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A CAUSAL MODEL OF MATH/SCIENCE CAREER ASPIRATIONS

By

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ABSTRACT

A CAUSAL MODEL OF MATH/SCIENCE CAREER ASPIRATIONS

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In an effort to clarify career decision-making behaviors of men and women, this study examined the relationship of identity development to the development of math self-efficacy beliefs. The purpose of this study was to test a causal model of math/science career aspirations that incorporated key elements of math self-efficacy and identity development theories. The extent to which SES, age, sex-role identity, gender, math ability, number of math/science high school courses, identity status, math anxiety, math self-efficacy, and interests influence occupational aspirations was evaluated. The sample included 289 high school and college student participants. Structural modeling using LISREL was supportive of math self-efficacy models and research, though unsupportive of the inclusion of identity status variable in the model. Separate models were fit for the high school, college, male and female samples.

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CHAPTER I

Introduction

Women's participation in the labor force has dramatically increased during the 20th century. Although women are entering male-dominated occupations at a greater rate, they still tend to avoid those occupations, as well as college majors which require math (Bureau of Education Statistics, 1988; Bureau of Labor Statistics, 1990). Lack of an adequate math background--and thus lower math achievement--seems to effectively bar women from high level, technological, and male-dominated occupations. Thus, inadequate preparation can act as a "critical filter" which limits women's choice of undergraduate majors and, correspondingly, their consideration of math-relevant non-traditional careers (Sells, 1980; Fennema, 1990). Understanding why women prematurely circumscribe their occupational aspirations is a necessary goal if counselors and educators are to facilitate women's exploration and consideration of non-traditional careers.

What inhibits women from obtaining the math background necessary to pursue math and science-related occupations? Leder (1990) suggests a wide variety of factors including one's beliefs (e.g., confidence, usefulness of math, sex-role congruency, motivation), social/cultural influences (e.g., media, peers), family related variables (e.g., parents, siblings, socioeconomic status), and school-related variables (e.g., teachers, curriculum, organization, textbooks).

One might also suspect that women do not pursue further training in mathematics because they lack the necessary ability level. But if gender differences in math abilities ever did exist, those differences are narrowing (Feingold, 1988). Men and women, except at the highest ability levels, have comparable math abilities. Furthermore, Kimball (1989) reported that girls consistently receive better math grades than do boys. Fox, Brody, and Tobin (1980) proposed that parents, teachers, peers, and school practices are factors which combine to prevent women from receiving the math background necessary to enter math/science occupations. Research supports the idea that lower motivation and differential socialization are in large part responsible for women's underrepresentation in math/science careers (e.g., Meece, Parsons, Kaczala, Goff, & Futterman, 1982; Wilson & Boldizar, 1990).

The empirical literature devoted to women's vocational decision-making has dramatically increased in recent years (Betz & Fitzgerald, 1987). However, few theories exist which adequately explain women's vocational behavior and career development. Most theories were developed with the intent of explaining men's vocational behavior (Fitzgerald & Crites, 1980; Osipow, 1983; Vetter, 1978) and do not address why women fail to enter math/science careers. One exception is career self-efficacy theory (Hackett & Betz, 1981) and in particular studies of math self-efficacy (Betz & Hackett, 1983, Hackett, 1985; Post-Kammer & Smith, 1986).

Self-efficacy beliefs are a person's perceived ability to successfully perform particular tasks. Low math self-efficacy expectations have been found to restrict consideration of math-related careers (Betz & Hackett, 1983). Furthermore, women were found to have lower math self-efficacy beliefs than men (Betz & Hackett, 1983). Hackett (1985) tested a causal model of math-related major choice for college-age men and women which incorporated math self-efficacy as a major mediating variable. Her model supported a mediating role for math self-efficacy in predicting major choices. Though a model of math self-efficacy has received preliminary support, a broader, more integrated research model would advance our understanding of those factors contributing to math self-efficacy beliefs. Also, such a model would illuminate those factors which inhibit women's consideration of math/science occupations.

Thus far the majority of math self-efficacy research has used college samples. Studies utilizing both a college and high school sample are warranted. Recent studies (Wilson & Boldizar, 1990) have reported that women enter college with weaker mathematics and science backgrounds than do men, a discrepancy believed to be responsible for the difference between men's and women's aspirations to science-oriented fields. Examining both a college and high school sample of men and women will increase understanding of the factors which may limit women from developing adequate math and science backgrounds while in high school.

A number of potentially important background variables should be studied as part of such a model (e.g., age, socioeconomic status [SES], gender, sex-role identity, math ability, and the number of prior high school math/science courses) as well as other variables such as math anxiety and interests (Hackett, 1985; Lapan, Boggs, & Morrill, 1989). These factors are expected to directly and indirectly influence the degree to which one aspires to math/science occupations. In addition, both men and women should be included in the development of such a model. Knowledge of the factors which influence men to enter math/science careers, contrasted with the factors which influence women, will increase our understanding of gender-related influences on career choices.

Efforts to explore conceptual linkages between self-efficacy and other established theories of self development are also warranted. For example, self-efficacy theory has yet to be studied in relationship to identity development theory. An individual's level of identity development is an indication of how committed he or she is to an inner sense of stability or consistency (Marcia, 1966). It is also an indication of how capable an individual is at thinking self-referentially. Asking an individual to rate self-efficacy beliefs presumes that the individual is confident in and capable of self-referential thinking.

Self-efficacy beliefs regarding a particular performance domain should be reliable indices of competence only insofar as an individual is already committed to a particular self view. For an individual whose self view is uncertain or diffuse, self-efficacy beliefs should be less reliable predictors of competence, motivation, and choice behavior. It is thus expected that an individual's level of identity development will influence the stability and predictive utility of math self-efficacy beliefs. Research linking identity development to career development (Blustein, Devenis, & Kidney, 1989) and vocational decision-making (Blustein & Phillips, 1990; Blustein & Strohmer, 1987) has found preliminary support for several theory-derived predictions.

It is further expected that the joint effect of one's gender role and one's identity status will influence the development of math self-efficacy beliefs and math/science aspirations. The gender intensification hypothesis postulates that expectations regarding girls' behavior change during puberty, with expectations for girls becoming more gender specific (Hill & Lynch, 1983) at puberty. Bush and Simmons (1987) have suggested that the gender intensification hypothesis is a key element in understanding how girls narrow their career-related expectations and aspirations. For example, those girls receiving social pressure to be "feminine" may pay less attention to or place less importance on information they are receiving regarding their math ability. Instead, these girls may concentrate on information which is less threatening to or more consistent with their gender identity. Girls who consolidate their self-views (identities) under these circumstances may be especially unlikely to develop strong math self-efficacy beliefs or math/science occupational aspirations.

Problem Statement

In conclusion, women with high math ability are failing to enter math/science occupations at the same rate as men with high math ability (Bureau of Labor Statistics, 1990). Math self-efficacy is an important construct for understanding the career behavior of both women and men. Thus far, the impact of identity development on the formation of math self-efficacy beliefs has not been examined. The exploration of the relationship between math self-efficacy and identity development theory will facilitate our understanding of the factors which influence adolescents to enter math/science careers.

The purpose of this study is to propose and test a causal model of math/science career aspirations for high school and college-age men and women that incorporates key elements from math self-efficacy and identity development theories. Clarification of those factors which contribute most importantly to the choice of a math/science career will assist counselors, teachers, and other professionals in their efforts to promote students' optimal career development. Identification of the most influential factors for a particular group (i.e., women) will be of use in the development of appropriate career interventions.

CHAPTER II

Review of the Literature

Self-efficacy Theory

Self-efficacy theory is part of a larger social cognitive theory which emphasizes the importance of self-referent mechanisms on human action (Bandura, 1986; 1989). Self-efficacy beliefs are a person's perceived ability to successfully perform particular tasks. Self-efficacy beliefs are not so much concerned with the skills one possesses, but rather with the beliefs concerning what one does with these skills (Bandura, 1986). Bandura (1989) has stated that self-efficacy beliefs "function as an important set of proximal determinants of human motivation, affect, and action ... through motivational, cognitive, and affective intervening processes," (p. 1175). In addition to self-efficacy beliefs, Bandura (1986) proposed that expectations regarding the outcome of a certain behavior are also important, though less so than one's judgement of one's ability.

In general, efficacy expectations are assumed to be acquired via four major sources of information: (a) enactive attainments (past performance accomplishments); (b) vicarious learning experiences (observation of and identification with successful models); (c) verbal persuasion; and (d) one's physiological state (Bandura, 1986). Bandura (1986, 1977) hypothesized that enactive attainments provide the most influential information, followed by (in decreasing order) vicarious learning, verbal persuasion, and emotional arousal.

Self-efficacy beliefs are expected to determine whether a particular behavior is initiated, how much effort will be expended, and how long an individual will persist with a behavior in the face of obstacles (Bandura, 1977). Bandura's self-efficacy theory has been successfully applied to a variety of areas including, for example, the treatment of anxiety and pain management (Bandura, 1986; Manning & Wright, 1983), acrophobic behavior (Williams & Watson, 1985), tennis performance (Barling & Abel, 1983), assertiveness behavior (Lee, 1984), sales performance (Barling & Beattie, 1983), educational achievement (Schunk, 1981; Schunk, 1982) and to the career domain as well (Hackett & Betz, 1981; Betz & Hackett, 1981).

Career Self-efficacy

Career self-efficacy beliefs refer to judgements of personal efficacy in relation to the behaviors involved in aspects career choice and development. Hackett and Betz (1981) proposed that women have lower levels of career self-efficacy expectations because men and women differ in their the access and exposure to the sources of efficacy information: performance accomplishments, vicarious experience, verbal persuasion, and physiological state. The resulting gender differences in efficacy expectations influence the career-related behaviors (i.e., career choices) of women. Career self-efficacy theory was expected to be particularly useful in explaining the career behavior of women, though it was also expected that it would be useful in examining the career behavior of men (i.e., lack of persistence, problems in performance). Though the research on career self-efficacy has emphasized gender differences, the impact of career self-efficacy beliefs on career behaviors for both men and women has also been emphasized (Betz & Hackett, 1986).

Career self-efficacy theory appears to be useful in understanding the career choices and behavior of adult men and women (Betz & Hackett, 1981; Branch & Lichtenberg, 1987; Landino & Owen, 1988; Layton, 1984 in Lent & Hackett, 1987; Lent, Brown, & Larkin, 1984, 1986; Rotberg, Brown, & Ware, 1987; Schoen & Winocur, 1988; Wheeler, 1983;), Japanese college students (Matsui, Ikeda, & Ohnishi, 1989), black college freshmen (Post, Stewart, & Smith, 1991), high school and junior high school students (Post-Kammer & Smith, 1985, 1986) and economically disadvantaged students (Bores-Rangel, Church, Szendre, & Reeves, 1990; Post-Kammer & Smith, 1986). Gender differences in self-efficacy beliefs which have emerged are related to the relative traditionality-nontraditionality of the occupations under consideration.

Overall gender differences in self-efficacy expectations have not been found.

Career self-efficacy theory has also been useful in predicting college major choices, academic achievement and persistence in academic programs. Lent et al. (1984, 1986) found that college students who were confident in their ability to complete the educational requirements of their major obtained significantly higher grades and higher levels of persistence in science and engineering majors. Gender differences were not found in ratings of career self-efficacy expectations; however, such differences may not have emerged due to the homogeneity of the samples used. Multon, Brown, and Lent (1991) conducted two meta-analytic investigations of 39 studies which examined the relationship of career self-efficacy beliefs to academic performance and persistence. Their results supported the hypothesized facilitative relationship of self-efficacy beliefs to academic performance and persistence across a wide variety of subjects, experimental designs, and assessment methods.

Lent et al. (1986) provided support for career self-efficacy as a unique construct, distinct from career indecision or overall self-confidence. Lent, Brown, and Larkin (1987) found that self-efficacy was a more useful predictor of academic performance and range of perceived career options than two alternative theory-based variables: interest congruence and consequences of career decisions.

The majority of studies evaluating the adequacy of career self-efficacy theory have focused on the content of career choice: what major or career an individual considers or chooses. Three studies however, have concentrated on the process dimension of career choice (Betz & Hackett, 1987; Taylor & Betz, 1983; Taylor & Popma, 1990). Taylor and Betz (1983) found that self-efficacy expectations were significantly related to career indecision, but that there were no gender differences in career decision-making self-efficacy expectations. This failure to obtain gender differences in self-efficacy expectations suggests that gender differences are less likely when examining non-gender-linked activities. Taylor and Popma (1990) further investigated career decision-making self-efficacy. They found that career decision-making self-efficacy was the only significant predictor of vocational indecision in college students. Betz and Hackett (1987) found that both male and female college students lacked the behavioral competence and perceived self-efficacy necessary to respond effectively in situations which were relevant to educational and career interests. It is somewhat surprising that no gender differences were found; the agentic responses necessary to be effective in these situations (i.e., assertiveness, initiative) are generally associated with the masculine sex role.

Foss and Slaney (1986) conducted one of the few studies examining the effect of an intervention on women's career choices and self-efficacy beliefs. They found that when women watched a videotape on women's career development, their career decision making self-efficacy beliefs were increased as well as their career decisiveness. The videotape was developed as part of a program designed to reduce sex-role stereotyping in career planning.

In summary, career self-efficacy appears to be useful in describing the career behavior and academic persistence behavior of both men and women, even when compared with alternate theoretical perspectives (Lent et al., 1987; Siegel, Galassi, & Ware, 1985; Wheeler; 1983). Gender differences in career self-efficacy expectations have been established, though not uniformly. Very little research has addressed the sources of efficacy information, the development of intervention strategies, or the process dimension of career choice.

