations of success in determining task value. It is our contention that these variables interact to influence the perceived cost/benefit ratio and thus influence achievement behaviors. Whether or not this process is implemented at all, however, should depend, in part, on the initial levels of one's expectations for success and the perceived psychological cost of failure. To the extent that one's expectations are low or that the cost of failure is high, one should consider the cost/benefit ratio very carefully. Conversely, to the extent that one's expectations are high or the cost of failure is low, other criteria should play a more critical role in determining achievement-related behaviors.

In summary, while past research on math achievement has not examined these cost variables, evidence from different lines of research provides support for our suggestions. Sex differences have not been examined for most of these variables. There have, however, been suggestions that females are not as likely to take risks as are males. This difference may reflect a differential sensitivity to the cost/benefit ratio discussed throughout this section. While these suggestions have not been tested in light of our model, they do provide support for our theoretical analysis and could add to the understanding of sex differences in achievement behaviors.

Affective Experiences Achievement activities elicit a wide range of emotional responses. Past affect-laden experiences can influence one's responses to similar tasks in the present or future. For example, if one has had bad experiences with a math teacher in the past, one may be less positive in general toward current mathematics courses and mathematics teachers. To understand the value of various achievement activities, then, it is important to consider variations in the affective experiences students have had with different achievement activities. Variations in these experiences can take two quite different forms: (1) variations caused by overt, objective events like success, failure, and the responses or behaviors of major socializers such as parents and teachers, and (2) variations created by psychological factors such as causal attributions and individual differences in confidence or anxiety. A brief discussion of each of these follows.

1. *Objective events.* Past successes and failures themselves have been shown to elicit characteristic affective responses (e.g., Weiner, Russell, and Lerman, 1978). Success, especially on challenging tasks, leads to positive feelings; failure, especially on easy tasks, leads to negative feelings (Harter, 1980; Ruble, Parsons, and Ross, 1976). Other things being equal, these affective responses should influence the enjoyment or intrinsic value of subsequent related activities (Bandura, 1977). One should like activities that have been associated with positive feelings in the past more than activities that have been associated with negative feelings.

Both affect-laden behaviors of teachers and parents (e.g., praise, criticism, public ostracism, rejection) and more general experiences in school (e.g., test-taking procedures, curriculum variations) could have similar effects. Evidence documenting teacher and parent effects are discussed in a later section. Evidence documenting the impact of the more general school experience is abundant (e.g., see reviews by

Hill, 1977, on optimizing test-taking situations and by Nicholls, 1979, on optimizing motivation) and is not reviewed in detail in this chapter. One set of findings directly related to math achievement is, however, especially relevant for this discussion. Both Brush (1980) and Heller, Futterman, Kaczala, Karabenick, and Parsons (1978) have found a developmental decline in the perceived value and enjoyment of math. Brush interviewed students to assess the possible causes of this decline. Her students reported that high-level math courses are especially anxiety-provoking because students are called on and tested a great deal in these classes. Brush has speculated that this teaching style increases the negative experiences for the students and thus lowers the perceived value of these courses.

2a. *Psychological events: causal attributions.* Weiner (1972) has proposed that attributions of success and failure influence one's affective response to achievement tasks, such that attributing success and failure internally magnifies the associated affect. Thus, we should feel best about successes attributed to our abilities and efforts and feel worst about failures attributed to a lack of effort and/or ability. Evidence has supported this prediction (Ruble, Parsons, and Ross, 1976; Weiner, 1974). In more recent work, Weiner, Russell, and Lerman (1978, 1979) have provided empirical support for the link between attributions and affective responses. Weiner et al. (1978) have found that attributing one's success internally leads to feelings of pride, satisfaction, and competence, while attributing success externally leads to feelings of gratitude and surprise. Attributing one's failure to internal causes leads to feelings of guilt, resignation, and regret, while attributing failure to external causes leads to feelings of anger and surprise. Thus, it appears that attributions influence, in part, the affective responses one experiences in achievement settings. Individual differences in attributional patterns, consequently, should produce individual differences in the affect associated with similar tasks, which, in turn, should influence the value of these tasks.

2b. *Psychological events: individual differences in anxiety.* There has been a long tradition in the achievement literature of a concern with the effects of negative affective states on achievement-related behaviors, beginning with Atkinson's inclusion of a motive to avoid failure in his original model of need achievement (Atkinson, 1964) and related work on test anxiety (e.g., Sarason, 1972) and extending to more recent work on mastery orientation versus learned helplessness by Harter (1980) and Diener and Dweck (1979). Research in these areas has indicated that students classified as either high test-anxious or learned-helpless are more likely to label a given outcome as failure (Diener and Dweck, 1979), to blame themselves for their "failures"

(Diener and Dweck, 1978; Doris and Sarason, 1955), to experience more negative affect in general in testing situations that include both success and failure (Diener and Dweck, 1979; Mandler and Sarason, 1952), to suffer greater losses in self-esteem when confronted with evaluative situations (Diener and Dweck, 1979; Wine, 1971), to gain less in self-evaluation from success (Diener and Dweck, 1979), and to exhibit a range of debilitating behaviors reflecting anxiety in evaluative settings (e.g., Diener and Dweck, 1979; Ruble and Boggiano, 1980). This set of characteristics certainly would lead one to conclude that evaluative situations are particularly painful for some students. Since schools rely heavily on evaluative testing, we predict that the value of school-related achievement behaviors will decrease for these students as a consequence of the negative affect experienced during these evaluations.

The influence of negative affective states in achievement has received a great deal of attention in the area of math achievement. In particular, math anxiety has emerged as a popular explanation for sex differences in students' mathematics learning and course selection. Citing anecdotal evidence that more women than men openly admit feeling anxious about mathematics and enroll in math-anxiety clinics, some researchers (e.g., Lazarus, 1974; Tobias, 1978) have argued that women and men differ in their emotional reactions to mathematics and that women avoid math because it is anxiety-provoking.

Although there have been only a few studies that directly address affective outcomes of mathematics learning, and the findings have not been especially consistent, some support for this proposal is found in the literature. In terms of general affective responses to mathematics, expressed as a liking or preference for the subject matter, few differences are evident in males' and females' responses during elementary and junior high school. Sex differences in these variables do appear after junior high school, with males expressing more positive affective responses toward math (Aiken, 1970, 1976; Ernest, 1976; Fox, 1975, 1977). With respect to more negative affective responses to mathematics, the view that greater numbers of females are math-anxious has been supported by a few empirical studies (Brush, 1978; Dreger and Aiken, 1957; Suinn and Richardson, 1972). However, interpretation of these studies is problematic, given the possibility that males might be less willing to admit to feelings of anxiety, especially with regard to an area of achievement that is viewed as masculine, particularly by other males.

Fennema and Sherman have argued that math anxiety is psychologically equivalent to a lack of confidence in one's ability to learn mathematics. In support of this conclusion, they (1977) have reported a strong correlation between measures of students' confidence in math and their math anxiety. Meece (1980), however, has argued that equating math anxiety with lack of confidence in one's ability does not fully account for the intensity and range of students' emotional responses stemming from their lack of confidence in math. She has proposed instead that the affective reactions associated with math anxiety arise from a complex interplay of social and personal factors and are primarily a joint function of low expectancies for success and high psychological cost associated with failure in mathematics. If students believe that they have low mathematics ability and that low achievement in math is undesirable, then a reasonable emotional response would be to feel uneasy or anxious about math and, as a means of reducing this anxiety, to avoid mathematics. Research on the modification of test anxiety has provided some support for this hypothesis. Interventions designed to alter students' perceptions of task difficulty have had a beneficial effect on the performance of test-anxious subjects (Sarason, 1972; Weiner and Schneider, 1971). However, whether these manipulations worked because they reduced anxiety or because they raised expectations is not clear.

Summary Comment Our model proposes that task value is an important mediator of achievement-related behaviors that interacts with expectancies to influence these behaviors. In this section, we have discussed a set of factors that might influence task value. Unfortunately, less systematic research has been done on task value than on expectancies. Consequently, this section has been more speculative than the preceding section on expectancies and related mediators.

EMPIRICAL STUDY OF PSYCHOLOGICAL COMPONENT

In the previous sections, we identified a set of constructs as critical psychological mediators of students' achievement behaviors, and we suggested a model of the interrelations among these constructs. This model is summarized in Figure 2-2a, and the translation of the model into the domain of mathematics is summarized in Figure 2-2b. The model suggests that students interpret the external reality to which they are exposed and form concepts of their abilities and opinions about both the difficulty and the importance of various activities based on these interpretations. Previous research in the area of achievement has suggested many of the critical variables specified in Figures 2-2a and 2-2b, but has not explored in any depth the nature of the relations among these variables. Our model was designed to fill this gap. What follows in this section is a description of the project now in progress and a summary of our initial findings.

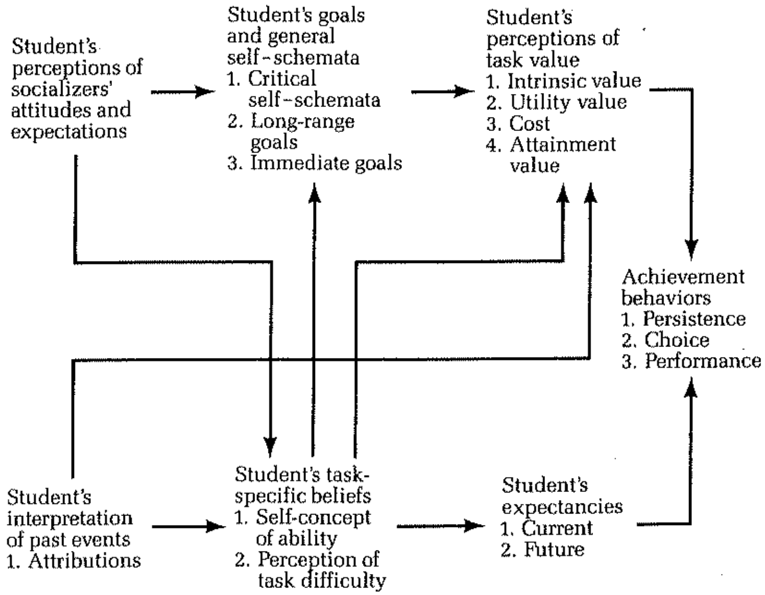

Figure 2-2(a)
Psychological model of achievement attitudes and behaviors.

As was discussed at the beginning of the chapter, the test of our model is being carried out as part of a larger study of the determinants of students', especially female students', decisions to enroll in advanced math courses. In keeping with this specific goal and with the tenets of our model, we administered specially developed measures of expectancies for success in current and advanced math courses, of perceived difficulty of current and future math courses, of self-concept of math ability, of attributional patterns for previous success and failure in math, of perceived interest value of math, of perceived utility value of math, of sex stereotyping of math, and of perceptions of the expectancies and values held by teachers and parents. In addition, we administered a test of sex-differentiating personality characteristics used in previous research on achievement.

Initial data collection took place in two waves during the years 1978 and 1979, designated as Year 1 and Year 2. The sample consisted of 668 students, in grades five through twelve, their parents, and their teachers. Data were collected in the following forms: student record data, student questionnnaires, parent questionnaires, teacher questionnaires, and classroom observations.