Math Self-Efficacy

More recently, the extension of career self-efficacy theory to the math domain is gaining support as a particularly relevant concept. Math self-efficacy beliefs have been helpful in explaining the career behavior of college (Betz & Hackett, 1983; Hackett, 1985; Lapan et al. 1989) and pre-college women (Post-Kammer & Smith, 1986). Hackett (1985) theorized that women may avoid majors related to mathematics and science because of a lack of confidence in these areas, thus resulting in their underrepresentation in mathematics and science careers relative to men. Math self-efficacy has been useful in the study of math and science-related academic and occupational choices (Betz & Hackett, 1983; Hackett, 1985; Hackett & Betz, 1989; Lent, Lopez, & Bieschke, in press; Post et al., 1991) and performance and persistence related to math problem-solving (Hackett & Betz, 1989; Norwich, 1987). Math self-efficacy may have more utility than more common models of math/science academic choice, such as the math aptitude-anxiety model (Siegel et al., 1985).

Occupational/Major Choice. Betz and Hackett (1983) investigated the role of mathematics self-efficacy expectations to the selection of science-based majors in college males and females. A Math Self-Efficacy Scale (MSES) was developed to assess three domains of mathematical tasks: everyday math tasks, math problems, and math-based college courses. The reliability of the total MSES using coefficient alpha was .96. Results of a stepwise multiple regression indicated that subjects reporting stronger math self-efficacy expectations, more years of high school math, and lower levels of math anxiety were more likely to select science-based college majors. Mathematics scores from the American College Test (ACT) did not enter into the prediction equation after these predictors had been entered. In addition, the math self-efficacy beliefs of college-age males were significantly stronger than those of college-age females. The results of this study also demonstrated that males were more likely to choose science-based college majors than females. Clearly, beliefs about one's math abilities influence educational and career choices.

Hackett (1985) conducted a path analysis testing the hypothesis that math self-efficacy beliefs mediated the effects of gender, number of math courses taken in high school, and math achievement on math related college major choice. Her results indicated that gender, gender-role socialization, high school math preparations, and past math achievement all influence math self-efficacy beliefs. Math self-efficacy expectations were in turn significantly predictive of college major choice and math anxiety. This study supports the central role math self-efficacy plays in math-related major and career choice. Hackett (1985) suggested that several other background variables be included in the model in order to explain mathematics behavior in high school (e.g., socioeconomic status, parental attitudes, influence of teachers and school systems).

Performance and Persistence. Hackett and Betz (1989) explored the correspondence between mathematics performance and mathematics self-efficacy beliefs. Though men tended to have stronger math self-efficacy beliefs than did women, there was no support for the hypothesis that women's self-efficacy beliefs were significantly lower or less realistic than men's. Results of a hierarchical regression analysis indicated that mathematics self-efficacy beliefs were stronger predictors of mathematics-related educational and career choices than were mathematics performance or past mathematics achievement.

These results appear to be in contrast to those of Norwich (1987), who examined the relationship between self-efficacy and mathematics achievement in a sample of elementary school children. When predicting task performance, self-efficacy was not found to contribute significant unique variance above and beyond that accounted for by math self-concept and prior math performance. These differences in results may be explained by the types of tasks being predicted. Norwich (1987) examined task-specific self-efficacy, while Hackett and Betz (1989) examined global math self-efficacy beliefs.

Sources of Math Self-Efficacy Beliefs. Very few studies have addressed the sources of math self-efficacy beliefs or intervention efforts designed to bolster math self-efficacy expectations. Two studies have examined sources of math self-efficacy expectations in college student populations (Matsui, Matsui, & Ohnishi, 1990; Lent et al., 1991). Lent et al. (1991) found that only perceived and actual performance variables explained unique significant variation in self-efficacy beliefs. The other hypothesized sources of efficacy information (vicarious learning, verbal persuasion, emotional arousal), did not add substantially to the predictive equation beyond the effects of perceived performance. By contrast Matsui et al. (1990) found that vicarious and emotional arousal factors did explain significant, though small, unique increments in math self-efficacy. Both studies found significant correlations among the sources of math self-efficacy, indicating that those students who see themselves as relatively successful at math tasks are also likely to perceive strong vicarious influences, more support, and less anxiety related to math than do those with weaker perceived performance backgrounds.

One study has examined sources of math self-efficacy in a high school population (Lopez & Lent, in press). Similar to the results of studies using a college sample, performance accomplishments accounted for a significant amount of the variance in explaining math self-efficacy beliefs. In contrast with Lent et al.'s (in press) results, the emotional arousal source also explained additional variance in self-efficacy. Furthermore, compared to males, females in this sample also reported receiving significantly more verbal support for their math-related achievements.

Schunk (1981, 1982) developed intervention strategies for elementary school-aged children based upon Bandura's (1977) self-efficacy theory. These strategies, which included attributional feedback and modeling, enhanced the development of math self-efficacy expectations and the children's subsequent performance. Schunk's (1981) study demonstrated that modeling was more effective than verbal reinforcement in increasing the accuracy of children showing low arithmetic achievement. This finding is consistent with the hypotheses set forth by Bandura (1977).

Studies which examine the sources of self-efficacy expectations for both males and females, as well as intervention efforts based upon these sources, seem to be necessary. Such studies could help close the gap in our understanding of the relationship between math self-efficacy beliefs and career behavior.

Math Anxiety. Another variable that has been studied in association with math self-efficacy is math anxiety. Math anxiety has been defined as "feelings of tension and anxiety that interfere with the manipulation of numbers and the solving of mathematical problems in a wide variety of ordinary life and academic situations," (p. 551; Richardson & Suinn, 1972). While most studies of gender differences in math anxiety have found women to be more anxious than men (Betz, 1978; Dew, Galassi, & Galassi, 1983; Wigfield & Meece, 1988) some studies have found no gender differences (e.g., Cooper & Robinson, 1989; Richardson & Suinn, 1972).

Math anxiety has been found to directly influence math-related choices (Betz & Hackett, 1983; Hackett, 1985; Meece, Wigfield, & Eccles, 1990). Hackett (1985) also speculated that math anxiety had an indirect effect on major choice through math self-efficacy beliefs, and Lapan et al. (1989) treated math anxiety as a "co-effect" of math self-efficacy beliefs. As noted earlier, self-efficacy theory assumes that the person's performance-related emotional arousal (i.e., anxiety level) is an important source of efficacy information. As efficacy expectations increase, anxiety should decrease and vice versa.

Generally speaking, the math self-efficacy model has been shown to be more useful than the math aptitude-anxiety model (Siegel et al., 1985) in studying women's math performance in a course. Similarly, Llabre and Suarez (1985) found that, after controlling for math aptitude, math anxiety did not significantly contribute to the prediction of grades in a college algebra course for either men or women. Nevertheless, the role of math anxiety in math/science major and career choice is currently unclear and merits further study.

Socioeconomic status. In addition to math anxiety, it seems important to study a number of other variables in conjunction with self-efficacy theory. While the results of Hackett's (1985) model were consistent with self-efficacy theory, she suggested that socioeconomic status be studied as a background variable in order to explain enrollment in math courses during high school. Only two studies have gathered information on socioeconomic status in the context of their career choices (Rotberg et al., 1987) and math self-efficacy beliefs (Lapan et al., 1989). Rotberg et al. (1987) found that socioeconomic status did not predict career choice or self-efficacy expectations. Lapan et al. (1989) did not examine the variable at all because of its restricted range in their sample.

Interests. A number of studies have consistently found a moderate to strong relationship between career self-efficacy beliefs and interests (Betz & Hackett, 1981; Bores-

Rangel, et al., 1990; Branch & Lichtenberg, 1987; Hackett, Betz, O'Halloran, & Romac, 1990; Lent et al., 1986, 1987; Lent, Larkin, & Brown, 1989; Post-Kammer & Smith, 1985, 1986; Rotberg et al., 1987), and math self-efficacy beliefs and interests (e.g., Lapan et al., 1989; Lent et al., in press; Lopez & Lent, in press). In regression equations, interest has usually been the stronger predictor of occupational choice with self-efficacy beliefs sometimes accounting for unique variance (e.g., Post-Kammer & Smith, 1986).

It is not clear however, how these variables function with respect to math/science occupational choice. Lent, et al. (1989) have recommended further study of the link between self-efficacy and interests. They posit a reciprocal interaction in which interests emerge from activities in which individuals perceive themselves to be efficacious; interests lead individuals to further activity exposure, which yields more opportunities for success experiences and increased self-efficacy. Lent, et al. (1991) found support for a reciprocal interaction between interests and self-efficacy.

Results of a path analysis (Lapan, et al., 1989) indicated independent roles for mathematics self-efficacy and high school mathematics preparation in explaining lower science/technical interests among women. They also found that math preparation and math self-efficacy beliefs explained differences in occupational interest between men and women. Lapan, et al. (1989) argued that responses to a measure of occupational interest were highly related to efficacy expectations.

Sex role identity. A number of studies have examined the relationship of sex role identity to self-efficacy beliefs (Betz & Hackett, 1983; Hackett, 1985; Rotberg, et al., 1987). Math self-efficacy expectations were significantly related to higher scores on the Bem Sex Role Inventory (BSRI) Masculinity scale, but were unrelated to BSRI Femininity scores (Betz & Hackett, 1983). Hackett (1985) and Rotberg, et al., (1987) found that while scores on the BSRI Masculinity Scale were related to gender and self-efficacy beliefs, they were not directly related to occupational aspirations. Additionally, scores on the BSRI Masculinity Scale were also found to be negatively related to math anxiety (Hackett, 1985).

Surprisingly, in the Hackett (1985) study, scores on the Masculinity Scale failed to contribute to the number of high school math courses taken or math ACT scores. Gender differences in mathematics preparation were expected to be mediated by the extent of sex role socialization. Hackett (1985) speculated that measurement problems may account for these results, noting that there is generally no satisfactory instrument for assessing the effects of socialization. In addition, she acknowledged that using the Masculinity Scale in isolation from the Femininity Scale or the fourfold sex role classification (masculinity, femininity, androgenous and undifferentiated) may have also accounted for the problematic findings. The role of sex role identity to the development of math/science occupations is in need of further study.

High school population. With few exceptions (Bores-Rangel et al., 1990; Lopez & Lent, in press; Post-Kammer & Smith, 1986), researchers have not examined the relation of math self-efficacy beliefs and career aspirations in populations other than college students. Studying math self-efficacy beliefs in other populations is necessary in order to explore the generalizability of the model (Betz & Hackett, 1986). High school students seem to be a particularly important group in which to study self-efficacy beliefs, as girls' confidence in their mathematics ability deteriorates during high school while boys' confidence grows (Brush, 1979; Sherman, 1980). In addition, high school girls enter college with weaker backgrounds in math and science than do their male peers (Wilson & Boldizar, 1990).

Identity Development Theory

Erikson's (1963, 1968) concept of identity has become one of the principal ways of understanding adolescent development. Identity is defined by Marcia (1980) as "an existential position, to an inner organization of needs, abilities, and self-perceptions as well as to a sociopolitical stance," (p. 159). Persons with a well-developed sense of identity are more aware of their own relative strengths and weaknesses and how they compare to others. Those who are struggling to establish their identity rely more on external sources to define themselves and lack confidence in their own ability to make decisions and commitments. Several concurrent issues become the focus of the developmental crisis that is presumed to precede and promote the consolidation of identity (Erikson, 1963). These include the choice of an occupation, the development of a world view, and decisions about sex roles and sexual orientation. Identity status has been examined in relationship to areas such as fear of success (Larkin, 1987; Freilino & Hummel, 1985), vocational development (Blustein, et al., 1989; Blustein & Phillips, 1990; Munley, 1975; Raskin, 1985; Savickas, 1985), and family dynamics (Lopez, in press).

Marcia (1966, 1980) has operationalized the concept of identity by postulating four outcomes of this developmental period which vary along the dimensions of commitment and crisis: identity achievement, moratorium, foreclosure, and identity diffusion. Each "status" has different implications for adolescent functioning. Much of the psychological research on identity status in the past 20 years has utilized Marcia's identity status model (Lopez, in press; Waterman, 1982).

Individuals in the identity achievement status can be described as those who have experienced a crisis period and who are committed to an occupation and an ideology which they are currently implementing, or intend to implement. These individuals tend to be autonomous and to have high self-esteem (Marcia, 1980). Persons in this status typically are reflective and planful when making decisions. They tend to self-reliant rather than dependent on others (Blustein & Phillips, 1990).

Those in the moratorium status are currently in the crisis period and are engaged in an active struggle to make commitments to an ideology and an occupation. This stage is often the one which precedes identity achievement (Waterman, 1985). Failure to make a commitment usually results in identity diffusion or a prolonged period in the moratorium status. Those in the moratorium status are found to be more anxious than those in the other statuses, and more autonomous than those in the foreclosed and diffused statuses (Marcia, 1980). When making decisions, individuals in moratorium status use planful strategies which involve an internal locus of responsibility (Blustein & Phillips, 1990).

Foreclosure status is characterized by a premature commitment to an occupation and ideology that individuals will actively defend before they have experienced a crisis. For these individuals, it is difficult to tell where their parents' goals leave off and their own begin. They typically make a commitment which is an extension of the values of others--values which are accepted without consideration of alternatives. Individuals classified in the foreclosure status have been found to be the least anxious and to be the most endorsing of authoritarian values (Marcia, 1980). When making identity-relevant life decisions, these individuals tend to rely on others, and often seek out rapid solutions (Blustein & Phillips, 1990).

The least developmentally sophisticated identity status is the identity diffusion status. For individuals in this status a crisis period may or may not have taken place. The hallmark of this status is both a lack of commitment to an occupation or an ideology and the absence of any active struggle to make such commitments. These individuals typically avoid decision-making situations (Marcia, 1980). When making a decision, they may rely on intuitive strategies, or seek answers from others (Blustein & Phillips, 1990). Raskin (1989) described the occupational commitments of identity diffused individuals as, "At best, individuals in this status resemble chameleons, able to fit in anywhere, open to a variety of occupational alternatives, but without lasting commitments. At worst, individuals in this status appear apathetic and without any interests or ambition" (p. 377).

It is assumed that identity is progressively strengthened during the transition from adolescence to adulthood. Waterman (1982) and Marcia (1980), in their reviews of the identity development research, have found consistent support for this hypothesis, as have other recent studies (Archer, 1982; Freilino & Hummel, 1985). Prior to high school, there appears to be little interest in questions of identity. It is during the college years that the greatest changes in identity development are observed (Marcia, 1980). In general, senior men and women have a greater sense of personal identity as a result of an identity crisis than do their younger classmates.

More information is needed regarding the roots and development of identity, particularly before and during high school. Marcia (1980) reported that most of the research on identity development has focused on the college years, though junior high and high school students are expected make a variety of commitments, including commitments to educational decisions (such as course enrollment), religious affiliations, and sex-role behaviors (Archer, 1982). It is likely that identity formation is a continually evolving process, a "spiral of cycles of exploration and commitment," (p. 402, Grotevant & Thorbecke, 1982; Low & Bailey, 1990).

<u>Identity development in women</u>

Consistent with Erikson's (1968) theory, both Waterman (1982) and Archer (1982) concluded that males and females are more similar than they are different in their patterns of identity development. In contrast, Grotevant and Thorbecke (1982) concluded that while men and women may progress to the same point of identity development, they pursue different paths. Results of their study indicate that for men, occupational commitment is related to an instrumental orientation, an acceptance of challenging tasks, and a lack of concern about the negative evaluations of others. For women, occupational identity is related to an orientation of working hard and avoiding competition. Savickas (1985) found that decisiveness and commitment to a vocation was related to ego identity for men but not for women, while exploration of self and careers was related to ego identity for women but not for men.

There is some evidence, however, suggesting differential gender development in the resolution of the identity and intimacy tasks (Marcia, 1980; Schiedel & Marcia, 1985). Specifically, Schiedel and Marcia (1985) found that males resolve the tasks of identity and intimacy sequentially, with intimacy following the resolution of the identity crisis. Females appear to merge these two tasks, attempting to resolve them simultaneously. Similar to the findings of Grotevant and Thorbecke (1982), men were not found to be at a more developmentally advanced stage of identity than women.

Vocational Identity

Identity formation involves exploring and making a commitment to a vocational direction (Galinsky & Fast, 1966; Marcia, 1980) which is both socially recognized and personally expressive (Waterman, 1982). Determining an occupational identity is one of the central challenges adolescents face in the identity formation process (Blustein et al., 1989; Raskin, 1989). It is clear that college facilitates identity development in the area of vocational plans (Waterman, 1982). But, Archer (1982) and Grotevant and Thorbecke (1982) both found that students in high school were also exploring and committing to vocational plans.

In one of the first studies to examine the relationship of identity status to vocational choice, Fannin (1979) examined the relations among sex-role attitude, work-role salience, atypicality of college major and self-esteem to ego-identity status in college women. Her results indicated that women categorized as identity achieved had more contemporary sex-role attitudes and were enrolled in less typical majors than women in the other statuses. Women in the foreclosure status were more traditional in sex role attitude and enrolled in more typical majors. Moratorium status women seemed to assume a "middle of the road" position, perhaps caused by the presence of crisis. Women in the diffusion status were enrolled in the least typical majors and were more work salient than women in the other stages. Their lack of commitment to occupational goals may be a reflection of the difficulties of getting into graduate school and/or obtaining a job in an untraditional field for women. Fannin concluded that "vocational development is inextricably entwined with other aspects of growth, for women as well as for men," (p. 21). The results of this study are somewhat limited, as only categorical data for the identity statuses was obtained.

Savickas (1985) explored whether vocational identity, as measured by the Vocational Identity Scale (Holland, Daiger, & Power, 1980), was related to ego identity status. Those students who had a clearer picture of their career goals, abilities, and talents had also progressed further in ego-identity achievement.

Recent research has focused on the application of the identity formation process to career development and decision-making in college students (Blustein & Phillips, 1990; Blustein, et al., 1989). Differences in career decision-making styles may be tied to a developmental process of exploring and committing to one's ego identity. Blustein et al., (1989) found career exploration behavior to be associated with the identity achievement and moratorium status, and unrelated to the identity diffusion status. Consistent with identity formation theory, Blustein et al., (1990) found a strong relationship between the identity achievement status and systematic, planful decision-making strategies. The foreclosure and diffusion statuses were found to be unrelated to systematic information-gathering activities (Blustein & Phillips, 1990).

A few researchers have examined how resolving career development tasks may be related to the identity formation process in late adolescence (e.g., Blustein & Phillips, 1990; Munley, 1975; Savickas, 1985). Variations in career decision making may be related to the manner in which individuals resolve or fail to resolve their identity crises. Thus far, vocational identity has not been studied with respect to self-efficacy beliefs, though it seems important to examine how one's beliefs about one's competence are incorporated into a vocational identity.

Hypothesized Model

The model of math/science career aspirations to be tested is represented pictorially in Figure 1. This model will examine variables believed to influence such aspirations. These factors include age, sex-role identity, gender, math ability, prior math and science courses, identity status, math anxiety, math self-efficacy beliefs, and math/science interests.

Background variables

The background or exogenous variables in this study are SES, age, sex-role identity, gender, math ability, and number of high school math/science courses. There is expected to be some intercorrelation among these variables. For example, high correlations are expected between gender and sex-role identity, between age and number of high school math/science courses taken, and between math ability and number of high school math courses taken.

SES. Hackett (1985) suggested that background variables such as SES be included in studies of math self-efficacy beliefs in order to explain the mathematics preparation an individual engages in during high school. Furthermore, SES is expected to affect the type of occupations an individual considers. For example, those who come from low SES backgrounds are more likely to consider low prestige occupations (Gottfredson, 1981; Hannah & Kahn,

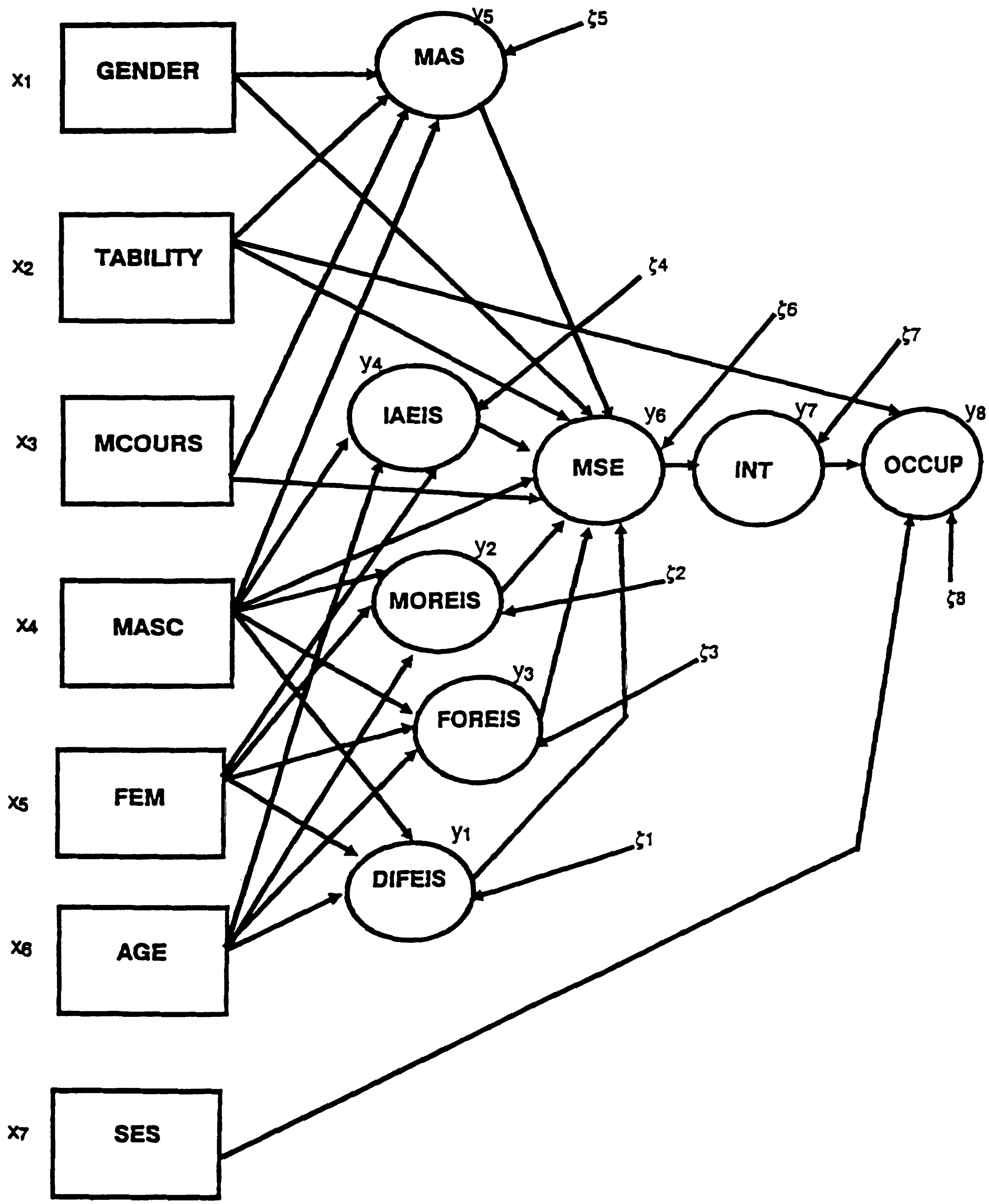

Figure 1. Proposed Structural Model

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1989, Henderson, Hesketh, & Tuffin, 1988). Math/science careers often require further education and/or training and thus may be less likely to be pursued by those from low SES backgrounds. Though Rotberg, et al. (1987) found that SES did not predict a range of career choice or self-efficacy expectations, the relationship of SES to math/science-related occupations and math/science courses taken in high school will be further examined in the present study.

Sex role. Sex-role identity is expected to directly influence math self-efficacy and math anxiety. Those who adopt a more masculine sex role are expected to have lower levels of math anxiety (Hackett, 1985) and higher levels of math self-efficacy (Betz & Hackett, 1983; Hackett, 1985; Rotberg, et al., 1987).

Sex-role identity is also expected to indirectly influence self-efficacy beliefs through identity status. Children begin to form sex-role identity at an early age (Gottfredson, 1981; Henderson et al., 1988) and these perceptions of self are considered to be an integral part of the identity formation process (Marcia, 1966; 1980). Sex-role identity impacts on what classes one might take and/or enjoy. Furthermore, the gender intensification hypothesis suggests that, during adolescence, girls in particular become more sensitive to what others think of them (Bush & Simmons, 1987; Hill & Lynch, 1983). The influence of sex-role identity and gender intensification may be one reason why some girls do not explore careers inconsistent with their gender identity.

<u>Gender</u>. Gender is expected to have a direct effect on sex-role identity. Gender should influence the choice of sex-role; those who are female will tend to be more feminine and those that are male will tend to be more masculine. The effect of gender on sex role is expected to indirectly affect identity status.

It is also expected that gender will affect the level of math anxiety and one's self-efficacy beliefs. Women are expected to have higher math anxiety (Betz, 1978; Dew, et al., 1983) and lower math self-efficacy beliefs (Betz & Hackett, 1983; Hackett, 1985; Lapan et al., 1989; Lent et al., in press) than men.

<u>Math ability</u>. Math ability is expected to directly influence math anxiety, math self-efficacy beliefs, and occupational aspirations. High math ability is expected to be associated with low math anxiety. High math ability should also directly contribute to high math self-efficacy beliefs and to math/science career aspirations (Fassinger, 1990).

<u>Previous math/science courses</u>. The number of previous high school math and science courses is expected to be directly related to math anxiety and math self-efficacy. Those students who have taken more math and science courses in high school are expected to have decreased levels of math anxiety (Cooper & Robinson, 1989) and increased levels of math self-efficacy (Betz & Hackett, 1983).

Identity status

Identity status is expected to be directly related to math self-efficacy beliefs. Those students who are at a more stable stage of identity development (i.e., identity achievement or foreclosure) are expected to be strongly associated with strong, stable patterns of self-efficacy beliefs. Those students at less stable stages of identity (i.e., moratorium or identity diffusion) are expected to be associated with weaker relationships between self-efficacy beliefs. Age and sex role are expected to be directly related to identity status, and to indirectly influence math self-efficacy beliefs. For example, an individual who is in college, has a feminine sex-role, and is at the identity achieved stage of identity development is expected to have low math self-efficacy beliefs and occupational aspirations which are unrelated to math and science.

Math anxiety

Math anxiety is expected to be directly related to math self-efficacy beliefs. It is expected that high math anxiety is associated with low math self-efficacy beliefs. Bandura (1977, 1986) discusses four sources of self-efficacy: past performance accomplishments, vicarious experience, verbal persuasion, and emotional arousal. Math anxiety measures often focus on reported physiological reactions, or the degree of emotional arousal subjects experience in math performance situations. Thus, math anxiety is expected to be directly related to the formation of self-efficacy beliefs.