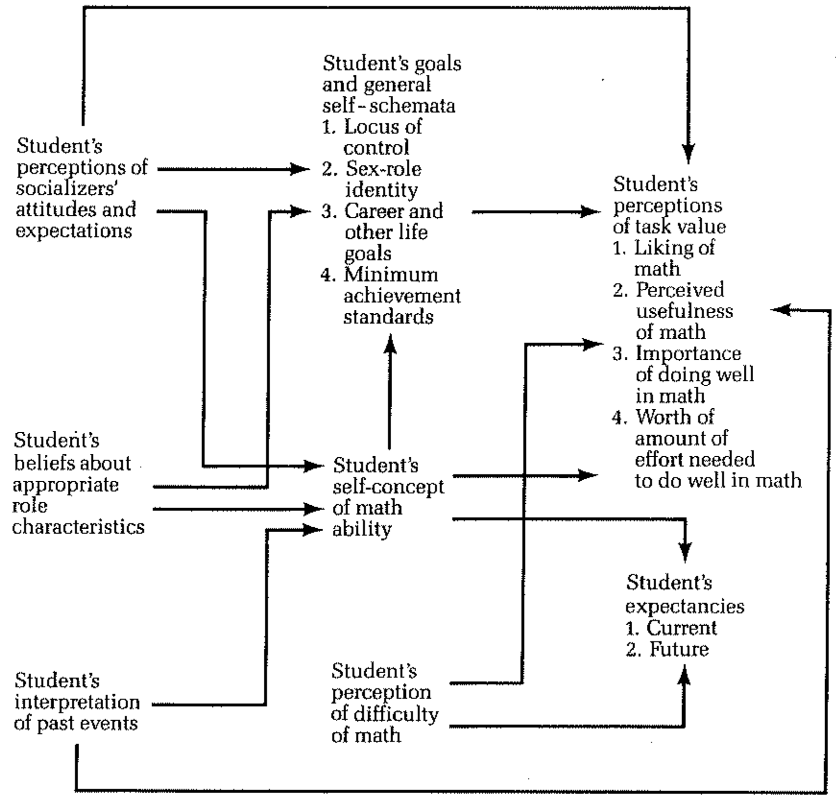

Figure 2-2(b)
Psychological model of mathematics attitudes and behaviors.

Data analysis proceeded in four distinct phases. Descriptive analyses comprised Phase 1. These analyses, in keeping with our interest in developmental trends and sex discrepancies, examined the distributions of variables in the sample as a whole as well as within each sex and within each grade level.

In Phase 2, bivariate and multivariate relations were examined. Correlation, regression, and single- and multiple-dimension contingency table analyses were used to assess relations among the variables and the relative importance of the student variables collected in Year 1 in predicting our major dependent variables: expectancies, values, course plans, and Year 2 math grades.

Phase 3 of analysis, that of model testing, integrated the knowledge obtained from prior analyses with our theoretical model in a test of the model's predictive power. The specific theoretical model tested is presented in Figure 2-2b. Multiple regression path analysis was the model-testing procedure used.

The final phase of our analysis involved the use of our longitudinal data to test causal hypotheses. The collection of data at two points in time strengthens one's ability to make inferences regarding the causal direction of correlational relations. We made use of cross-lagged panel analyses for these tests.

Descriptive Analyses

To assess the effects of year in school and sex on the student attitudinal variables, analyses of variance using year in school and sex as the independent variables were performed on each of the student scales. Table 2-1 summarizes the results of the analyses of variance for Year 1 and Year 2 separately. Effects significant at the .05 level or better are listed. Given the large number of analyses, one must be very cautious in interpreting the .05 probability findings. We call attention only to effects significant at the .01 level or better.

Sex Differences Few sex differences emerged, but those that did confirmed previous findings. Compared with the females, males rated math as easier and more useful, felt math required less effort, and had higher expectations for their performance in future math courses, even though these males and females had done equally well in their previous math courses and on previous standardized math aptitude/achievement tests. In addition, males in Year 2 rated their math abilities higher than did the females. Males and females did not differ in expectations for performance in the current mathematics course, in estimates of current performance, in perceptions of parents' estimates of both the difficulty of the current math courses and the students' math abilities, and in liking of current or previous mathematics activities.

When asked to recall a previous success and failure on a mathematics examination, males and females provided different attributions for their performances (tested with chi-square analyses, $p<.05$). In both years, males attributed failure to ability less frequently and success to ability more frequently than did females; in contrast, females attributed success more frequently to consistent effort than did males. These sex differences were especially marked among those students with the highest expectations for their own performances.

This pattern of sex differences suggests that males and females have different perceptions of both the task demands and the value of math courses. This difference may be sufficient to explain, in part, the sex differences in students' decisions about enrolling in advanced

math courses. For example, attributing one's success to constant effort rather than ability combined with the belief that future courses are more difficult, demanding even more effort, should reduce the likelihood of voluntary enrollment in advanced math courses, especially if there is some doubt about the value of the advanced math courses. Assuming that the amount of effort students can or are willing to expend has limits, perceptions of the need for greater effort would certainly have an adverse effect on their expectancies for future success in math and would predispose them against continuing to take math. Assuming that ability is not seen as a limited quantity like effort, the same dynamics would not apply to students who have attributed success to ability. Perceptions of increasing difficulty in math courses should not create concern over the effort needed to succeed if one believes ability is responsible for one's success.

Year in School Year-in-school effects were both more numerous and stronger than sex effects. In general, these effects indicate that students become more pessimistic and negative about math as they grow older. The older students had lower expectancies for both their current and future math performances, rated both their math abilities and math performances lower, saw both their present and future math courses as more difficult, thought their parents shared these pessimistic views of their abilities and performance potentials, were less interested in math activities in general, liked their math teachers less, and rated the utility of advanced math courses lower than the younger students did. For most of these variables, there was a consistent downward linear trend as a function of grade level, with the females preceding the males (see Figure 2-3).

General Differences Students in Year 1 rated math as more useful for males than for females. Students did not, however, rate males as having more math ability. The stereotyping of math as more useful for males (calculated by subtracting the usefulness-for-women score from the usefulness-for-men score; hereafter referred to as the stereotyping of math as a male domain) dropped from Year 1 to Year 2, due largely to an increase in the rating of the usefulness of math for women from Year 1 to Year 2.

In Year 2, the tenth- to twelfth-grade students were asked to rate the amount of encouragement to continue in math they had received from their fathers, mothers, last year's teachers, guidance counselors, older friends, siblings, and peers. Of these, fathers, mothers, and previous math teachers were perceived as having encouraged the students, while the other individuals were perceived as having neither encouraged nor discouraged the students. Contrary to the popular

Table 2-1
Summary of significant results from analyses of variance

Variables yielding significant sex effects	Effect	p[a]
Year 1		
Actual and required effort	F > M[b]	.01
Expectancies for future math courses	M > F[c]	.01
Difficulty of current math course	F > M	.01
Anticipated difficulty of future math	F > M	.01
Perception of task difficulty for self	F > M	.05
Stereotyping of math utility for females	M > F	.01
Femininity score on PAQ	F > M	.0001
Masculinity score on PAQ	M > F	.0001
Year 2		
Self-rating of math ability	M > F	.01
Expectancies for future math courses	M > F	.01
Expectancies for current math course	M > F	.04
Actual and required effort	F > M	.01
Utility of advanced math	M > F	.001
Utility of basic math	M > F	.01
Stereotyping of math utility for females	F > M	.05
Femininity score on PAQ	F > M	.0001
Masculinity score on PAQ	M > F	.0001

[a]Only F's with p <.05 are summarized.
[b]F > M = females greater than males.
[c]M > F = males greater than females.

belief that peer pressure prevents some females from enrolling in difficult academic subjects, peers were not rated as having a negative influence on the students' enrollment decisions. One sex difference did emerge: males, in comparison with females, felt that their counselors had provided more encouragement ($p<.05$). Perceived counselor encouragement did not, however, predict future course plans.

The students also rated the importance of various reasons in influencing their decisions to take math. Three reasons emerged as the most influential: (1) preparation for either a college major or a career, (2) gaining admission to a prestigious college, and (3) the importance of math in a well-rounded education. Intrinsic properties of math, such as its challenge, ease, or interest value, were seen as

Table 2-1 (continued)

Variables yielding significant grade effects	Effect	p[a]
Year 1		
Math aptitude score	O > Y[d,f]	.01
Self-concept of math ability	Y > O[e]	.001
Perception of task difficulty for self	O > Y	.0001
Perception of socializers' perception of math ability	Y > O	.0001
Perception of socializers' perception of task difficulty	O > Y	.01
Importance of math	5th > O[g]	.01
Expectancies for current math course	Y > O	.01
Difficulty of current math course	O > Y	.001
Utility of advanced math	Y > O	.001
Interest in and liking for math	Y > O	.01
Liking of teacher	Y > O	.01
Year 2		
Stereotyping of math utility for females	Y > O	.0001
Stereotyping of math utility for males	Y > O	.0001
Stereotyping of math ability	Y > O	.001
Self-concept of math ability	Y > O	.0001
Perception of socializers' perception of task difficulty	O > Y	.0001
Perception of socializers' perception of math ability	Y > O	.0001
Expectancies for current math course	Y > O	.001
Difficulty of current math course	O > Y	.001
Utility of advanced math	Y > O	.001
Interest in and liking for math	Y > O	.01
Liking of teacher	Y > O	.0001
Anticipated difficulty of future math	O > Y	.0001

[d]O > Y = linear trend increasing with age.
[e]Y > O = linear trend decreasing with age.
[f]Not calculated for Year 2.
[g]Fifth-graders were significantly higher than children in all other grades.

less important. Again one sex difference emerged: males rated the importance of future plans (college or career) in their decisions higher than did females ($p<.01$).

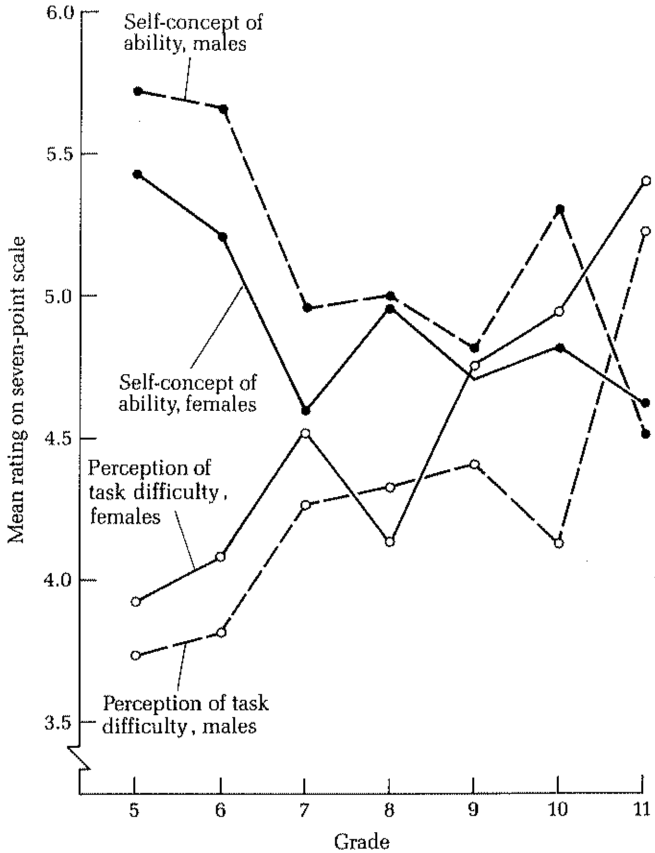

Figure 2-3
Developmental shifts in students' attitudes toward their own abilities and the difficulty of math.