Math anxiety is expected to be influenced by math ability and the number of math/science courses taken. Low math anxiety is expected to be associated with high math ability and a high number of math/science courses taken in high school.

Math self-efficacy.

Math self-efficacy is expected to be directly related to interest level in math/science careers (Lapan et al., 1989; Lent et al., in press). Those with a high level of math self-efficacy beliefs are expected to express more interest in math/science-related careers.

Interests

Interest in math/science-related careers is expected to directly influence the preference of occupational roles and the level of exploration (consideration) given to those roles (Lent et al., 1986; Rotberg et al., 1987; Lent, et al., 1991). Specifically, those interested in math/science careers are expected to have higher math/science occupational aspirations.

Occupational preference

Occupational preference serves as the outcome variable for this model. It is expected to be directly affected by SES (e.g., Gottfredson, 1981; Hannah & Kahn, 1989), interests (e.g., Lent et al., 1986; Rotberg et al., 1987) and math ability (Betz & Hackett, 1983; Hackett, 1985).

CHAPTER III

Methodology

Subjects

The sample used in this study included 289 high school and college students (118 males, 170 females, 1 unidentified). The mean age of participants was 20.51. Participation in the research was voluntary. Each participant received extra credit in one of his or her courses for completing the study questionnaires.

College students enrolled at a major western university were asked to participate in the study for extra credit in a course. 153 college students (94 females, 58 males, 1 unidentified; mean age = 25.1) agreed to complete the questionnaires. Approximately two-thirds of the students were enrolled in a Career and Life Planning course; the remainder were enrolled in a Psychological Foundations in Education course. For information regarding year in school for the college sample, see Table 1. Information regarding the marital status of the college sample can be found in Table 2.

The high school sample included 136 students (76 females, 60 males; mean age = 15.9) enrolled in math classes

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Table 1. Year in School by Sample

	High School		College	
Year in School	Frequency	Percent	Frequency	Percent
Freshmen			25	16.3
Sophomores	78	57.3	43	28.1
Juniors	55	40.4	43	28.1
Seniors	3	2.2	31	20.3
Graduate Students			10	6.5
Missing			1	.7
Total	136	99.9	153	100

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Table 2. Marital Status for College Sample

Marital Status	College Sample Frequency	College Sample Percent
Single	228	78.9
Separated	3	1.0
Married	39	13.5
Divorced	16	5.5
Missing	3	1.0
Total	289	100

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who also agreed to complete the study for extra credit. The majority of the high school students were enrolled in a required algebra or geometry course. The remainder of the students were enrolled in a non-required advanced math course. Information regarding year in school of the high school can be found in Table 1.

Procedures

College students were provided with a general statement of the purpose of the project and asked to participate in the research during one of their classes. Participation included the completion of a battery of questionnaires and permission to access the student's university record in order to obtain American College Test (ACT) Math scores. College students received extra credit for their participation. Students who wished to receive extra credit but who did not wish to participate in the research project had the option of completing an alternative project (Winefordner, 1980).

High school students were also provided with a general statement of the purpose of the project. Parents of high school students were asked to sign a parental consent form (Appendix A) which explained the purpose of the project. Those students whose parents had given their consent were asked to participate in the research by the principal investigator. Participation included the completion of a battery of questionnaires and permission to access the student's high school record in order to obtain math

Stanford Achievement Test scores. Those students who did not wish to participate in the research project had the option of completing an alternative project. Students who completed either the research project or the alternative project received extra credit. The statement of purpose read to both college and high school subjects can be found in Appendix B.

Questionnaires were administered to each subject in counterbalanced order, with the exception of the Bem Sex Role Inventory (BSRI), which was always administered last. Parental informed consent forms were completed by all the parents of high school students. Informed consent forms were completed by all high school and college students (Appendix C).

Instruments

Background questionnaire. Subjects were asked to provide the following background information: birthdate, gender, a list of math and science courses taken in high school, year in school, marital status, probable career choice, degree of commitment to career preferences, parents' occupations, and parents' levels of education (see Appendix D). College students were also asked to identify their academic major.

Career/major preference. Both college major and career occupation were rated according to Goldman and Hewitt's (1976) 5-point math/science-relatedness continuum, from the fine arts (1) to the physical sciences and mathematics (5). This scale was used as an index of the math relatedness of major and career preference.

Socioeconomic Status. Parent occupations were rated using Duncan's Socioeconomic Index (1961). In a critique of measures of socioeconomic status, Mueller and Parcel (1981) strongly recommended use of the Socioeconomic Index (SEI). The SEI provided one of the best measures of socioeconomic status (SES) and satisfied sociologists' demands that socioeconomic status be estimated by occupation-based measures. The SEI has demonstrated utility as a predictor of prestige ratings for occupations. Duncan (1961) demonstrated the ability of the SEI to predict North-Hatt prestige scale ratings for occupations (multiple $R = .91$).

In the present study, subjects were asked to identify the occupations of both their parents on the demographic questionnaire. All identified occupations were rated using the SEI. The highest SEI rating was used as a measure of socioeconomic status (Rotberg et al., 1987). Blau and Duncan (1967) found a correlation of .74 between adult reports of their occupations and the reports of their high school-aged children.

Another measure of socioeconomic status used in this study was the level of father's education (FED).

Math/Science Courses. College and high school students were asked to list the high school math and science courses they had taken. The total number of courses taken by each student was computed (MCOURS).

Ability. Two different ability measures were utilized in this study for high school and college students. Scores for each measure were converted to t-scores in order to make the scores comparable to one another.

American College Test (ACT). Scores from the ACT Mathematics Usage test were obtained for college students from university records. The four academic tests included as part of the ACT are the English Usage Test, Mathematics Usage Test, Social Studies Reading Test, and Natural Sciences Reading Test. Total testing time for the Academic Tests is 2 hours, 40 minutes, and the Mathematics Usage Test comprises approximately 30% of the testing time. Only the result of the Mathematics Usage Test was used in this study. The Mathematics Usage Test is described in the brochure, Content of the Tests in the ACT Assessment, as follows:

> The Mathematics Usage Test is a 40-item, 50-minute test that measures the students' mathematical reasoning ability. It emphasizes the solution of practical postsecondary curricula and includes a sampling of mathematical techniques covered in high school courses. The test emphasizes quantitative reasoning, rather than memorization of formulas, knowledge of techniques, or computational skill. Each item in the test poses a question with five alternative answers, the last of which may be "None of the above." ... (Aiken, 1985, p. 29)

The same standard score scale is used for reporting scores on the four ACT Academic Tests and the Composite. The scale ranges from 1 to 36; the overall mean standard scores for entering college freshmen in 1982 were 17.4 for Mathematics. Internal consistency reliability data was examined using the ACT tests administered in June 1984.

These results indicated that the reliability coefficient for the Mathematics Usage Test was .91. There also appears to be adequate content and predictive validity information for the ACT. The ACT is thought to be an accurate measure of past achievement and future performance (Aiken, 1985).

The ACT score for each subject was converted to a t-score. The t-score was used as an indication of each college subject's ability (TABILITY).

Stanford Achievement Test Series: Mathematics Tests. Scores from the SAT were obtained from high school academic records for high school students. The Stanford Achievement Test Series is three integrated test batteries designed to measure student academic achievement from kindergarten through the 12th grade. Percentile ranks from two of the batteries are used in this study. Percentile ranks from the mathematics portion of the 7th edition of the Stanford Achievement Test (SAT) administered in the ninth grade have been obtained for freshmen and sophomore high school students. Percentile ranks from the mathematics portion of the 8th edition of the Stanford Test of Academic Skills (TASK) administered in the eleventh grade have been obtained for high school juniors and seniors.

The mathematics subtests of the SAT emphasize three skill areas: concepts of number, mathematical computation, and mathematical applications. The KR-20 reliabilities for the 7th edition of the Total Mathematics Test range from .92 to .97 with a median of .96 for the national sample. The alternate form reliabilities range from .88 to .95 with a median of .93 for the Total Mathematics Test. The Otis Lennon School Ability Test was correlated with the three subtests. The median correlations increase with grade level; in grades 7 through 9 the median correlation is .76 (Aleamoni, 1985; Ahmann, 1987).

The percentile ranks for each student were converted to t-scores. The t-score was used as an indication of high school subjects' ability (TABILITY).

Identity Status. One measure of ego identity was used to assess the degree to which subjects identify with a particular identity status. Each of the four scales was split in half in order to have two measures of each identity status.

Extended Objective Measure of Ego Identity Status (EOM-EIS; Bennion & Adams, 1986). This 64-item measure (see Appendix E) uses a 6-point Likert response format to assess the relative dominance of each of the four ego identity statuses (i.e., diffusion, moratorium, foreclosure, and identity achievement). Each of the four identity statuses is assessed by 16 items. Previous research (Blustein et al., 1989) with college students indicates that the scales have adequate to excellent internal consistency (i.e., Diffusion, .68; Foreclosure, .90; Moratorium, .73; and Identity Achievement, .66) and excellent stability (with correlation coefficients ranging from .82 to .90) across a 2-week interval (Blustein & Phillips, 1990).

There is also evidence which supports the validity of the EOM-EIS (Bennion & Adams, 1986; Grotevant & Adams, 1984). The content validity is established by an overall mean percentage agreement of 96.5% across 10 raters for the 64 items. The evidence for the concurrent validity of the EOM-EIS is equivocal. Correlations between the EOM-EIS, a related identity measure (Rosenthal, Gurney, & Moore, 1981), and the Ego Identity Interview (Grotevant & Cooper, 1981) are in the expected direction, while Craig-Bray and Adams (1986) reported little convergence between the EOM-EIS and the Ego Identity Interview. In addition, Bennion and Adams (1986) reported that the factor structure of the EOM-EIS is generally consistent with theoretical predictions. Three separate factor structures emerged: foreclosure, achievement, and a combination of diffusion and moratorium. This suggests that diffusion and moratorium, as measured by the EOM-EIS, are interrelated. Blustein et al., (1989) reported non-significant correlations between the identity statuses, with the exception of diffusion and moratorium which were significantly correlated ($r = .32$, $p < .002$).

In the present study, a measure of each identity status (identity achievement, foreclosure, moratorium, and diffusion) was obtained. Higher scores in each status indicated stronger endorsement of items consistent with that identity status. Each subscale was split in half in order to obtain two measures of each subscale: identity achieved (IAEIS1, IAEIS2), foreclosure (FOREIS1, FOREIS2), moratorium

(MOREIS1, MOREIS2), and diffusion (DIFEIS1, DIFEIS2).

Mathematics Anxiety. Two separate measures of math anxiety were used in this study: the Fennema-Sherman Mathematics Anxiety Scale and the Test Anxiety Inventory.

Fennema-Sherman Mathematics Anxiety Scale (MAS; Fennema & Sherman, 1976). Mathematics anxiety was assessed by the 10-item scale (see Appendix F) which uses a 5-point Likert scale from 1 (strongly disagree) to 5 (strongly agree). The MAS possesses acceptable internal consistency (.72) and two-week test-retest reliability (.87) when used with a college-age population (Dew et al., 1983). This study used the 10-item revised version of the MAS developed by Betz (1978) for use with college students. The split-half reliability of the revised Math Anxiety Scale with college students was .92 (Betz, 1978). Lopez and Lent (1990) used the MAS with high school juniors and seniors; their obtained Cronbach alpha coefficient was .90.

Half of the items on this scale are negatively worded; the other half are positively worded. Those negatively worded were reverse scored. In this study, after the items were reverse scored, the items ratings were summed to obtain a total Math Anxiety score.

Test Anxiety Inventory (MTAI; Spielberger, 1980). This twenty-item scale was developed to assess individual differences in test anxiety in high school and college students (see Appendix G for sample items). A 4-point Likert scale is used to rate responses, from 1 (indicating that the response almost never occurs) to 4 (indicating that the response almost always occurs). All twenty items are used to compute the total score; thus, scores may range from 20 to 80, with higher scores indicating higher levels of anxiety (Spielberger, 1980). In the present study, TAI items were modified to reflect how one feels when taking a math test. For example, the first item on the TAI was reworded to read "I feel confident and relaxed while taking math tests," as opposed to "I feel confident and relaxed while taking tests."

Spielberger (1980) reported evidence for the reliability and validity of the TAI as a situation-specific measure of test anxiety. Test-retest reliability coefficients of the TAI Total scale ranged from .62 for a six month time period to .80 for time periods of one month or less. The alpha coefficients for the TAI Total scale were high for both males and females (.92 or higher). The item-remainder correlation coefficients (i.e., the relationship between the score for an individual item and the total score for the remaining items) provided further support for the internal consistency of the TAI. The pattern of correlations of the TAI scales with the Test Anxiety Scale, the Worry and Emotionality Questionnaire, and the State Trait Anxiety Inventory A-Trait and A-State scales provided evidence of the concurrent and construct validity scales. DeVito (1984, p. 680) stated in his review of the TAI that he believed it to be "by far the best psychometric instrument currently available for measuring test anxiety."

Math Self-efficacy. Two subscales of the Math Self-Efficacy Scale were used to assess math self-efficacy beliefs. Elements of each subscale were used to create two separate measures of math self-efficacy beliefs.

Math Self-efficacy Scale (MSE1 and MSE2; Betz & Hackett, 1983). Two subscales of the Math Self-Efficacy Scale were used in this study: Math Problems and Math Tasks (see Appendix H). Each of these scales contains 18 items. A third subscale, College Courses, was not used in this study as it was not judged to be appropriate for a high school sample. A college student sample was used by Betz, et al. (1983) to develop and assess the psychometric characteristics of the MSE. The Math Problems scale was designed to assess confidence in one's ability to solve math problems (i.e., similar to those found on standardized tests of mathematical aptitude and achievement). Item-total score correlations ranged from .24 to .66 for this subscale, and the internal consistency reliability (coefficient alpha) was .92. Moderate test-retest reliability ($r = .82$) has been demonstrated for this scale (Hackett & O'Halloran, 1985 in Hackett et al., 1989). The Math Tasks subscale was constructed to measure confidence in one's ability to solve everyday math problems (i.e., balancing a checkbook). Item-total score correlations for this subscale have been reported as ranging from .29 to .63, and the internal consistency reliability (coefficient alpha) as .90.

Moderate test-retest reliability for this scale has also been established (Hackett & O'Halloran, 1985 in Hackett et al., 1989). Using a 10-point scale ranging from 0 ("No confidence at all") to 9 ("Complete confidence"), subjects indicated their degree of confidence in solving each problem (Betz & Hackett, 1983).

The total mathematics self-efficacy score was defined as the sum of responses to the Math Tasks and Math Problems subscales. Two measures of math self-efficacy were obtained. Each measure included nine items from the math tasks subscale and nine items from the math problems subscale (MSE1, MSE2).

Sex Role. One instrument was used to assess sex role in this study. The instrument included subscales of both femininity and masculinity. Each subscale was split in half in order to obtain two measures of both masculinity and femininity.

Bem Sex Role Inventory (BSRI; Bem, 1974). The BSRI measures the extent to which subjects identify themselves along gender-typed attributes (see Appendix I). Unlike many other instruments that attempt to identify sex roles, the BSRI does not expect that masculinity and femininity are opposite ends of one dimension. Instead, masculinity and femininity are considered to be two separate dimensions; thus the inventory allows for the possibility that an individual could have both masculine and feminine traits in varying degrees. It has been argued that the BSRI measures instrumental and expressive traits and is related to sex-role preferences that call on such traits (Spence & Helmreich, 1981). In a review of the BSRI, Bieger (1985) stated that the measure is useful for research, and that its value has been demonstrated by its use in a number of research studies.

The BSRI consists of 60 adjectives for which subjects are asked to rate themselves according to a 7-point scale, ranging from 1 (never or almost never true) to 7 (always or almost always true). The 60 items are personality characteristics scaled as being desirable for men, women, or desirable for both (neutral). The characteristics can be associated with feminine, masculine, undifferentiated, or androgynous sex role types. Though the BSRI was developed using data from college students, the author has stated that the test "should be comprehensible to most high school students," (Bem, 1981, p. 5).

Estimates of test-retest reliability have been found to range from .76 to .94 over a one-month time period. Internal consistency estimates, as measured by coefficient alpha, have ranged from .75 to .90 (Long, 1989). There is also evidence which supports the construct validity of the BSRI. The BSRI has a very different theoretical basis than other instruments which claim to measure the same construct; thus, it is inappropriate to examine the correlation between the results of the BSRI with these other instruments as evidence of validity. Instead, support for the validity of the BSRI has been demonstrated in the context of empirical research. The results of these empirical studies indicate that the experimental hypotheses involving sex roles are supported when the BSRI is the criterion for identifying sex roles (Bieger, 1985).

The total scores for the masculinity and femininity subscales of the BSRI were used in this study. These scales were split in half in order to provide two measures of both masculinity (MASCA, MASCB) and femininity (FEMA, FEMB).

Interests. One instrument measuring the degree of math/science interests was used in this study. This scale was split in half in order to obtain two separate measures of interests.

Math/Science Interests. Items from the investigative activities section of the Self-Directed Search (SDS; Holland, 1977, 1985) and six additional items (see Appendix J) were used to create a scale to assess math/science interests. Subjects were asked to indicate whether they liked, disliked, or were indifferent to each of the activities. Internal consistency for the SDS calculated by KR-20 yielded coefficients ranging from .67 to .94 for college freshmen. Test-retest reliability coefficients for high school students over a 3-4 week time interval yielded a median coefficient of .81 for boys and .83 for girls. For college freshmen, the test-retest reliability coefficients over a 7-10 month time interval ranged from .60 to .84 (Zunker, 1986). The revised interest scale to be used in this study has been pilot tested on a sample of 50 high school students. Internal consistency as measured by coefficient alpha for this sample was .91.

Item scores were totaled, with higher scale scores indicating less interest in math/science activities. This scale was split in half in order to obtain two measures of math/science interests (INTA, INTB).

Math/Science Career Aspirations. The present study utilized one instrument which measured the degree of math/science career preference. This scale was split in half in order to obtain two separate measures of career preferences.

Occupational Preference. This questionnaire used a 9-point Likert scale to assess how seriously the student has considered each of 23 math/science related occupations (see Appendix K). Each of the 23 occupations were rated along a 5-point science continuum (scores ranging from 1 to 5) developed by Goldman and Hewitt (1976). Lower scores characterized fields with a relative absence of math/science content (e.g., art), while higher scores reflected progressively greater scientific emphasis (e.g., engineering). This questionnaire only included those occupations rated either a 4 or a 5 using the Goldman-Hewitt continuum. All of the occupations were assigned a Holland code; investigative was either the first or second letter for each occupation on the list. Occupations were also selected to represent a wide variety of educational requirements.

This survey was pilot tested on a group of 50 high school students. Internal consistency as measured by coefficient alpha for this pilot sample was .71.

Items for this scale were summed and the mean was obtained. Higher scores indicated a greater level of interest in math/science occupations. This scale was split in half in order to obtain two measures of math/science occupational preferences (OCCUPA, OCCUPB).

Research hypotheses. The model in Figure 1 represents the research hypotheses for this study. The overall fit of this hypothesized model will be assessed. Since the proposed model is exploratory and the relationships hypothesized between variables are tentative, the model will be revised if necessary.

Data analysis.

1. For each of the 25 measures of the latent and background variables, the following descriptive statistics will be computed: mean, standard deviation, variance, kurtosis, and skew.
2. Coefficient alpha, a measure of internal consistency reliability, will be computed for each of the instruments used in the study.
3. A correlation matrix will be computed which will examine the relationships between each of the variables.
4. The first stage of data analysis will be a path model using multiple regression. Results of this analysis

will be used to develop a structural model using the computer program LISREL VII (Joreskog & Sorbom, 1989). To account for measurement error in the present study, either split scales or two measures will be used to assess each variable, with the exception of number of math courses, ability, and age. A chi-square statistic will be used to assess the goodness of fit of the model in conjunction with other tests of fit provided by the LISREL program. Kerwin, Howard, Maxwell, and Borkowski (1987) and Fassinger (1987) advised that other tests of fit be used in addition to the chi-square since the chi-square statistic is easily influenced by sample size.

Fassinger (1987) stated that structural equation modeling allows for analysis of causal patterns among latent variables represented by multiple measures. A full structural equation model consists of (a) a structural model which stipulates the hypothesized causal structure among latent variables and (b) a measurement model that defines relations between measured variable and latent variables (Fassinger, 1987; Francis, 1988; Kerwin, et al., 1987). The sample data are then transformed into correlation or covariance matrices and a series of regression equations. Next, the model is analyzed to examine its fit in the population. Finally, parameter estimates and goodness-of-fit information for the model are examined for possible modification and retesting of the theoretical model (Fassinger, 1987).

Kerwin et al. (1987) stated a number of advantages of structural equation modeling. First, in contrast to path analysis and multiple regression techniques, structural equation modeling does not assume that observed variables must be measured perfectly in order to make causal inferences. Second, with structural equation modeling it is possible to test how well the overall model fits the data. Finally, with structural equation modeling it is possible to specify simultaneous or bidirectional causation.

5. Post hoc analyses will include examining the fit of the model for each of the four subsets of the sample: females, males, high school students, college students.

CHAPTER IV

Results

Descriptive Statistics

Prior to analysis, each variable was examined for missing values, skewness, outliers, and accuracy of data entry. Less than five data entry errors were identified and subsequently corrected; these errors were primarily due to a subject's use of out-of-range values. Scale mean substitution was used to account for missing values in the following scales: identity achievement, diffusion, moratorium, foreclosure, math anxiety, math/science occupations, math/science interests, math self-efficacy beliefs, masculinity, femininity, math test anxiety. The number of missing values for a scale item ranged from 0-11. Missing values were also found for gender (n = 1), socioeconomic status (n = 96), number of math courses (n = 5), career/major preference (n=62) and math ability (n = 96). For number of math courses, it was decided that a 0 value would be assigned to missing cases in this variable. Failure to list any math courses may indicate that none were taken in high school. The career/major preference variable was eliminated, given that there was little missing data in the occupational aspirations scale. It was not felt that an adequate value could be identified for substitution in the math ability or socioeconomic status variables. No outliers were identified, and, with the exception of age, the distribution of each of the variables was fairly normal.

Table 3 contains the full name, abbreviated name, mean, standard deviation, range and skewness of each of the variables specified in the proposed model. The age variable is considerably positively skewed (sk = 1.95). This is to be expected, given the sizeable high school population sampled for the study.

The zero-order correlation matrix for all the variables used in the proposed model can be found in Table 4. Math/science interests, math self-efficacy beliefs, math anxiety, masculinity, foreclosure, and math ability are all significantly correlated with math/science relatedness of occupation ($p < .001$). Interest in math/science activities was most highly correlated with math/science relatedness of occupation ($r = -.42$; $p < .001$). Somewhat surprisingly, number of math courses was not significantly related to math/science relatedness of occupation ($r = .04$), though it was related to math self-efficacy beliefs ($r = .33$; $p < .001$).

With one exception, the identity subscales were not found to be significantly intercorrelated with one another. However, a significant positive correlation was found between diffusion and moratorium ($r = .47$; $p < .001$).

Socioeconomic status was not found to be significantly

Table 3. Descriptive Statistics for All Variables

Variable Name	Abbreviation	M	SD	SK	Range
Math/Science Occupations (Combined)	OCCUP	1.80	1.21	.93	0 - 6.01
Math/Science Occupations A	OCCUPA	1.89	1.23	.93	0 - 6.75
Math/Science Occupations B	OCCUPB	1.71	1.25	.80	0 - 5.55
Math/Science Interests (Combined)	INT	1.95	.43	.17	1.00 - 3.00
Math/Science Interests A	INTA	2.03	.47	-.03	1.00 - 3.00
Math/Science Interests B	INTB	1.88	.45	.382	1.00 - 3.00
Math Self-Efficacy Scale (Combined)	MSE	6.43	1.75	-.680	.64 - 9.00
Math Self-Efficacy Scale A	MSEI	6.51	1.75	-.667	.56 - 9.00
Math Self-Efficacy Scale B	MSE2	6.34	1.80	-.69	.72 - 9.00
Math Anxiety Scale	MAS	2.98	1.10	.03	1.00 - 5.00
Math Test Anxiety Inventory (Combined)	MTAI	2.14	.77	.597	1.00 - 3.85
Identity Achievement Status (Combined)	IAEIS	3.96	.64	-.24	1.25 - 5.56
Identity Achievement Status 1	IAEIS1	4.01	.65	-.43	1.38 - 5.50
Identity Achievement Status 2	IAEIS2	3.91	.74	.04	1.13 - 6.00
Foreclosure Status (Combined)	FOREIS	2.19	.76	.315	1.00 - 4.31
Foreclosure Status 1	FOREIS1	2.27	.79	.349	1.00 - 5.13
Foreclosure Status 2	FOREIS2	2.12	.81	.453	1.00 - 4.75
Moratorium Status (Combined)	MOREIS	3.21	.62	-.188	1.44 - 4.81
Moratorium Status 1	MOREIS1	3.24	.73	-.189	1.00 - 5.13
Moratorium Status 2	MOREIS2	3.18	.24	-.120	1.38 - 4.88
Diffusion Status (Combined)	DIFEIS	2.78	.63	.174	1.19 - 4.56
Diffusion Status 1	DIFEIS1	2.73	.69	.087	1.00 - 4.38
Diffusion Status 2	DIFEIS2	2.83	.69	.155	1.00 - 5.00
Father's Education	FED	3.70	1.53	.12	1.00 - 6.00
Socioeconomic Index	SES	63.53	16.89	-.60	9.00 -96.00
Age	AGE	20.77	6.98	1.95	15.00 -50.00
Masculinity (Combined)	MASC	5.08	.77	-.15	3.10 - 7.00
Masculinity A	MASCA	5.35	.84	-.46	2.60 - 7.00
Masculinity B	MASCB	4.80	.87	.07	2.60 - 7.00
Femininity (Combined)	FEM	5.08	.70	-.38	2.90 - 7.00
Femininity A	FEMA	4.76	.73	-.02	2.60 - 7.00
Femininity B	FEMB	5.41	-.89	-.43	2.60 - 7.00
Number of Math Courses	MCOURS	2.33	1.10	.41	0 - 5.00
T-Values/Ability Scores	TABILITY	52.17	10.07	-.23	26.7 -73.26

Table 4. Correlation Matrix of all Variables

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. OCCUP	1.00													
2. INT	-.42**	1.00												
3. MSE	.24**	-.55**	1.00											
4. MAS	-.19**	.41**	-.58**	1.00										
5. IAEIS	.03	-.12*	.20**	-.06	1.00									
6. FOREIS	.20**	.00	.07	-.04	.08	1.00								
7. MOREIS	.05	.03	-.10*	.11*	-.21**	-.01	1.00							
8. DIFEIS	-.01	.17*	-.13*	.06	-.27**	.03	.49**	1.00						
9. SES	-.01	.02	-.04	-.03	-.02	-.01	-.03	-.05	1.00					
10. AGE	-.09	-.01	-.01	.26**	.18**	-.33**	-.21**	-.20**	-.15*	1.00				
11. MASC	.19**	-.32**	.36**	-.29**	.26**	-.03	-.17*	-.24**	.10	-.09	1.00			
12. FEM	-.07	.14*	-.06	.06	.13*	.01	.06	-.11**	.10	.01	.18**	1.00		
13. MCOURS	.04	-.23**	.33**	-.18**	.04	.09	.04	-.17*	-.01	-.08	.02	.01	1.00	
14. TABILITY	.29**	-.39**	.40**	-.51**	-.04	.23	-.03	-.12*	.10	-.26**	.05	-.18*	.34**	1.00

Significance levels: ** $p \le .001$; * $p \le .05$.