Relational Analyses

Sex-Role Measures It has been suggested by a variety of scholars that sex differences in achievement behaviors are influenced by either the sex typing of the task or the sex-role identity of the individual or by some combination of these factors interacting with each other. Sex typing of mathematics is fairly easy to measure. Sex-role identity, on the other hand, is very difficult to conceptualize, much less to measure. We chose to focus instead on the relation of sex-related personality characters to mathematics achievement behaviors. Measures exist for these constructs, and several theoreticians have suggested the

importance of personality characteristics for achievement choices. For example, Hoffman (1972) has suggested that females' lesser goal-oriented, instrumental qualities and greater affiliative needs and expressive orientations lead them to have weaker achievement strivings and to be less self-confident than males about certain academic tasks. To determine the role of these personality variables, we decided to use a simplified version of the Personal Attributes Questionnaire (PAQ) (Spence, Helmreich, and Stapp, 1975), a self-report measure containing a "masculinity" scale that taps instrumental personality traits and a "femininity" scale that taps expressive, interpersonally oriented traits. As has been found by other investigators, males perceived themselves as higher in "masculine" instrumentality and lower in "feminine" expressiveness than did females.

To evaluate both sex-typed personality characteristics and the effects of the stereotyping of math as a male domain on mathematics attitudes and course enrollment plans, we correlated the students' rating of the usefulness of advanced math for both males and females, their perception of math as a male domain, their sex stereotyping of math ability, and their ratings of themselves on a simplified version of the PAQ with the other student measures. Expressiveness, as measured by the PAQ, was not related to any of the student measures. Instrumentality, on the other hand, related consistently and positively to measures of expectancy and self-concept of math ability for both males and females. These results are consistent with data reported in Chapter 1, this volume.

To test more directly for the combined effects of "masculine" instrumentality and "feminine" expressiveness, we classified students on their joint scores on the two PAQ scales, using the median split method outlined by Spence et al. (1975). These variables, along with a measure of the degree of stereotyping of math as a male domain (neutral, moderately masculine, or highly masculine) and sex of student, were entered as predictor variables into a series of multivariate contingency table analyses. Self-concept of math ability, concept of task difficulty, concept of the value of math, estimate of the utility of math for future goals, and current expectancies were the dependent measures in these analyses. Neither a student's personality classification nor her or his degree of stereotyping of math as a masculine domain had any significant influence on these dependent measures. These findings, in conjunction with the correlational findings reported above, suggest that it is *only* the responses to the instrumental items on the PAQ that are related to self-concept of ability.

These findings do not, however, invalidate the significance of a student's sex-role identity as an influence in course selection. What they suggest is that the link between androgynous and feminine personality structures and achievement-related behaviors is weak at best. In addition, our data do not support the popular notion that sex typing of subject matter as masculine acts as a deterrent to female achievement.

Self- and Task-Concept Measures To provide an initial test of our hypotheses regarding the relations among the student attitudinal items, we correlated Year 1 student attitudes with each other and with a composite score reflecting both past math grades and performance on either the California Achievement Test (CAT) or the Michigan Educational Assessment Program (MEAP), with their Year 2 math grades and with their plans to enroll in advanced math courses. A summary of these correlations is depicted in Table 2-2. Correlations for the sample as a whole and for females and males separately are listed.

As predicted, self-concept of ability was correlated positively with perceived value of math, with expectancies, with plans to continue in math, and with Year 2 math grades; self-concept of ability correlated negatively with ratings of task difficulty. Generally, these relations were true for both males and females. The relation of the math performance score (the composite score described above) to the other student measures varied, however, depending on the sex of the student. Measures of males' math performances were consistently related to their self-concept measures; the relations between the females' math-performance scores and their self-concept measures were neither as consistent nor as strong.

Model-Testing Analyses

Path Analysis Path analysis was used to provide a more direct test of the psychological components of our model (Duncan, 1966; Wright, 1934). Theoretical models like ours specify the direct and indirect relations among variables; i.e., they specify variables that mediate the relations found between other variables. For example, our model specifies that the variables reflecting students' interpretation of their achievements mediate the relation between their past performance and expectancies for future success. Path analysis is a statistical procedure, based on multiple regressions, that allows one to estimate both direct and indirect relations among a set of variables. Its use provides a test for the relations hypothesized to exist in a causal model like ours. To the extent that significant paths (the coefficient of the relation between the predictor variable and the criterion variable) emerge where predicted, support is provided for one's theoretical model. To the extent that predicted paths are nonsignificant, the support for one's theoretical model is weakened. The path coefficients are estimated using a series of multiple regression equations. We have standardized our coefficients, so that the size of the coefficients provides an estimate of the relative strength of the relations specified by each path. Since multiple regression is used, these relative strengths are totally dependent on the set of variables entered into the analysis and should not be taken as absolute estimates of any given relationship.[2]

Figure 2-4 represents the reduced path model, with only those paths that are significant at $p<.05$ included. The percent of variance of each variable accounted for by the variables on which it was regressed is listed as the R^2 under the variable. This percent is the multiple R^2 for each of the unique regression equations. It indicates the percent of variance of the criterion variables accounted for by all of the variables in the columns to the left of the criterion variable.

As predicted, intention to take more math was directly influenced by students' perceptions of the value of math. Contrary to our predictions, combined expectancies (current and future) had a nonsignificant relation to students' intentions to take more math. However, values and expectations, as predicted, were related to both students' self-concepts of math abilities and their estimates of their parents' and teachers' beliefs regarding the students' abilities. Math performance did not have a direct effect on students' plans, expectancies, self-concepts of math abilities, or estimates of the difficulty of math. Finally, stereotyping of math as a male domain increased the value of math.

Separate stepwise multiple regression equations were calculated to assess the predictive power of our Year 1 data for Year 2 math grades. (Path analysis was not repeated, since only the last step of the analysis had changed.) Self-concept of math ability and performance emerged as significant predictors for both males and females ($p<.02$). Perception of the value of math was also a significant predictor ($p<.03$) for males.

In summary, the path-analytic procedures used provided support for our model. The Year 1 variables included in the model explained 68–78%[3] of the variance in expectancies, 32–46% of the variance in

[2]Only those variables measured using interval scales and having significant zero-order correlations with the expectancy, value, or course-plan measure were used in these analyses. Path coefficients were calculated using a series of regression equations, with each variable regressed on the set of variables to its left (those theorized to have had a causal effect on it).

[3]The two values given represent the total percentage of variance accounted for by the two path analyses summarized in Figures 2-4 and 2-6.

Table 2-2
Zero-order correlation matrix of major student attitudinal and achievement variables

	Intention to take more math	Math grade: Year 1	Math grade: Year 2	Current and future expectancies in math	Perception of parents' aspirations	Perception of socializers' perception of task difficulty	Perception of socializers' perception of math ability	Self-concept of math ability	Perception of task difficulty	Value of math	Stereotyping of math as male domain	Masculinity score on PAQ
Intention to take more math	1.00											
Math grade: Year 1	.25** .23** .29**	1.00 1.00 1.00										
Math grade: Year 2	.11* .12 .10	.42** .29** .54**	1.00 1.00 1.00									
Current and future expectancies in math	.39** .46** .31**	.48** .39** .59**	.35** .27** .45**	1.00 1.00 1.00								
Perception of parents' aspirations	.14* .12 .18*	.04 −.07 .19*	.06 .08 .05	.38** .38** .38**	1.00 1.00 1.00							
Perception of socializers' perception of task difficulty	.17** .18* .16	−.36** −.35** −.38**	−.21** −.11 −.34**	−.44** −.42** −.46**	−.12* −.07 −.21*	1.00 1.00 1.00						
Perception of socializers' perception of math ability	.20** .22** .19*	.43** .38** .50**	.26** .16* .37**	.72** .69** .75**	.32** .25** .41**	−.46** −.51** −.39**	1.00 1.00 1.00					
Self-concept of math ability	.35** .40** .30**	.53** .46** .63**	.39** .29** .50**	.93** .92** .94**	.33** .31** .36**	−.53** −.53** −.54**	.76** .77** .74**	1.00 1.00 1.00				
Perception of task difficulty	.05 .07 .04	−.31** −.25** −.38**	−.21** −.10 −.34**	−.45** −.45** −.43**	−.14* −.07 −.25**	.59** .53** .67**	−.41** −.50** −.29**	−.64** −.67** −.59**	1.00 1.00 1.00			
Value of math	.52** .55** .49**	.23** .11 .40**	.11* .07 .18*	.59** .55** .66**	.35** .30** .43**	−.19** −.18* −.19*	.42** .34** .54**	.53** .49** .59**	−.09 −.05 −.12	1.00 1.00 1.00		
Stereotyping of math as male domain	.22** .30* .11	.04 .02 .04	.09 .12 .06	.24** .30** .20*	.17** .18* .18*	.02 −.08 .15	.18** .21** .15	.19** .24** .16	.10 .08 .10	.51** .58** .43**	1.00 1.00 1.00	
Masculinity score on PAQ	.20** .28** .10	.10 .12 .12	.12* .10 .17	.34** .38** .26**	.14* .12 .14	−.03 .01 −.07	.19** .16 .22*	.29** .30** .24**	−.03 −.03 .05	.21** .28** .06	.10 .24** −.03	
Past math performance	.25** .27** .24**	.65** .60** .70**	.40** .28** .52**	.39** .29** .52**	−.02 −.11 .09	−.18** −.11 −.26**	.25** .17 .33**	.41** .31** .52**	−.27** −.21* −.34**	.18** .06 .33**	.09 .02 .17	.08 .18* −.00

Notes: Within each row, there are three sets of correlations: the top set contains the correlation for all subjects; the middle set, the correlation for females; the bottom set, the correlation for males.

Boxed correlations contain a set of correlations in which the male and female correlations differ p<.05.

*p<.05.