Note. OCCUP=occupations, INT=interests, MSE=math self-efficacy beliefs, MAS=math anxiety, IAEIS=identity achievement status, FOREIS=foreclosure status, MOREIS=moratorium status, DIFEIS=diffusion, SES=socioeconomic status, MASC=masculinity, FEM=femininity, MCOURS=math courses, TABILITY=math ability.

related to any of the other variables in the study, with the exception of age. Younger subjects were more likely to be in the foreclosure ($r = -.33; p < .001$), moratorium ($r = -.21; p < .001$) or diffusion ($r = -.20; p < .001$) statuses of identity development. Surprisingly, lower math ability scores were reported for older students ($r = -.26; p < .001$), as well as higher math anxiety scores ($r = .26; p < .001$). The unexpected correlation between math ability and age may be due to measurement error.

The correlation between each set of two scales which were purported to measure an underlying latent variable are reported in Table 5. All the correlations were significant at the $p < .001$ level. The highest correlation was between the two scales measuring math self-efficacy beliefs ($r = .93$); the two lowest correlations were between the two scales measuring socioeconomic status and the two scales measuring femininity ($r = .48$).

Table 6 reports the internal consistencies (coefficient alpha) for each of the scales used in the study. For the combined scales, coefficient alpha ranged from a low of .66 for the masculinity and femininity scales to a high of .97 for the math self efficacy beliefs scale. For the split scales, coefficient alpha ranged from a low of .32 for femininity (A) and a high of .94 for math self-efficacy beliefs (1). Given the small number of items for some of the split scales, deletion of items in order to increase coefficient alpha seemed counterproductive.

Table 5. Correlations between Observed Variables

Variable	Variable	r
OCCUPA	OCCUPB	.83**
INTA	INTB	.73**
MSEI	MSE2	.93**
MAS	MTAI	.82**
IAEIS1	IAEIS2	.69**
FOREIS1	FOREIS2	.84**
MOREIS1	MOREIS2	.65**
DIFEIS1	DIFEIS2	.68**
FED	SES	.48**
MASCA	MASCB	.60**
FEMA	FEMB	.48**

Significance levels: **$p < .001$; *$p < .05$.

Table 6. Internal Consistency of Scales

Scale	# of items	Coefficient Alpha
OCCUP	23	.8625
OCCUPA	12	.7592
OCCUPB	11	.7296
INT	20	.8892
INTA	10	.8174
INTB	10	.8076
MSE	36	.9667
MSEI	18	.9365
MSE2	18	.9362
MAS	10	.9326
MTAI	20	.9544
IAEIS	16	.7688
IAEIS1	8	.5294
IAEIS2	8	.6615
FOREIS	16	.8870
FOREIS1	8	.7518
FOREIS2	8	.8235
MOREIS	16	.7430
MOREIS1	8	.6261
MOREIS2	8	.5044
DIFEIS	16	.7160
DIFEIS1	8	.4584
DIFEIS2	8	.5664
MASC	10	.7278
MASCA	5	.5430
MASCB	5	.5715
FEM	10	.6621
FEMA	5	.3199
FEMB	5	.6365

Inferential Statistics--Whole Sample

Path Analysis. The hypothesized model (see Figure 1) was revised slightly prior to the initiation of the path analysis procedure. Gender was deleted as an exogenous variable since differences in the models for males and females are explored in a later analysis.

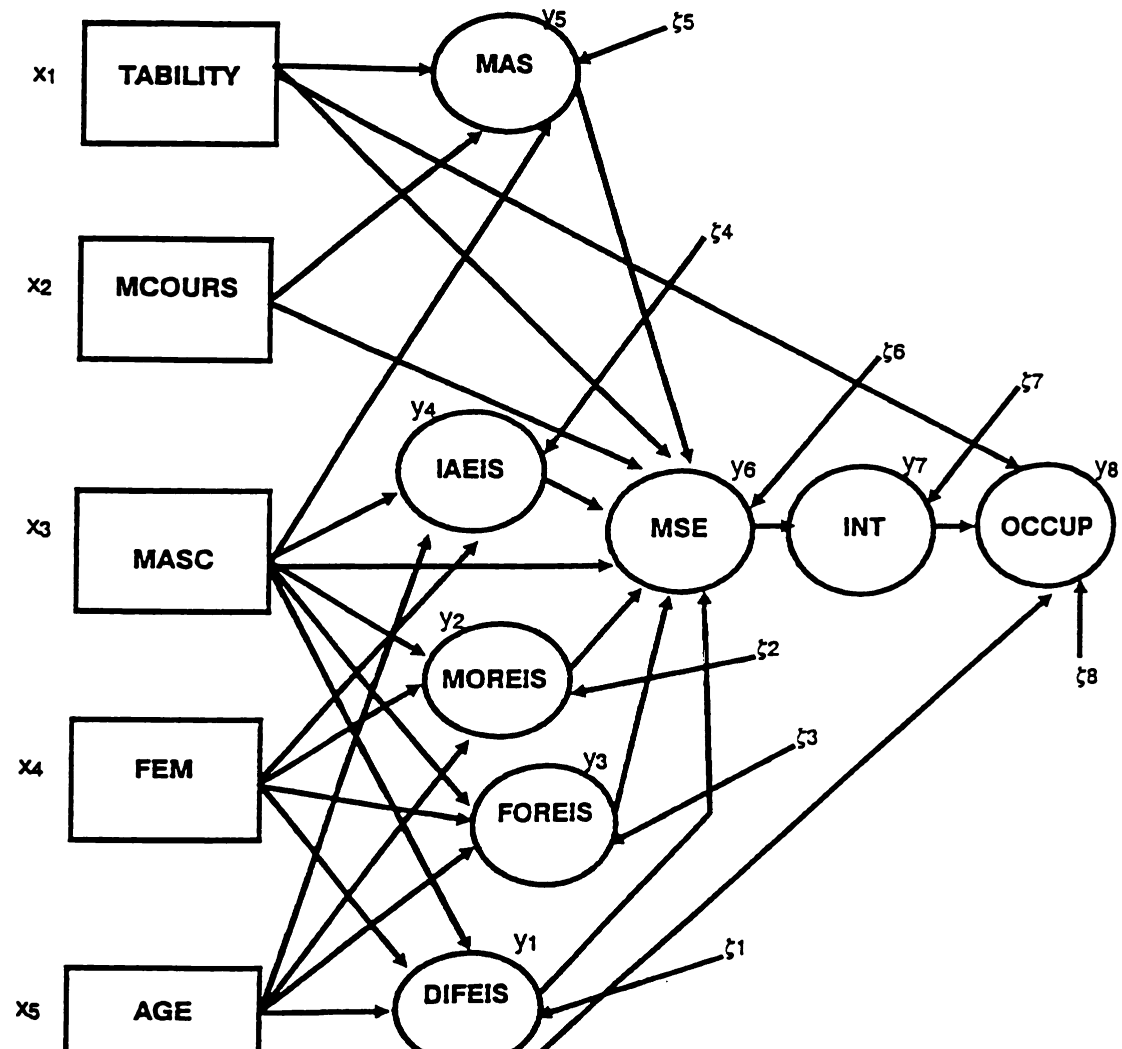
In order to test the revised hypothesized model (see Figure 2), path coefficients were estimated via a series of multiple regressions. Each endogenous variable was regressed on the exogenous and endogenous variables hypothesized to affect it. Beta (standardized regression) coefficients were then examined (Pedhazur, 1982). Given the complexity of the initial model, one goal of the path analysis was to eliminate non-significant paths. Standardized regression coefficients are particularly useful when making comparisons across different variables (Loehlin, 1987; Pedhazur, 1982). All path estimates equal to or greater than .15 were included in the reduced model (see Figure 3). These analyses are presented in Table 7, along with the decomposition of indirect, direct, and total effects for each variable and the calculation of R_2 for the reduced model. The direct effect is defined as the part of the effect that is not mediated by other variables in the model. An indirect effect is the part of the effect mediated by other variables in the model. A total effect of one variable upon another is the sum of its direct and indirect effects (Pedhazur, 1982). Table 8 presents a

Table 7. Decomposition of Effects - Whole Sample

Effect	Causal Effects: Direct	Indirect	Total	R^2 (reduced model)
On OCCUP				
Of INT	-.42	.00	-.42	.17
Of SES	-.01	not included in reduced model		
Of TABILITY	.29	.00	.29	
On INT				
Of MSE	-.54	.00	.54	.30
On MSE				
Of MAS	-.58	.00	-.58	.42
Of IAEIS	.20	.00	.20	
Of FOREIS	.06	not included in reduced model		
Of MOREIS	-.10	not included in reduced model		
Of DIFEIS	-.13	not included in reduced model		
Of MASC	.37	.22	.59	
Of MCOURS	.33	.10	.43	
Of TABILITY	.40	.30	.70	
On MAS				
Of MASC	-.29	.00	-.29	.33
Of MCOURS	-.18	.00	-.18	
Of TABILITY	-.51	.00	-.51	
On IAEIS				
Of AGE	.19	.00	.19	.11
Of MASC	.25	.00	.25	
Of FEM	.12	not included in reduced model		
On FOREIS	This variable not included in reduced model			
Of AGE	-.32			
Of MASC	-.03			
Of FEM	.01			
On MOREIS	This variable not included in reduced model			
Of AGE	-.21			
Of MASC	-.17			
Of FEM	.06			
On DIFEIS	This variable not included in reduced model			
Of AGE	-.20			
Of MASC	-.23			
Of FEM	-.11			

Table 8. Comparison of Beta Weights - Whole Sample

Effect	Estimated B	SE	Standardized B
On OCCUP			
Of INT	-1.180	.150	-.42
Of TABILITY	.034	.008	.29
On INT			
Of MSE	-.135	.012	-.54
On MSE			
Of MAS	-.923	.077	-.58
Of IAEIS	.555	.158	.20
Of MASC	.828	.124	.37
Of MCOURS	.508	.086	.33
Of TABILITY	.067	.011	.40
On MAS			
Of MASC	-.406	.080	-.29
Of MCOURS	-.174	.056	-.18
Of TABILITY	-.051	.006	-.51
On IAEIS			
Of AGE	.221	.046	.19
Of MASC	.018	.008	.25



Structural Equations

$y_1 = \beta_{16}\ y_6 + \gamma_{13}\ x_3 + \gamma_{14}\ x_4 + \gamma_{15}\ x_5 + \zeta_1$

$y_2 = \beta_{26}\ y_6 + \gamma_{23}\ x_3 + \gamma_{24}\ x_4 + \gamma_{25}\ x_5 + \zeta_2$

$y_3 = \beta_{36}\ y_6 + \gamma_{33}\ x_3 + \gamma_{34}\ x_4 + \gamma_{35}\ x_5 + \zeta_3$

$y_4 = \beta_{46}\ y_6 + \gamma_{43}\ x_3 + \gamma_{44}\ x_4 + \gamma_{45}\ x_5 + \zeta_4$

$y_5 = \beta_{56}\ y_6 + \gamma_{53}\ x_3 + \gamma_{54}\ x_4 + \gamma_{55}\ x_5 + \zeta_5$

$y_6 = \beta_{67}\ y_7 + \gamma_{61}\ x_1 + \gamma_{62}\ x_2 + \gamma_{64}\ x_4 + \zeta_6$

$y_7 = \beta_{78}\ y_8 + \zeta_7$

$y_8 = \gamma_{81}\ x_1 + \gamma_{86}\ x_6 + \zeta_8$

Figure 2. Proposed Structural Model - Revised

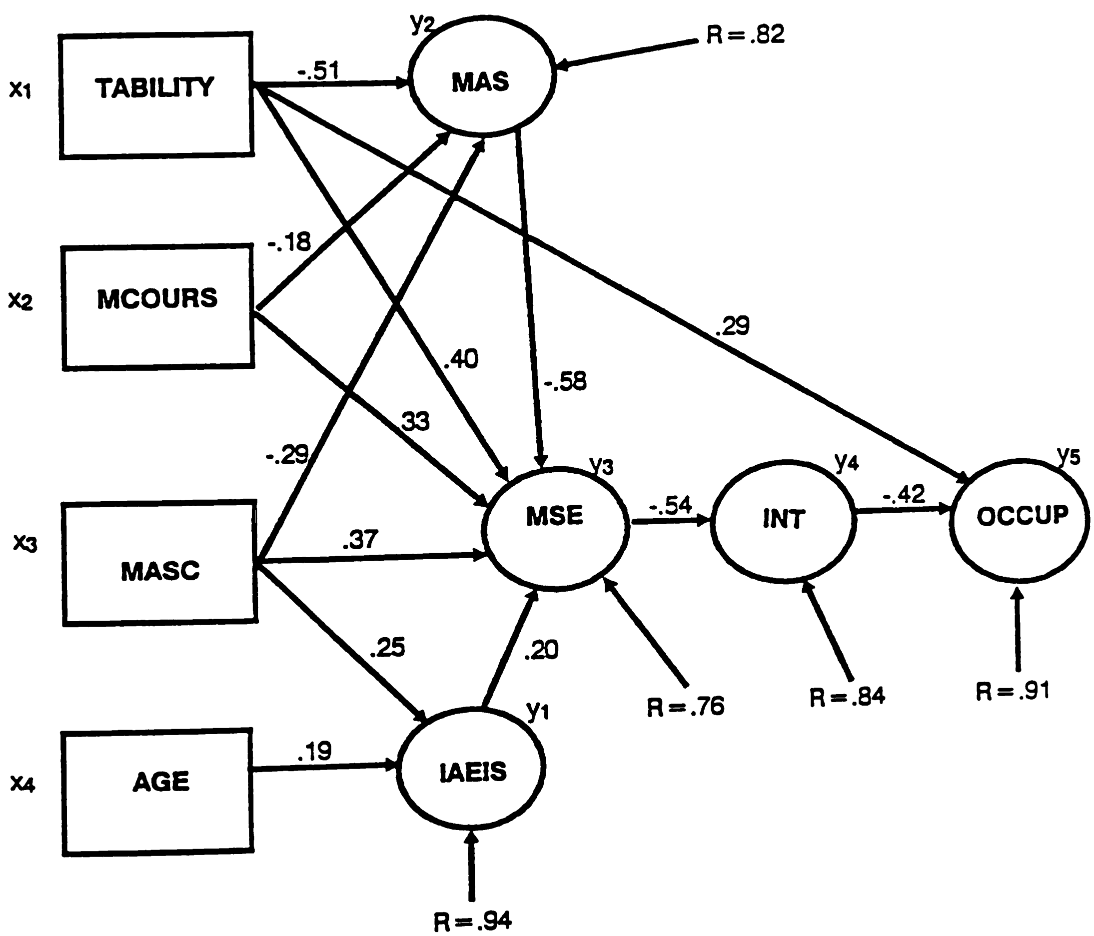


Figure 3. Reduced Path Model - Whole Sample

comparison of the standardized beta for each path included in the reduced model with the estimated beta and its accompanying standard error.

Figure 3 presents the reduced path model with all significant path coefficients (p values > .15) representing the direct influence of one variable upon another. Squaring a path coefficient represents the percentage of explained variance for each path. Path coefficients for the residual variables are also included, and are represented by the R's in Figure 2. These effects have been calculated according to the formula $(1 - R^2)^{1/2}$, or, the square root of 1 minus the percentage of explained variance from each regression equation (Asher, 1976).

Masculinity, number of math courses taken in high school, and math ability level all contributed to the prediction of math anxiety. Together these three variables accounted for 33% of the variance in math anxiety (R^2 = .33).

In the reduced model for the whole sample, three of the identity statuses were excluded (diffusion, moratorium, foreclosure) because they did not contribute significantly to the prediction of math self-efficacy beliefs as hypothesized. Identity achievement status remained a predictor of math self-efficacy beliefs, along with math anxiety, masculinity, number of math courses and math ability level. Together these variables accounted for 42% of the variability in math self-efficacy (R^2 = .42).

Only age and masculinity contributed significantly to the prediction of identity achievement status, accounting for only 11% of the variance ($R^2 = .11$). Clearly, other exogenous variables not included in the model are contributing to the variability in the prediction of identity achievement status.

Math self-efficacy beliefs contributed significantly to the prediction of interest in math/science activities, accounting for 30% of the variance on the interest measure ($R_2 = .30$).

Interest in math/science activities and level of math ability both predicted consideration of math/science occupations, accounting for 17% of the variance ($R^2 = .17$). Socioeconomic status did not contribute to the prediction of math/science occupations as expected.

Data analyses to this point were conducted using SPSSX.

Structural equation modeling. The PRELIS procedure was used to create a matrix system file to be used as the data source for LISREL. The PRELIS procedure allows for the incorporation of user and system defined missing values in the creation of the matrix system file. In addition, the PRELIS procedure allows for specification of pairwise deletion of missing data, rather than listwise deletion. Given the amount of missing data present in the math ability and SES variables, pairwise deletion of missing data was considered to be the optimal alternative (SPSS, 1990).

When the reduced path model presented in Figure 4 was tested using LISREL, it failed to pass the admissibility test. Failure to pass the admissibility test indicates that the computer program does not constrain the solution to be admissible. The model tested in Figure 4 was not found to be admissible because it had a non-positive definite theta epsilon matrix. The program prints the current solution once the admissibility test is failed. Results indicated that the model was a poor fit ($X^2 = 316.68$, $p < .001$). The model in Figure 4 was further explored using listwise deletion of data. Though the fit of the model was improved ($X^2 = 150.57$, $p < .001$), the model was still rejected. Both the theta epsilon and theta delta matrices were non-positive definite. Finally, it was decided to explore whether the low internal consistency of the masculinity measures (coefficient alpha ranged from .54 to .57) was responsible for the failure of LISREL to explore the model. Since the original masculinity scale was split in order to provide us with two separate measures, it was combined again for the analysis. This model also failed to pass the admissibility test because the psi matrix was not positive definite. In addition, the fit of this model was also poor ($X^2 = 835.18$, $p < .001$).

The possibility that the model in Figure 4 was not identified was explored. Pedhazur (1982) stated that causal models can be just identified, overidentified or underidentified. Overidentification is desirable, and exists when there are more equations than there are

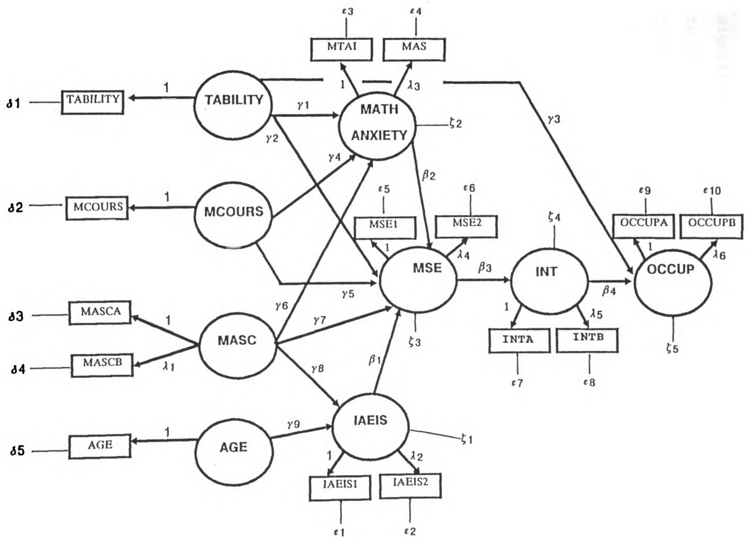


Figure 4. Reduced Stuctural and Measurement Model

unknowns. An overidentified model can be tested for significance. The model represented in Figure 4 was found to be overidentified. Loehlin (1987) reports that Monte Carlo studies have shown that both convergence problems and negative estimates of residual variance can be attributed to sample size and number of indicators per factor. In such studies, problems commonly occurred with sample sizes of less than 100 with only two indicators per factor. Problems rarely occurred with three or more indicators per factor and samples sizes of 200 or more (Loehlin, 1987). The present study has an adequate sample size (n ranges from 288-89) for all variables with the exception of math ability level (n = 193), but has at most only two indicators per factor. It was thus decided to eliminate the measurement portion of the equations and use LISREL to test the structural portion. In order to test the structural portion, the split scales were combined to form a composite scale for each variable with the exception of the math anxiety variable. Two separate measures (the Math Anxiety Scale and the revised Test Anxiety Inventory) were used to measure math anxiety. The Math Anxiety Scale was chosen as the measure of math anxiety because it has been used previously in the literature by other math self-efficacy researchers (i.e., Hackett, 1985). In addition, the revised Test Anxiety Inventory had never been used as a measure of math anxiety prior to its inclusion in this study.

Table 9 presents a summary of the overall and detailed

Table 9. Summary of Model Fit Information - Whole Sample

Model	χ^2	df	p	Goodness of Fit Index	Root Mean Square Residual	Coefficient of Determination: Structural Equation	Squared Multiple Correlations[a]: Equations	Modification Indices[a]	t-values[a]	Standardized Residuals[a]
Initial	37.41	17	.003	.962	.049	.50	IAEIS= .110 OCCUP= .182	MSE/THETA EPSILON= 9.60	MCOURS/MAS= -.103 TABILITY/MSE= 1.68	TABILITY/INT= -2.72 OCCUP/INT= -2.31
Revised	29.92	16	.042	.97	.037	.582	IAEIS= .110 OCCUP= .191	MSE/AGE= 10.35	MCOURS/MAS= -1.03	-- --
Final	15.98	16	.454	.98	.033	.625	IAEIS= .110 OCCUP= .193	-- --	IAEIS/MSE= 1.377	-- --

[a] Reported values are those which indicate a need for modification of the model.

fit information for the Initial, Revised and Final Models for the whole sample. The testing of the Initial Model produced a significant X^2 (X^2=37.41, df=17, $p < .003$). A significant X^2 indicates the rejection of the null hypothesis, suggesting that the model being tested is not a plausible one in the population. Since the X^2 statistic is easily influenced by sample size, other measures of fit were also examined including the goodness of fit index and the root mean square residual. The goodness of fit index is interpreted similarly to a correlation coefficient in terms of desirable values (Fassinger, 1987) and is relatively free from the influence of sample size (Marsh, Balla, & McDonald, 1988). The value of .962 is indicative of a good fit of the initial model to the sample data. The root mean square residual for the Initial Model is also supportive of the model. Values close to zero are desirable; the value of .049 in this model is desirable (Fassinger, 1987).

Detailed fit information presented in Table 9 suggested where some of the fit problems in the Initial Model were located. The coefficient of determination for the structural equations (which indicates the overall strength of the relations among the latent variables; Fassinger, 1987) is moderate (.50), suggesting structural weaknesses. The equations predicting identity achievement status and consideration of math/science careers have low squared multiple correlations (.110 and .182, respectively), again indicating structural weakness. Squared multiple correlations for equations are an indication of how accurate a measure is and an indication of the strength of the relationships among the latent variables (Fassinger, 1987). In addition, there are two standardized residuals which are significantly greater than 2.0, indicating that the relationships between these pairs of variables (math ability and math/science interests, math/science occupations and math/science interest) are not being fit well.

Possible problems in the prediction of math anxiety is supported by a non-significant t-value for the path between number of math courses and math anxiety (t = -.103). Possible problems in the prediction of math self-efficacy beliefs is supported by a non-significant t-value for the path between math ability and math self-efficacy beliefs (t = 1.68). Values of t less than 2.0 determine which paths might be removed from the model without large increases in X^2 (Fassinger, 1987). There is also a high modification index for one indicator (math self-efficacy beliefs in relation to theta epsilon) indicating the possibility of measurement error in the math self-efficacy beliefs variable (Joreskog & Sorbom, 1989).

Based on the above fit information, only one modification was made in the Revised Model. The math self-efficacy beliefs variable was allowed to vary in the theta epsilon matrix in order to account for possible measurement error in this variable. As a result, the overall fit of the model improved. The value for X^2 was barely significant (X^2

= 26.92; $p < .042$). The goodness of fit index increased to .97 and the root mean square residual decreased to .037; both are indications of improved model fit. Though the coefficient of determination improved to .582, the low squared multiple equations for identity achievement status and occupations stayed approximately the same indicating structural weakness in the model. Normalized residuals for variables were all less than 2.0, indicating that relationships between variables were being fit well in the Revised Model. Finally, the t-value of -.103 indicates that the path between number of math courses and math self-efficacy beliefs can be eliminated. A high modification index of 10.35 indicated that the path between age and math self-efficacy beliefs be added to the model.

The following modifications in the model were made prior to testing the Final Model. Based on the non-significant t-value, the path between number of math courses and math anxiety was eliminated. Theoretically, it seemed plausible that the other variables predicting math anxiety (masculinity and math ability level) might subsume the effects of the number of math courses variables. In addition, a path between age and math self-efficacy beliefs was added. It seemed possible that older students, further along in their high school or college education, would have higher math self-efficacy beliefs. The overall fit information for the Final Model was very supportive. The X^2 value of 15.98 was non-significant ($p=.454$), the goodness of fit index improved to .98, and the root mean square residual improved to .033. All these are supportive of the Final Model being plausible in the sample. Though the coefficient of determination increased to .625, it still fell somewhat short of an acceptable value of .70. The squared multiple correlations for identity achievement status and math/science occupations also remained the same. Thus, though the overall fit information is supportive of the model there is still some indication of structural weakness in the model. Finally, the t-value for the path between identity achievement status and math self-efficacy beliefs ($t = 1.377$) indicates that this path should be eliminated.

Despite the suspicion of structural weakness between endogenous variables, other changes in the model did not seem statistically or theoretically justified, and thus the Final Model is presented in Figure 5 with parameter values.

Gender Differences

In order to decide whether separate models should be fitted for males and females, Box's M test was conducted. Box's M test examines whether variance-covariance matrices are homogenous (Tabachnik & Fidell, 1989). Results of this test can be found in Table 10 and indicate that the variance-covariance matrices are different for males and females. Given these results, separate models for males and females were explored and fitted.