**p<.01.

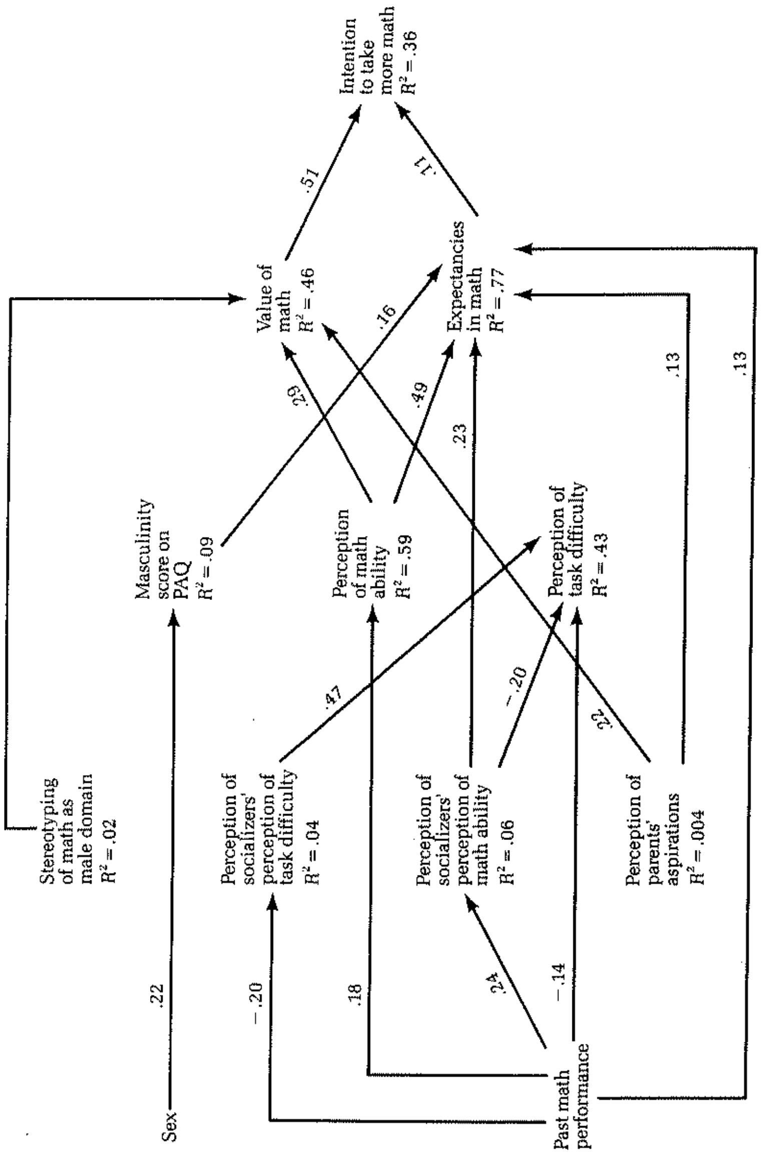

Figure 2-4
Student attitudinal variables: Year 1. All paths significant at $p < .05$, except the path from expectancies to intention to take more math, for which p = .31; N = 286; standardized beta weights are shown on path; R^2 = percent of variance accounted for on each criterion measure by all preceding predictor variables; each R^2 is listed under its criterion measure.

task value, 32–36% of the variance in course plans, and 13% (females)–40% (males)[4] of the variance in Year 2 math grades. In general, the predicted relations between the variables also emerged as significant paths. The path analysis also demonstrated that we can predict variation in expectancies better than we can predict variation in task value. Further conceptual work on the determinants of task value is needed. Interestingly, task value is the major predictor of plans to enroll in math, while self-concept of ability is the major predictor of subsequent grades. These data suggest that one's perception of the value of an activity is more important in determining one's decision to engage in that activity, while one's self-concept of ability is more important in determining one's actual performance once involved in the activity.

In summary, our model of the interrelations among these student achievement attitudes at one period of time provides a good representation of the data, especially for high school students. But how do these attitudes influence each other in the process of development? It is to this question that we now turn.

Longitudinal Analyses

Longitudinal data allow for more refined assessment of causal relations in correlational data sets. We used cross-lagged panel analyses for this purpose. Cross-lagged panel correlation (CLPC) is a technique used in evaluating evidence for causal inference (Kenny, 1975). The CLPC program examines correlations between pairs of variables collected at a minimum of two points in time. Significant differences between the values of the cross-lagged correlations (rx_1y_2 and rx_2y_1) suggest that one variable of the pair is causally dependent on the other. Using these analyses, we can infer the more probable causal direction in a correlational relation. The results of these analyses are given in Table 2-3.

In support of our predictions, future expectancy appears to be influenced by self-concept of ability and perceptions of task difficulty; self-concept of ability appears to be influenced by perceptions of task difficulty and of the amount of effort needed to do well; both the utility value and the intrinsic value of math appear to be influenced by perceptions of the worth of the effort needed to do well; one's estimate of the difficulty of future math courses appears to be influenced by one's perceptions of the estimates of future difficulty held by parents and teachers.

[4]These figures are based on the two stepwise multiple regression analyses reported above.

Table 2-3
Causal effects from cross-lagged panel analyses

Year 1	Effect	Year 2
Current math ability	→	Future expectancies
Difficulty of current math course	(−) →	Future expectancies
Worth of effort needed to do well	→	Future expectancies
Current expectancies	→	Perception of socializers' perceptions of math ability
Self-concept of math ability	→	Perception of socializers' perceptions of math ability
Difficulty of current math course	(−) →	Perception of socializers' perceptions of math ability
Actual and required effort	(−) →	Perception of socializers' perceptions of math ability
Estimated performance in math	→	Perception of socializers' perceptions of math ability
Difficulty of current math course	(−) →	Self-concept of math ability
Actual and required effort	(−) →	Self-concept of math ability
Difficulty of current math course	(−) →	Estimated performance in math
Difficulty of current math course	(−) →	Worth of effort needed to do well
Perception of socializers' perceptions of task difficulty	→	Difficulty of future math courses
Worth of effort needed to do well	→	Utility of math
Difficulty of future math courses	(−) →	Interest in and liking for math
Worth of effort needed to do well	→	Interest in and liking for math

Note: All causal effects lead to increases in Year 2 variables except where indicated by negative (−) sign, which indicates a causal effect leading to decrease in Year 2 variables.

Contrary to our predictions, perceptions of parents' and teachers' estimates of students' abilities did not have a causal influence on students' self-concepts or task variables. Instead, self-concept variables and perceptions of task difficulty appear to influence students' perceptions of the attitudes of parents and teachers. These latter results are consistent with the findings of Calsyn and Kenny (1977), who also found that students' self-concepts influenced their perceptions of others' opinions, rather than the reverse.

Summary Comment

What can we conclude from these results? These analyses provide reasonable preliminary support for our model. It is clear that self-concepts of ability and subjective task value are important mediators of achievement behavior. Furthermore, both the path-analytic results

and the CLPC results indicate that we understand the determinants of self-concept of ability and expectancies better than we understand the determinants of task value. This could, however, be a consequence of the measures we used in these analyses. Since not all measures hypothesized to predict value were measured with ordinal scales, some important variables were not included in these analyses. For example, neither attributions nor math-anxiety measures were included.

With regard to sex differences, no single variable emerged as the critical mediator of sex-differentiated math achievement behaviors. Course plans and actual achievement in math are mediated by a complex set of interrelations for both males and females. While males and females do not differ greatly on any one variable, there are small but consistent sex differences on several of the important mediators: namely, self-concept of ability; expectancy (especially expectancy for future courses); perception of task difficulty; and attributions of success and failure to ability. In combination, these variables could mediate differential achievement behaviors. It should be noted, however, that we did not find sex differences in either course plans or grades. Whether actual enrollment differs by sex in this sample will require two more years of followup data. Nonetheless, the sex differences in achievement attitudes themselves are important phenomena to be studied, since these attitudes do play a significant role in future course plans and actual achievement and since we know, from national samples, that males and females differ in both course enrollment patterns and grades once they reach college.

One additional important sex difference emerged. Females' grades did not relate as highly to their attitudes and past performances as did males'. It has been speculated that females' expectations are more closely tied to their grades than are males' (Crandall, 1969). These data suggest just the opposite. Why this might be true is not apparent in this data set. Since the bulk of our sample was junior high school students, perhaps these results reflect the emergence of the conflict between social roles and achievement in the females. If this were true, then one would predict that females' school performance would be coming under the influence of variables we have not measured and would appear more erratic throughout this developmental period.

DEVELOPMENTAL COMPONENT OF ACHIEVEMENT MODEL

Developmental hypotheses comprise the second component of our model. Many theorists have suggested the important contributions of both parents and teachers to individual differences in children's concepts of their abilities, perceptions of task difficulty, expectancies, and values. The following three mechanisms of influence have emerged with some regularity in developmental research: (1) role modeling, (2) parent and teacher expectations, and (3) the shaping of activities through reinforcement and the provision of toys, clothes, and other experiences. The possible role of each of these processes in shaping students' achievement behaviors and attitudes is discussed in the following sections.

Socialization Effects of Role Modeling

Experimental research has established the importance of adult behavior as a standard or model for children's behavior. The process of "observational learning" is presumed to account for the efficiency with which children adopt social norms, particularly those associated with adult and sex-appropriate qualities of behavior (Bandura and Walters, 1963).

The effects of role modeling have received some attention in the literature on math achievement. For example, Ernest (1976) has reported that fathers are more likely to help their children with math homework than are mothers after the sixth grade; Fox (1977) has reported a tendency for more advanced math courses to be taught by males. This underrepresentation of appropriate female role models in math has been suggested as one reason for the underrepresentation of females in math courses.

Effects of Socializers' Expectations

Several studies have indicated that the expectations of socializers regarding a student's performance can influence actual performance (Brophy and Good, 1974; Rosenthal and Rosnow, 1969). The role of teacher expectancies in the formation of students' achievement expectancies and behaviors has been particularly well documented (Brophy and Good, 1974; Cooper, 1979). Similarly, throughout the achievement literature, parental expectancies have been linked to both high achievement motivation and high achievement behavior (e.g., Crandall, 1969; Parsons et al., 1976b; Winterbottom, 1958).

If expectancies of others mediate behavior, then the degree to which socializers hold differential expectancies for males' and females' performances in various achievement activities is an important factor to consider in understanding the origin of sex differences in achievement-related behaviors. Several studies have suggested that, in general, parents and teachers have higher educational expectancies for males than for females (e.g., Good, Sikes, and Brophy, 1973; Hilton and Berglund, 1974; Sears, Maccoby, and Levin, 1957), although these

biases do not emerge consistently until students are older. In fact, during the elementary school years, parents and teachers generally expect females to do better than males (e.g., Maccoby and Jacklin, 1974). It is not until high school that teachers tend to express higher expectancies of academic performance for males than for females (Cooper, 1976; Good, Sikes, and Brophy, 1973).

Thus, while there is support for the suggestion that socializers hold differential achievement and performance expectancies for males and females, it is less clear how these expectancies are conveyed to students. There are undoubtedly a variety of indirect and direct means by which students learn what others expect of them. The nature of the evaluative feedback students receive about their academic performances and the causal attributions provided for students are two means that have received considerable recent attention.

Evaluative Feedback One line of research assessing the impact of evaluative feedback has examined the overall pattern of feedback students receive in response to their achievement efforts. In a comprehensive review of the literature on teacher expectancies, Brophy and Good (1974) have identified several teacher behaviors (e.g., praise for good performance, criticism for bad performance, and student questioning patterns) that are related to students' expectancies and achievement. Additionally, Brophy and Good have found that teachers vary their use of evaluative feedback depending on characteristics of the student; in particular, high-potential males are more likely than females to receive reinforcement for their achievements.

Taking a slightly different tack, Dweck and her colleagues have suggested that it is the pattern of discriminate and indiscriminate feedback, rather than the absolute frequency of praise or criticism, that is the key determinant of sex differences found in students' achievement expectancies. Dweck, Davidson, Nelson, and Enna (1978) have argued that evaluative feedback has meaning to children only when it has been associated discriminately with the intellectual quality of their academic work. Thus, if teachers criticize males for both their work and their conduct, then negative feedback should lose its meaning for males and have relatively little effect on their achievement expectancies and performances. In contrast, if teachers criticize females primarily for their work, then negative feedback should have more meaning for females and, consequently, have a greater impact on them than on males. The main feature of this argument is that it is not the frequency of criticism or praise per se that is critical, but rather the ratio of discriminate to indiscriminate use. In fact, this is exactly what Dweck and her co-workers found. The teachers in their study used more indiscriminate criticism with males, addressing two-thirds of the total negative evaluation for males to intellectually irrelevant aspects of their academic performances. By comparison, over two-thirds of the negative evaluation of females was directed to the academic quality of their work. Extending this argument to the issue of more general individual differences, one would predict that the pattern of evaluative feedback received by a student would influence his or her expectancies. While this hypothesis has not been tested in the field, Dweck and her colleagues found support for the prediction in a laboratory simulation in which evaluative feedback was manipulated and self-expectancies served as the dependent measure.

Causal Attributions In addition to patterns of feedback, socializers may vary in the causal explanations they provide students. Parents, teachers, and peers have ample opportunity to provide explanations like "You must have tried very hard," "You're really smart," or "Maybe this is too hard for you" for students' successes or failures. These explanations could influence students' self-perceptions in at least two ways. First, various causal explanations convey different information regarding the expectations parents and teachers have for the student. For example, attributing a student's failure to illness or insufficient effort tells the student that he or she can do the task. Conversely, attributing a student's success to hard work may inadvertently convey the message that the parent or teacher does not really think the student is very smart. Second, the attributions of parents and teachers could influence students' self-perceptions through the mechanisms associated with role modeling. Parents and teachers provide students with a model of relevant attributions that they may incorporate into their own attributional systems. For example, by attributing a student's failure to lack of effort, parents or teachers may be encouraging the student to attribute her or his failure to an unstable characteristic (i.e., to lack of effort or bad mood) and consequently may be discouraging the incorporation of failure experiences into the student's self-concept. In contrast, by attributing a student's failure to lack of ability or by overlooking or agreeing with a student's attribution of her or his failure to lack of ability, parents or teachers may be encouraging both a low expectancy attributional pattern and the incorporation of failure information into the student's self-concept. Indirect support for these hypotheses comes from experiments showing that, in general, people tend to attribute men's successful performances to their abilities and women's to hard work (Deaux and Emswiller, 1974; Etaugh and Brown, 1975; Feldman-Summers and Kiesler, 1974).

Differential Experiences

In addition to these more direct effects, parents and/or teachers could be influencing students' choices, self-concepts, and values by the

types of general experiences they provide or encourage. Three types of experiences seem especially important. The first is the types of role models to which the student is exposed. The types of toys and recreational activities and the independence training the child receives are the other two. Each of these types of experiences has yielded rich theoretical discussion and some empirical study. For example, both Hoffman (1972) and Astin (1969) have suggested that males receive earlier independence training that do females, resulting in differentiated achievement patterns. Similarly, much of the thinking in role theory points to the importance of societal models in the formation of both self-concept and values.

Connor, Schackman, and Serbin (1978) have studied the impact of toys on spatial skills. They have suggested that "masculine" toys such as big wheels or large blocks encourage the development of spatial abilities in males, while "feminine" toys such as dolls fail to stimulate this skill in females. To support their hypothesis, they designed an intervention procedure for the preschool years that relied on exposure to certain "masculine" toys and other typically male play activities. Exposure to these activities produced an improvement in females' spatial skills. Since there is ample evidence that males and females are provided with sex-typed toys and develop an early preference for them, Connor and co-workers concluded their research report with the suggestion that socializers, especially parents, are not providing females with the necessary experiences for spatial skill acquisition.

Sex typing of toys and sports activities may also be creating deficits in females' experiences that impact on their subsequent achievement behaviors. For example, sex-differentiated participation in competitive sports programs during the elementary school years might be linked to later sex differences in response to failure experiences (e.g., Hennig and Jardim, 1976). Most bright females are exposed to few failure experiences in school. Consequently, they have little opportunity to experience public failure and to gain the knowledge that failure is often followed by continued social acceptance and by improvement in subsequent encounters. Bright males, on the other hand, are provided such opportunities if they play in organized competitive sports.

Summary Comment

We have argued in this section that parents and teachers influence students' achievement attitudes and behaviors through at least three processes: role modeling, communication of expectancies, and provision of differential experiences. Since their effects as role models and as expectancy socializers are assumed to be directly related to students' current achievement attitudes, we have chosen to focus on these two aspects of socialization in our study of math attitudes and behavior. It is to this part of our study that we now turn. The model guiding this portion of our research is depicted in Figure 2-5a; its specifications for the math study are depicted in Figure 2-5b.

EMPIRICAL STUDY OF DEVELOPMENTAL COMPONENT

To assess the developmental component of our model, we included in the study the parents and teachers of our student subjects and targeted the following sets of parent variables for study:

1. Parents as role models (assessed using measures of self-concept of ability, perceived task difficulty, perceived utility and intrinsic value of math, and estimates of amount of current use of math).

2. Parents as expectancy socializers (assessed using measures of parents' estimates of the following: their children's math abilities, the difficulty of math for their children, their children's liking for math, and their attributions for their children's math performances).

3. Parents as experience providers (assessed using measures of how important parents think it is that their children do well in and take math and how much encouragement in math they have given or planned to give their children).

To assess the impact of teachers as socializers, we made structured observations in classrooms and gave the teachers a brief questionnaire concerning each student. We identified the following teacher variables for study:

1. Teachers as reinforcers (assessed by using the amount of praise and criticism, pattern of praise and criticism, and frequency and type of teacher–student interaction).

2. Teachers as attitude socializers (assessed using public expectancy statements, public attributional statements, public responses to student errors, and written expectancies for and assessments of the relative abilities of students taken from the teacher questionnaire).

Teacher Effects

The effects of teachers' expectancies on their students' performance have been studied extensively since the publication of Rosenthal and Jacobson's *Pygmalion in the Classroom* (1968). Based on the studies of Brophy and Good (1974) and Dweck et al. (1978), we made the

following hypotheses regarding the relation between teacher behaviors and student achievement attitudes:

1. Teachers' behaviors influence students' expectancies for success.

2. Teachers treat differently students for whom they have high versus low expectations.

3. Males receive more indiscriminate criticism (criticism toward both the quality and the form of their academic work and toward their conduct) than do females.

4. Females receive more discriminate criticism (criticism directed only to the quality of their work) and more indiscriminate praise than do males.

5. Teachers are more likely to attribute males' mistakes to lack of effort than they are females' mistakes.

These predictions were tested with analyses of variance using the classroom as the unit of analysis (Heller, 1978).

Few significant effects emerged from our analysis, and none of our hypotheses was supported as stated. There were significant sex effects on teachers' use of evaluation feedback: females received less work-related criticism than did males. In addition, teachers' expectancies, measured by the teacher questionnaire, were predictive of student expectancies, even when the effects of the students' past performances in math classes and on standardized tests were partialed out (partial $r = .26$).

Contrary to our predictions, however, teachers did not give more positive feedback to students in the high-expectancy group, and males and females did not differ in the amount of discriminate and indiscriminate praise and criticism they received for the quality or form of their work or for their conduct. In addition, teachers made similar attributions for males and females. Thus, no support was found for the suggestions of Dweck et al. (1978). Further, in a series of stepwise regression analyses, classroom observational measures did not emerge as significant predictors of student attitudinal variables. Thus, while the proposed relations between teachers' expectancies and students' expectancies were supported, the mediating effects of observational variables on expectancies were not demonstrated, suggesting that teacher behaviors in general have little effect on students' achievement-related attitudes (for full details, see Heller, 1978; Parsons, Kaczala, and Meece, 1982).

The analyses reported thus far were performed on the entire sample. It is possible that the effects of classroom behaviors are dependent on teacher style. For example, some teachers may treat males

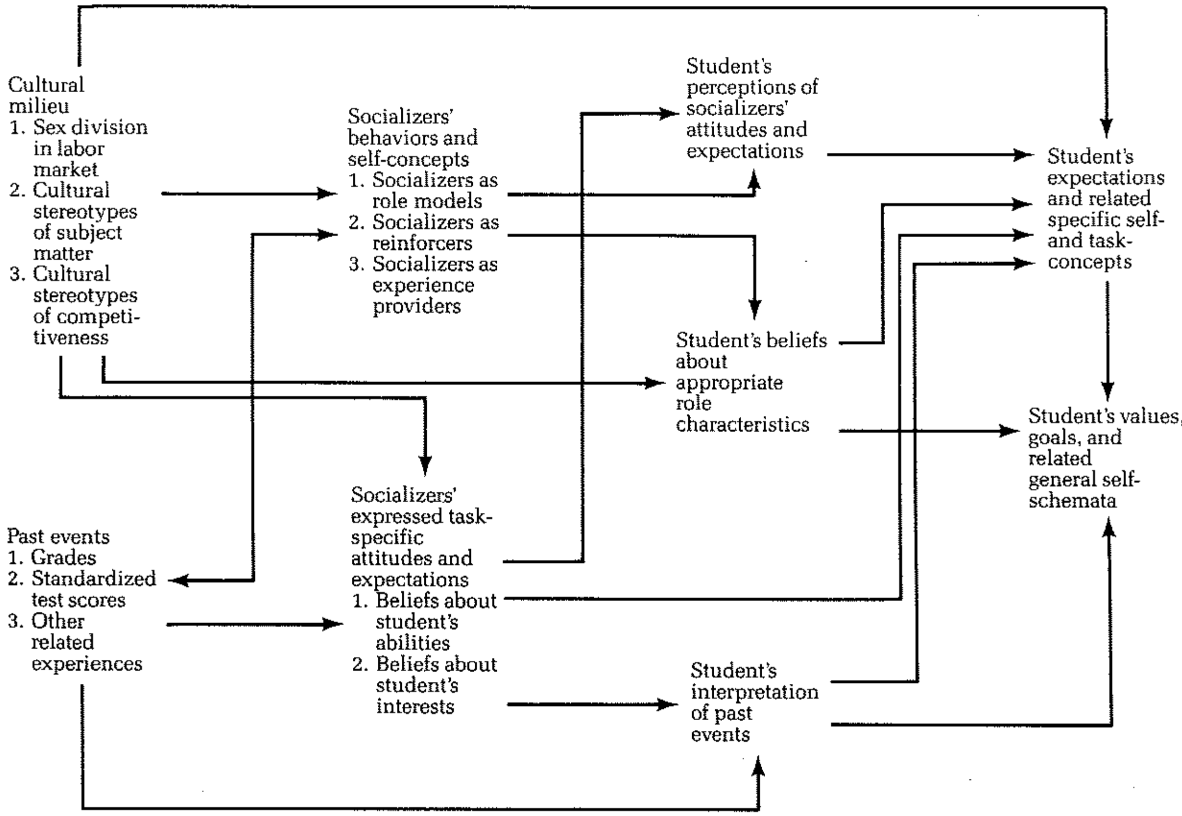

Figure 2-5(a)
Socialization model of achievement attitudes and behaviors.

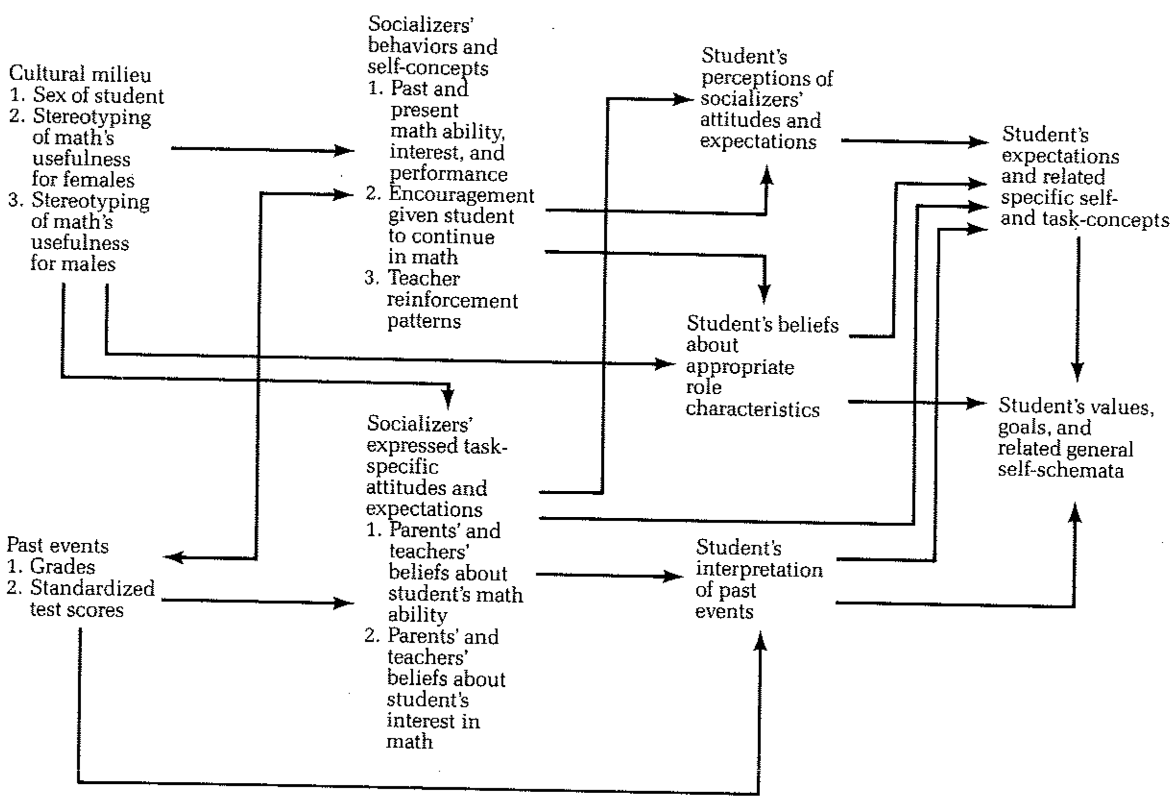

Figure 2-5(b)
Socialization model of mathematics attitudes and behaviors.

and females differently, while others may not. By collapsing across all of our teachers, these effects would have been masked. To explore this possibility, we selected from the sample the five classrooms with the largest sex differences in the students' self-reported expectancies and the five classrooms with no significant sex differences in expectancies. Then we reanalyzed the data using raw frequency scores (instead of the standardized scores used in the previous analysis) to allow for classroom comparisons (see Parsons, Kaczala, and Meece, 1982, for full details).

As was true for the previous analyses, most variables did not yield significant differences. None of the variables predicted by Dweck's model yielded classroom-type effects. Those effects that were significant were divided into three types:

1. Behaviors characteristic of teacher style (teacher behaviors under primary control of the teacher, e.g., use of praise following a correct answer).

2. Behaviors characteristic of student style (behaviors under primary control of the student, e.g., student-initiated dyadic interactions).

3. Behaviors dependent on both teacher and student style (behaviors requiring interactive responses of both the teacher and the student, e.g., total dyadics).

There were significant differences in the classroom dynamics observed in these two types of classrooms. Teachers in high sex-differentiated classrooms were more critical, were more likely to use a public teaching style and less likely to rely on private dyadic interactions, and were more likely to rely on student volunteers for answers rather than directing the class participation by calling on specific students ($p<.05$ in each case).

Table 2-4 summarizes the effects of student sex on classroom interactions as a function of classroom type. Females interacted more, received more praise, and had higher expectancies in the low sex-differentiated classrooms. Males, on the other hand, interacted more and received more praise in the high sex-differentiated classrooms and yet had similar expectancies across the two types of classrooms.

These data suggest that teacher praise is facilitative of females' expectancies for success in math. To test this hypothesis, we correlated teacher praise and the other teacher-style variables that discriminated the low from the high sex-differentiated classrooms with the following student attitudinal variables: future expectancies, current expectancies, self-concept of ability, interest in math, plans to continue in math, utility of advanced math, and ratings of the difficulty of present and future math courses. Few correlations were significant.

Table 2-4
Sex by classroom type: mean frequency per student per class period

	Classroom type			
	Low difference		High difference	
Behavior	Females	Males	Females	Males
Teacher-style behaviors				
Response opportunities yielding praise[a,b]	.043	.013[c]	.045	.085[c,d]
Total work praise[b]	.099	.032[c]	.066	.121[c,d]
Conduct criticism[a]	.089	.141	.179[d]	.274[d]
Teacher-initiated dyadics[a]	.094	.092	.035	.046
Total criticism[a]	.110	.164	.196	.334
Student-style behaviors				
Student-initiated interactions[b,e]	1.51	.61[c]	1.01	1.23[d]
Student-initiated dyadics[a]	.590	.375	.227	.329
Expectancies[f]	5.08	5.17	4.41[d]	5.24[c]
Joint-style behaviors				
Total response opportunities[a,b]	.536	.188[c]	.471	.842[c,d]
Total dyadics[a]	.684	.467[c]	.312[d]	.375[d]
Open questions[a,b]	.314	.017[c]	.271	.499[c,d]
Total interaction[b]	1.76	.80[c]	1.20[d]	1.52[d]

[a]Classroom type main effect significant: $p<.05$.
[b]Sex by classroom type interaction significant: $p<.05$.
[c]Sex differences within classroom type significant: $p<.05$.
[d]Classroom type effect within sex grouping significant: $p<.05$.
[e]Sex main effect significant: $p<.05$.
[f]Scored on a seven-point scale with 7 = highest expectancies.
Source: Parsons, Kaczala, and Meece (1982).

Teachers' expectancies as measured on the teacher questionnaire had the largest number of significant effects. However, the number of response opportunities and the number of open questions were positively and consistently related to how much students liked math.

We next divided the sample into two additional groups: those students for whom the teacher had high expectancies ("high" students), and those students for whom the teacher had low expectancies ("low" students). The results of these analyses are summarized in Table 2-5.

In general, we found that both high males and high females were

Table 2-5
Sex by classroom type by teacher expectancies[a]

	Low difference				High difference				
	Low teacher expectancy		High teacher expectancy		Low teacher expectancy		High teacher expectancy		
	Females	Males	Females	Males	Females	Males	Females	Males	Grand mean
Teacher-style behaviors									
Praise during response opportunities	.03	$.02^{x}$	.05	$.01^{x}$	$.11^{Y}$	$.02^{x}$	$.01^{x,y}$	$.12^{X}$	.05
Total praise for work	.08	$.02^{x}$	.12	$.04^{x}$	.14	.05	$.02^{x}$	$.17^{X}$	.08
Student-style behaviors									
Student-initiated procedure questions	$.05^{x}$	$.02^{x}$	$.09^{x}$	$.04^{x}$	$.24^{X}$	$.02^{x}$	$.03^{x}$	$.05^{x}$	.07
Student-initiated interactions	1.0	$.69^{x}$	1.9^{X}	$.56^{x,y}$	1.6^{Y}	$.88^{x}$	$.61^{x,y}$	1.4	1.1
Expectancies[b]	4.95^{N}	4.98	5.28^{M}	5.53	3.4^{n}	4.48^{N}	4.70^{m}	5.58^{M}	
Joint-style behaviors									
Open questions	.15	$.03^{x}$	.48	$.01^{x}$	.42	.28	.16	$.63^{X}$	.27
Response opportunities	$.32^{x}$	$.24^{x}$	.75	$.15^{x}$	.75	.50	$.29^{x}$	1.1^{X}	.51
Total interactions	1.23	1.00^{x}	2.15^{X}	$.67^{x,y}$	1.85^{Y}	1.15	$.76^{x,y}$	1.75^{Y}	1.33

Notes: Within each row, a capital letter (X, Y, Z) signifies a mean that is significantly greater than all means superscripted with a corresponding lowercase letter (x, y, z); significant differences were determined using Tukey's HSD, $p<.01$.
M, N and m, n: significant differences were determined using a priori t-tests at $p<.03$.
[a]All 3-way interaction terms significant: $p<.01$.
[b]Student questionnaire item; scale 1–7, 7 = highest.
Source: Parsons, Kaczala, and Meece (1982).

treated differently in each of the two classroom types. High females interacted the most, answered more questions, and received more praise for work and form and less criticism in the low sex-differentiated classrooms. In contrast, high males were accorded the most praise and interacted the most in the high sex-differentiated classrooms. High females in the high sex-differentiated classrooms were accorded less praise than most of the other eight student groups selected for comparison.

Since high females were treated so differently in these two classroom types, we did the correlational analyses outlined above separately for the samples of high and low females. For high females only, amounts of both praise and work criticism were predictive of perceptions of current and future math difficulty, and the total number of teacher-initiated interactions was predictive of both perceptions of future difficulty and plans to continue taking math. Apparently, high females who have a large number of teacher-initiated interactions followed by either praise or criticism see math as easier, and high females who have a large number of teacher-initiated interactions, regardless of the nature of the feedback, are more likely to plan to continue taking math.

Before concluding this discussion of teacher effects, three additional points are important to stress. First, the frequency rates of all these interactive variables were quite low. Second, interactional variables were not as predictive of students' expectancies as were other variables we measured, e.g., student sex and teacher expectancies. Third, the effects of classroom type may be mediated by the general social climate in the classroom rather than by the direct effects of one-to-one teacher–student interactions. Social climate is a function of both the teacher and the set of students in each particular class. Consequently, while classroom interactions may be having an effect on students' expectancies, the effects are not large and may be as much a function of the students as of the teachers.

Parent Effects

It was hypothesized that parents influence their children's achievement behaviors in two ways: through their roles as models, and through their roles as expectancy and value socializers. Tests of both of these hypotheses are discussed in this section.

Important models, especially parents, exhibit behaviors that children come to imitate and later adopt as part of their own behavioral repertoires. If mothers exhibit different behavior patterns than do fathers, then, it has been argued, females and males will acquire sex-differentiated behavioral patterns. With regard to math expectancies, it has been hypothesized that females exhibit more math avoidance and have lower math expectancies than do males because mothers are more likely than fathers to exhibit math-avoidance behaviors. To test this hypothesis, we compared the mathematics-relevant self-concepts of the mothers and fathers in our sample.

In comparison to mothers' self-evaluation responses, fathers' self-evaluations indicated that they felt that they were and always had been better at math, that math was and always had been easier for them, that they needed to expend less effort to do well at math, that they had always enjoyed math more, and that math had always been more useful and important to them. In sum, fathers had a more positive attitude toward math and had a more positive self-concept regarding their math abilities than mothers had. What is more, we found that these sex-differentiated beliefs were specific to math. Consistent with the fact that females on the average outperform males in school, mothers rated their general high school performances higher than did fathers (Parsons, Adler, and Kaczala, 1982).

In line with the modeling hypothesis, one might conclude at this point that we had identified a major cause of sex-differentiated math self-concepts. Males and females differ because their fathers and mothers differ. But one needs to demonstrate a relation between parents' behaviors and children's beliefs before this conclusion is justified. To test the modeling hypothesis more directly, we correlated the parents' self-concept variables with the children's responses to the student questionnaire and to their past-performance scale. None of the more than 100 correlations was significant. Thus, while parents' self-concepts do differ in the predicted direction, the influence of these differences on their children's math self-concepts is minimal.

The second hypothesized source of influence is the parents' expressed beliefs about either the math abilities of their children or the importance of math for their children. To assess the effects of this source, we compared the responses of parents of males and parents of females to questions regarding their perceptions of their children's math abilities, interests, and efforts, their expectancies for their children's future performances in math, and their perceptions of the relative importance of a variety of courses.

The sex of the child had a definite effect on parents' perceptions of their children's math abilities and on the parents' perceptions of the relative importance of various high school courses. While parents did not rate their daughters' math abilities significantly lower than their sons', they did think that math was more difficult for their daughters and that their daughters had to work harder to do well in math. Further, fathers exhibited more frequent sex-differentiated responses than did mothers (Parsons, Adler, and Kaczala, 1982).

That parents feel their daughters have to try harder to do well in math is of particular interest, given both our previous findings and a common finding in the attribution literature. As reported earlier, we found that females think they have to try harder than males to do well in math. Furthermore, on an experimental task, females actually rated their efforts as greater, even though an objective measure of effort did not reveal a sex difference (Parsons, 1978). Interestingly, women have been shown to attribute their success more to effort than do men (Frieze, Fisher, Hanusa, McHugh, and Valle, 1978). Taken together, these findings suggest that females *think* they have to try harder than males to receive a good grade. Our data suggest that parents are reinforcing this tendency. Whether parents initiate the bias or merely echo it is not clear, but they certainly are not providing their daughters with a counterinterpretation.

Is it necessarily harmful that both daughters and their parents think that females have to try harder to do well in math? It has been argued in the attribution literature that because attributions to effort do not contribute to a stable notion of one's ability in a particular domain, attributing one's success to effort is not as ego-enhancing as attributing it to ability. Attributing one's success to effort may also leave doubt about one's future performance on increasingly difficult tasks. If one is having to try very hard to do well now and one expects next year's math course to be even harder, one may not expect to do as well next year. In support of this suggestion, we found that perception of one's current effort is negatively correlated with both future expectancies and with estimates of one's ability and positively correlated with the perceived difficulty of the task ($p<.05$ in each case). If we add to this dynamic the fact that both daughters and their parents think that continuing math is less important for them than do sons and their parents, then a cognitive set emerges that certainly could produce a lower tendency in females to continue in advanced math courses.

Are these parental beliefs about their children's abilities and plans predictive of future math expectancies and future course plans? To answer this question, we correlated the major parent and child variables. The correlations are summarized in Table 2-6. Since the patterns of correlations were essentially the same for males and females, only the results from the entire sample will be discussed.

Children's plans, future expectancies, current expectancies, and perceptions of the importance and value of math were related consistently in the predicted direction to measures of their perceptions of their parents' beliefs and expectancies and to the parents' actual estimates of their children's abilities. Parents' beliefs about their children's abilities to do well in math were predictive of their children's

Table 2-6
Zero-order correlation of mother's and father's attitudes toward child and child's attitudes and perceptions of parents' attitudes

	Past math performance	Intention to take more math	Current expectancies in math	Future expectancies in math	Self-concept of math ability	Perception of task difficulty	Value of math	Perception of parents' perception of math ability	Perception of parents' expectancies	Perception of parents' perception of task difficulty	Perception of parents' aspirations
Mother's attitudes											
Perception of importance of math	.41**	.35**	.41**	.44**	.46**	−.11	.42**	.46**	.25**	−.17**	.12
	.42**	.40**	.43**	.44**	.47**	−.09	.43**	.46**	.28**	−.20*	.11
	.39**	.29**	.40**	.50**	.47**	−.16	.43**	.48**	.21*	−.16	.15
Perception of child's math ability	.40**	.34**	.44**	.46**	.54**	−.31**	.33**	.54**	.33**	−.23**	.16*
	.38**	.38**	.45**	.49**	.58**	−.37**	.32**	.58**	.36**	−.29**	.14
	.43**	.27**	.44**	.42**	.49**	−.23*	.35**	.50**	.28**	−.15	.19
Perception of child's effort in math	−.32**	−.21**	−.32**	−.35**	−.47**	.49**	−.20**	−.38**	−.27**	.41**	−.18**
	−.20*	−.26**	−.25**	−.35**	−.44**	.48**	−.19*	−.34**	−.26**	.45**	−.11
	−.47**	−.15	−.40**	−.31**	−.48**	.47**	−.18	−.42**	−.29**	.33**	−.26*

Notes: Within each row, there are three sets of correlations: the top set contains the correlations for all subjects; the middle set, the correlations for females; the bottom set, the correlations for males.

Boxed correlations contain a set of correlations in which the male and female correlations differ $p<.05$.

*$p<.05$.
**$p<.01$.
Source: Based in part on Parsons, Adler, and Kaczala, 1982.

	Past math performance	Intention to take more math	Current expectancies in math	Future expectancies in math	Self-concept of math ability	Perception of task difficulty	Value of math	Perception of parents' perception of math ability	Perception of parents' expectancies	Perception of parents' perception of task difficulty	Perception of parents' aspirations
Perception of task difficulty	−.35**	−.27**	−.42**	−.47**	−.58**	.52**	−.29**	−.46**	−.31**	.43**	−.19**
	−.28**	−.27**	−.35**	−.45**	−.53**	.50**	−.23**	−.38**	−.27**	.42**	−.07
	−.46**	−.26**	−.51**	−.48**	−.64**	.51**	−.38**	−.58**	−.38**	.40**	−.37**
Perception of child's perception of importance of math	−.03	.02	.13*	.15*	.14*	−.08	.17**	.18**	.17**	−.07	.21**
	−.09	.11	.09	.10	.09	−.05	.20*	.13	.18*	−.03	.22**
	.04	−.12	.17	.18	.18	−.09	.09	.24*	.17	−.09	.17
Expectancies for child	.51**	.29**	.48**	.50**	.56**	−.33**	.28**	.55**	.36**	−.35**	.19**
	.53**	.28**	.45**	.50**	.56**	−.41**	.18*	.49**	.37**	−.34**	.17*
	.49**	.29**	.51**	.50**	.56**	−.22*	.41**	.63**	.34**	−.35**	.21*
Father's attitudes											
Perception of importance of math	.41**	.34**	.26**	.37**	.31**	−.02	.26**	.34**	.19**	−.10	.07
	.48**	.38**	.30**	.36**	.34**	−.06	.22**	.38**	.15	−.19*	.02
	.32**	.28**	.21*	.40**	.27**	.03	.35**	.28**	.25*	−.00	.17
Perception of child's math ability	.46**	.27**	.36**	.43**	.47**	−.28**	.26**	.48**	.24**	−.28**	.07
	.47**	.25**	.36**	.41**	.48**	−.33**	.18*	.43**	.19*	−.35**	−.01
	.44**	.31**	.34**	.45**	.45**	−.20	.38**	.55**	.29**	−.16	.19
Perception of child's effort in math	−.31**	−.20**	−.35**	−.39**	−.45**	.38**	−.25**	−.37**	−.21**	.34**	−.16*
	−.28**	−.22**	−.34**	−.38**	−.43**	.32**	−.17*	−.30**	−.18*	.33**	−.11
	−.34**	−.17	−.33**	−.37**	−.43**	.41**	−.33**	−.43**	−.25*	.33**	−.18
Perception of task difficulty	−.36**	−.19**	−.43**	−.43**	−.53**	.40**	−.25**	−.50**	−.29**	.32**	−.12
	−.37**	−.17*	−.37**	−.35**	−.47**	.35**	−.14	−.42**	−.21*	.33**	.01
	−.35**	−.21	−.48**	−.49**	−.58**	.40**	−.38**	−.59**	−.37**	.27*	−.27*
Perception of child's perception of importance of math	−.02	.11	.06	.12	.03	.10	.17**	.06	.16*	.01	.18**
	−.07	.10	.05	.08	−.01	.13	.18*	.04	.21*	.04	.25**
	.03	.11	.06	.15	.06	.12	.10	.09	.04	.01	.00

(continued)

Table 2-6 (continued)

	Past math performance	Intention to take more math	Current expectancies in math	Future expectancies in math	Self-concept of math ability	Perception of task difficulty	Value of math	Perception of parents' perception of math ability	Perception of parents' expectancies	Perception of parents' perception of task difficulty	Perception of parents' aspirations
Expectancies for child	.53**	.22**	.30**	.40**	.39**	−.21**	.20**	.35**	.18**	−.21**	.09
	.57**	.21*	.30**	.40**	.38**	−.28**	.10	.28**	.15	−.22**	.07
	.49**	.24*	.30**	.42**	.40**	−.12	.34**	.43**	.22*	−.19	.11
Child's perceptions											
Perception of parents' perception of math ability	.34**	.32**	.61**	.64**	.72**	−.38**	.42**	1.00	.49**	−.36**	.25**
	.27**	.34**	.58**	.62**	.74**	−.44**	.35**	1.00	.45**	−.36**	.19**
	.42**	.29**	.64**	.65**	.69**	−.28**	.51**	1.00	.55**	−.36**	.33**
Perception of parents' expectancies	.10	.26**	.47**	.58**	.52**	−.21**	.45**	.49**	1.00	−.26**	.73**
	.04	.26**	.52**	.59**	.55**	−.21**	.41**	.45**	1.00	−.25**	.73**
	.17	.27**	.42**	.58**	.48**	−.21*	.50**	.55**	1.00	−.28**	.75**
Perception of parents' perception of task difficulty	−.13*	−.11	−.37**	−.32**	−.44**	.51**	−.15**	−.36**	−.26**	1.00	−.12*
	−.06	−.15	−.38**	−.29**	−.45**	.46**	−.16*	−.36**	−.25**	1.00	−.07
	−.22*	−.06	−.35**	−.34**	−.42**	.57**	−.13	−.36**	−.28**	1.00	−.18

course plans. Further, despite the greater sex typing by fathers, fathers' beliefs were not the stronger predictors of their children's self-concepts, expectancies, or plans (Parsons, Adler, and Kaczala, 1982).

In conclusion, parents had sex-differentiated perceptions of their children's math abilities, despite the similarity of actual performances of their sons and daughters. This difference was most marked for parents' estimates of how hard their children have to work to do well in math. Parents also thought advanced math was more important for their sons than for their daughters. Parents' perceptions of and expectations for their children were related to both the children's perceptions of their parents' beliefs and to the children's self-concepts, future expectations, and plans. Further, parents' beliefs and children's perceptions of these beliefs were more directly related to children's self-concepts, expectancies, and plans than were the children's own past performances in math. Finally, parents as role models of sex-differentiated math behaviors did not have a direct effect on their children's self-concepts, expectations, and course plans.

General Effects

As hypothesized, we found that parents' and teachers' beliefs are related to students' expectancies and plans. We predicted that this link would be mediated by students' perceptions of their parents' and teachers' beliefs rather than affected directly by the socializers' beliefs or by the shared knowledge of the students' math aptitudes. To assess these hypotheses, we performed a path analysis on the teacher, parent, and child scores. Results from this analysis are displayed in Figure 2-6.

In support of our predictions, the students' expectancies and plans were related most directly to their self-concepts of math abilities and to their perceptions of their parents' and teachers' beliefs about their math aptitudes and potentials. Furthermore, the influences of parents' and teachers' attitudes on students' math self-concepts, expectancies, and plans were mediated by the students' perceptions of these attitudes. Finally, while the zero-order correlations of the students' math-aptitude measure to the criterion measures occasionally were significant, the path coefficients, when other cognitive mediators were partialed out, were not significant. Thus, students' attitudes were more directly related to course plans and expectancies than either past objective measures of the students' performance or parents' actual attitudes. Any effect that these past objective measures might have had on the students' self-concepts was mediated by their impact on the perceptions of teachers and parents, rather than by their direct effect on the students' estimates of their own abilities.

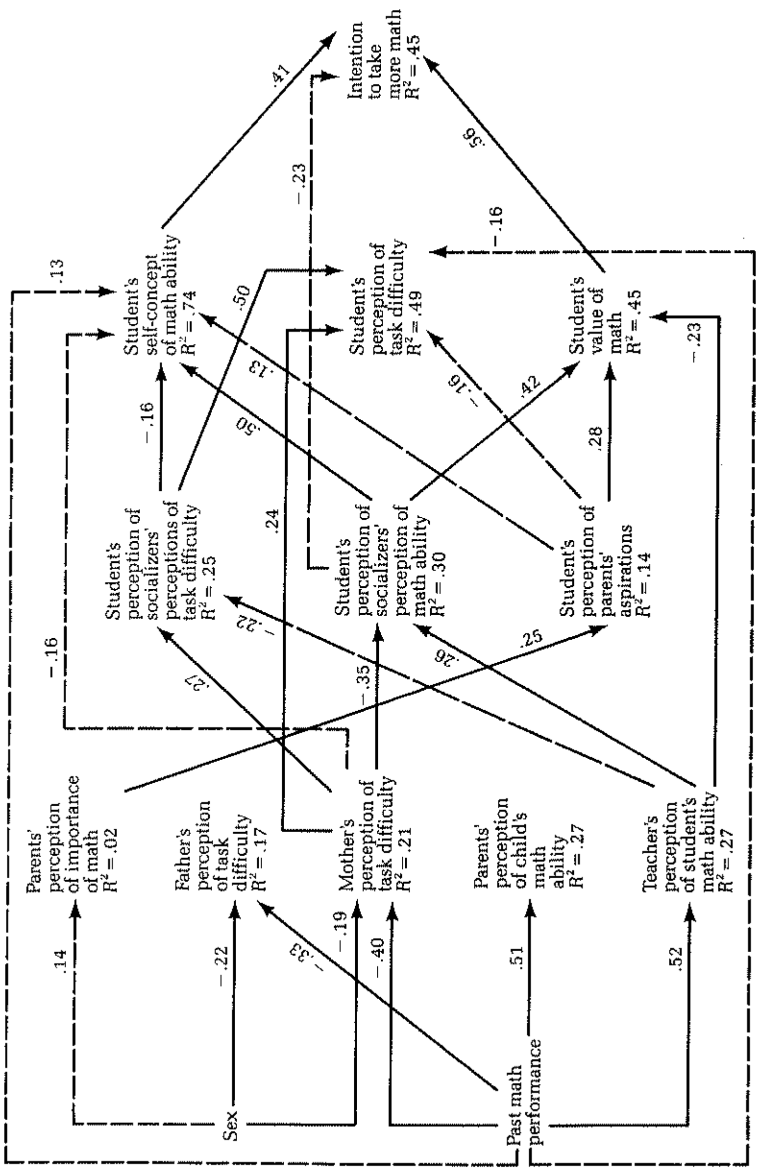

Figure 2-6
Reduced path-analytic diagram for test of socialization model. Dashed lines are significant at $p < .05$, solid lines at $p < .01$; $N = 156$; standardized beta weights are shown on path; R^2 = percent of variance accounted for on each criterion measure by all preceding predictor variables; each R^2 is listed under its criterion measure.

With regard to the differential effectiveness of various socializers, mothers appear to have the strongest influence on students' beliefs and attitudes; fathers had no significant independent effect over and above that which they shared with mothers. Teachers, especially last year's teachers, had less effect than either mothers or parents in general.

SUMMARY AND DISCUSSION

In conclusion, let us review where we've been and what we've found. At the theoretical level, we identified key achievement-related psychological constructs and presented a developmental model of individual differences in those key constructs. This model, depicted in Figure 2-1, has two major components: a psychological component, in which the interrelations of the various psychological constructs at one point in time and within each individual are specified (depicted in more detail in Figure 2-2); and a developmental component, in which the origins of individual differences are specified (depicted in detail in Figure 2-5). Because sex differences have received so much attention in recent years, we made specific reference when appropriate to the applications of our model to an analysis of the origins and implications of sex-differentiated achievement-related belief systems.

In the theoretical sections, we tried to provide as full a picture as possible of the various factors included in our general model of achievement-related behaviors. We discussed a wide range of influences and specified various relations among them. Given the scope of the chapter, however, the discussion of each of these influences was brief, and only the most salient and global interrelations were considered in any detail.

In general, the studies reviewed supported the importance of the variables specified in our model. Achievement-related behaviors are related to self-concepts of abilities, expectancies, perceptions of task difficulty, perceptions of task value, personal goals and self-schemata, perceptions of parents' and teachers' beliefs and attitudes, parents' and teachers' actual behaviors, beliefs, and attitudes, and perceptions of the cultural stereotypes associated with particular activities. However, while the empirical work reviewed has provided some insights into the factors related to achievement-related behaviors, this body of literature has several shortcomings.

First, while broad, theoretical models have been developed and tested in the laboratory, the external validity of these findings has rarely been tested. Instead, field studies on academic achievement have been designed without the guidance of a broadly based, integrative, theoretical orientation. Applied researchers have tended to proceed piecemeal, each researcher investigating a subset of the possible causes. What has emerged resembles the proverbial blind men's description of the elephant: many conclusions but little understanding of the broader picture. As a consequence, two related research problems surfaced: imprecise definitions of the variables being studied, and a paucity of comprehensive studies designed to assess the interactions between and relative importance of the many variables that undoubtedly are involved. What was needed was a framework that would (1) provide more precise conceptualization of the components, (2) link the various pieces together, (3) suggest causal sequences, and (4) outline the relations between parent and teacher variables and students' actual beliefs and achievement-related behaviors. We designed our model with these concerns in mind.

Second, while an array of possible mediators has been proposed, many studies examining these variables have not tested the mediating hypotheses directly. Instead, many have tested for differences on the proposed mediators between high and low need achievers or between the sexes. But the demonstration of a sex difference or expectancy group difference on a variable does not support a conclusion regarding the causal importance of that variable in influencing achievement-related behaviors. At the very least, research should provide a direct test of the relation between the proposed mediator and the target achievement-related behavior. The optimal research program would include studies designed to estimate the causal direction of the relation between mediators and behavior. Included would be (1) longitudinal studies that provide tests of both the causal sequence of developmental change in the natural setting and the impact of the various socializers, (2) experimental studies designed to assess the internal validity and causal significance of various experiences and attitudes, and (3) correlational studies that employ statistical techniques for making causal inferences.

In the empirical sections, we summarized a large-scale longitudinal study designed to test major aspects of both of the components of this model through the use of two of these methods: longitudinal data, and statistical techniques of causal inference. In particular, the study relied on the use of path-analytic and cross-lagged panel correlational procedures to provide support for both our psychological and our developmental hypotheses.

With regard to the psychological hypotheses, we found support for the importance of the constructs we had identified as critical determinants of achievement-related behaviors. In particular, we found

that students' interpretations of reality (i.e., attributions, self-concepts of abilities, and perceptions of the beliefs of parents and teachers) were more influential determinants of expectancies, values, and course plans than were objective indicators of past reality (i.e., previous grades and actual teachers' behaviors). In addition, self-concept of their ability was as powerful a predictor of subsequent grades as was their past performance in math.

Cross-lagged panel analyses provided a more rigorous test of our causal model. Expectancies were caused by self-concept of ability; self-concept of ability was determined by perceptions of both the effort required to do well and the difficulty of the task; and subjective task value was determined by the perceived cost of the effort needed to do well. Contrary to our predictions, however, perceptions of teachers' and parents' beliefs regarding one's abilities were determined by one's self-concept of ability and not vice versa.

We found few sex differences, but those that emerged indicated that females had a less positive self-concept of ability and felt that math was more difficult and of less value than did males. In addition, females were less likely to attribute their success to ability, more likely to attribute their failure to lack of ability, and more likely to attribute their success to stable effort than were males. Since no single variable emerged as the critical mediator of sex differences in expectancies or values, these findings suggest that sex-differentiated course enrollment is a joint function of perceived task difficulty, self-concept of one's ability, and the subjective value of math. Individual differences, especially sex differences, appear to be the result primarily of parents' beliefs regarding the difficulty of math for their children.

Turning to our developmental hypotheses, we found several intriguing results. First, parents, especially mothers, had a stronger influence on children's achievement-related beliefs than did teachers. Second, sex differences in expectancies were not mediated by teachers' use of discriminate or indiscriminate praise or criticism, as predicted by Dweck, Davidson, Nelson, and Enna (1978). Third, parents had little influence through their power as role models; instead, it was their role as direct socializers of achievement beliefs and attitudes that was important. Fourth, parents' beliefs regarding the amount of effort their children had to exert to do well and their beliefs about the importance of the activity for their children were the critical mediators of sex-differentiated self-concepts of math abilities and math expectancies. Finally, the effects of the students' sex and past academic histories on self-concepts and related achievement behaviors were mediated almost totally by the interpretation of these events made by socializers and by the students themselves.

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3 Achieving Styles in Men and Women: A Model, an Instrument, and Some Findings

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