In addition, univariate analyses of variance of each variable by sex were also conducted ($df = 1, 141$). Results

Table 10. Homogeneity of Variance-Covariance Matrices-Gender

Box's M	F	df	p	χ^2	df	p
163.20	1.38	105,48887	.006	145.77	105	.000

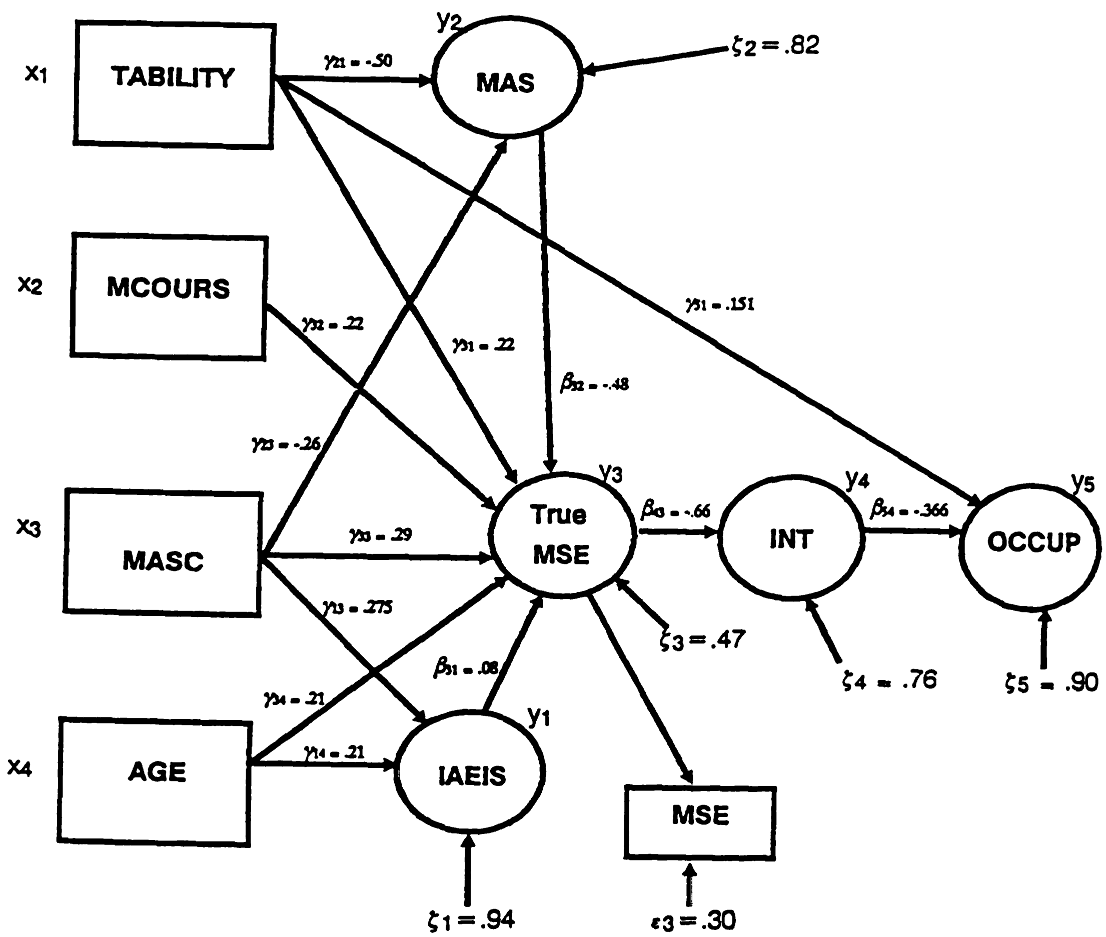


Figure 5. Final Structural Model - Whole Sample

are presented in Table 11. Examination of mean scores revealed that males scored significantly higher than females on the following variables: masculinity ($p < .001$), math ability ($p < .001$), math self-efficacy beliefs ($p < .001$), interest in math/science activities ($p < .001$), and consideration of math/science careers ($p < .001$). Examination of mean scores revealed that females scored significantly higher than males of the following variables: femininity ($p < .001$), math anxiety ($p < .020$), and moratorium ($p < .031$).

Path analysis for Males. Decomposition of the direct, indirect, and total effects for the path analysis for males can be found in Table 12. R^2 for the reduced model is also presented in Table 12. Comparison of the standardized and estimated beta weights can be found in Table 13. All paths with a p value of less than .15 were excluded from the reduced model. Figure 6 presents the path model with the significant paths and the path coefficients for the residuals.

Masculinity, number of math courses, and math ability level all significantly contributed to the prediction of math anxiety. Together, these variables accounted for 40% of the variance in the math anxiety measure ($R^2 = .40$).

Of the identity statuses, both identity achievement and diffusion significantly contributed to prediction of math self-efficacy beliefs, as did math anxiety, masculinity, number of math courses and math ability. These variables

Table 11. Univariate Analysis of Variance - Gender

Variable	M Men	M Women	F	Significance of F
SES	63.24	63.72	.452	.503
AGE	6.41	7.36	1.159	.283
MASC	5.27	4.94	10.655	.001**
FEM	4.71	5.34	32.545	.000**
MCOURS	2.42	2.27	1.066	.304
TABILITY	54.88	50.26	14.198	.000**
DIFEIS	2.85	2.74	.61	.434
MOREIS	3.11	3.28	4.72	.031*
FOREIS	2.32	2.11	2.58	.110
IAEIS	3.96	3.95	.33	.568
MAS	2.75	3.15	5.51	.020*
MSE	6.97	6.04	24.49	.000**
INT	1.83	2.04	11.71	.001**
OCCUP	2.25	1.49	27.72	.000**

Significance levels: *$p < .05$; **$p < .001$

Table 12. Decomposition of Effects - Males

Effect	Causal Effects Direct	Indirect	Total	R^2 (reduced model)
On OCCUP				
Of INT	-.35	.00	-.35	.12
Of SES	-.00	not included in reduced model		
Of TABILITY	.27	.00	.27	
On INT				
Of MSE	-.54	.00	.54	.30
On MSE				
Of MAS	-.45	.00	-.45	.30
Of IAEIS	.22	.00	.22	
Of FOREIS	.04	not included in reduced model		
Of MOREIS	-.09	not included in reduced model		
Of DIFEIS	-.20	.00	-.20	
Of MASC	.33	.27	.60	
Of MCOURS	.32	.10	.42	
Of TABILITY	.24	.22	.46	
On MAS				
Of MASC	-.32	.00	-.32	.40
Of MCOURS	-.23	.00	-.23	
Of TABILITY	-.51	.00	-.51	
On IAEIS				
Of AGE	.23	.00	.23	.32
Of MASC	.22	.00	.22	
Of FEM	.13	not included in reduced model		
On FOREIS	This variable not included in reduced model			
Of AGE	-.25			
Of MASC	-.01			
Of FEM	.08			
On MOREIS	This variable not included in reduced model			
Of AGE	-.13			
Of MASC	-.28			
Of FEM	-.03			
On DIFEIS				.20
Of AGE	-.15	.00	-.15	
Of MASC	-.41	.00	-.41	
Of FEM	-.15	.00	-.15	

Table 13. Comparison of Beta Weights for Males

Effect	Estimated B	SE	Standardized B
On OCCUP			
Of INT	-1.158	.283	-.35
Of TABILITY	.035	.014	.27
On INT			
Of MSE	-.146	.021	-.54
On MSE			
Of MAS	-.756	.138	-.45
Of IAEIS	.530	.215	.22
Of DIFEIS	-.489	.217	-.20
Of MASC	.660	.174	.33
Of MCOURS	.400	.108	.32
Of TABILITY	.031	.014	.24
On MAS			
Of MASC	-.386	.105	-.32
Of MCOURS	-.167	.067	-.23
Of TABILITY	-.046	.009	-.51
On IAEIS			
Of AGE	.023	.009	.23
Of MASC	.182	.076	.22
On DIFEIS			
Of AGE	-.015	.009	-.15
Of MASC	-.339	.071	-.41
Of FEM	-.152	.090	-.15

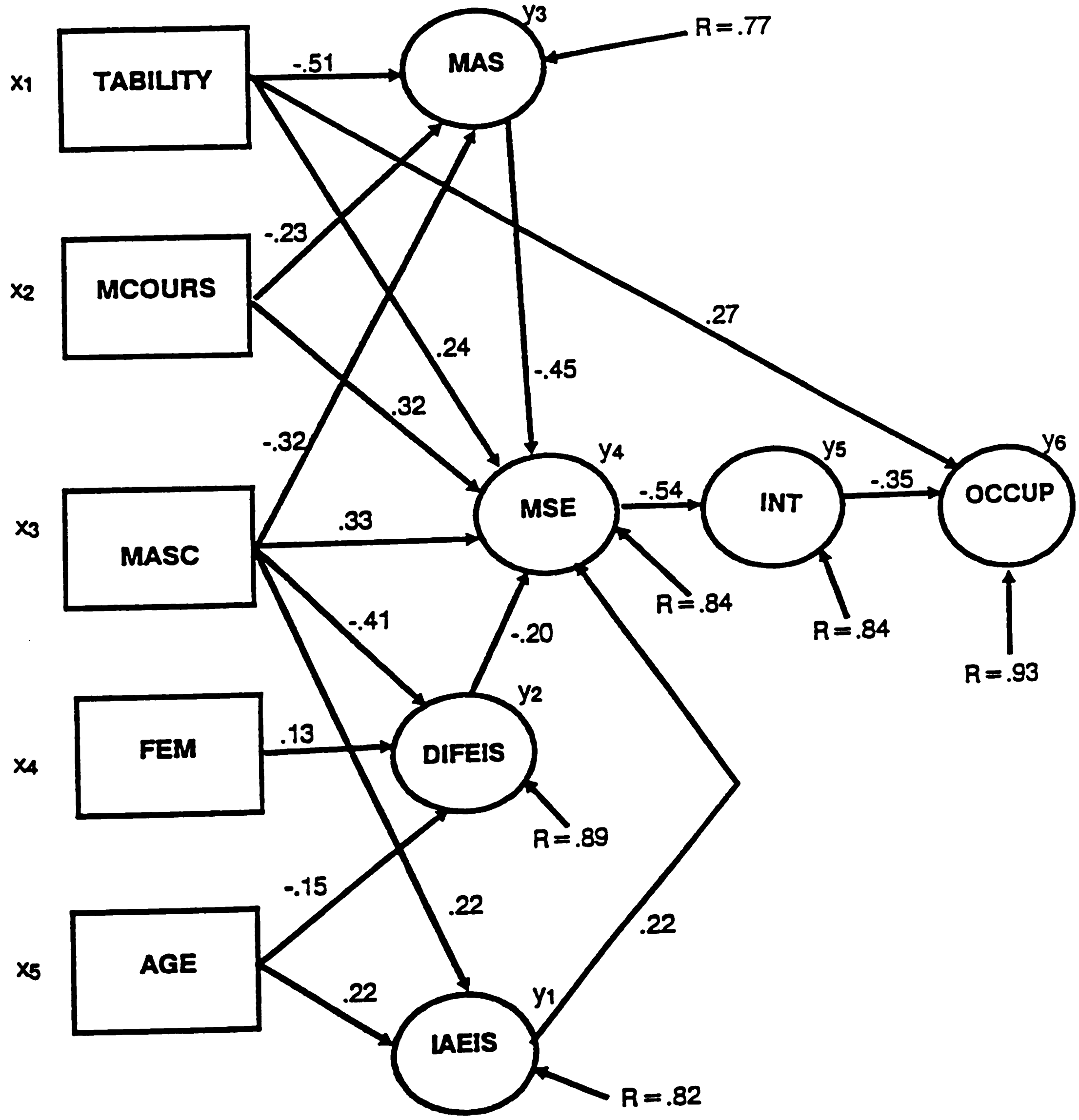


Figure 6. Reduced Path Model for Males

accounted for 30% of the variance in math self-efficacy beliefs (R^2 = .30). Age and masculinity were both significant predictors of identity achievement and diffusion statuses, while femininity was a significant predictor for diffusion status only. Thirty-two percent of the variance was accounted for in identity achievement status (R^2 = .32) and 20% of the variance was accounted for in the diffusion status (R^2 = .20).

As expected, math self-efficacy was a significant predictor of interest in math/science activities. The math self-efficacy beliefs variable accounted for 30% of the variance in the math/science interests variable (R^2 = .30).

Both interest in math/science activities and math ability were significant predictors of consideration of math/science occupations. Together, these two variables accounted for 12% of the variance (R^2 = .12).

Structural equation modeling for males. The PRELIS procedure was used to create a matrix system file to be used as a data source for LISREL. Table 14 is a summary of the overall and detailed fit information for the Initial, Revised, and Final Models for male sample.

The test of the Initial Model produced a non-significant X^2 (X^2 = 33.29, $p < .225$), indicating that the Initial Model is a plausible one for the data. The goodness of fit index of .933 is also supportive of the data. The root mean square residual of .085 is somewhat higher than the desirable value of .05.

Table 14. Summary of Model Fit Information-Males

Model	χ^2	df	p	Goodness of Fit Index	Root Mean Square Residual	Coefficient of Determination: Structural Equation	Squared Multiple Correlations[a]: Equations	Modification Indices[a]	t-values[a]	Standardized Residuals[a]
Initial										
	33.29	28	.225	.933	.085	.132	OCCUP= .076 INT= .126 IAEIS= .110	INT/MAS= 7.319 OCCUP/THETA EPSILON=5.29	IAEIS/MSE= .127 DIFEIS/MSE= -5.62 AGE/DIFEIS= -1.635 MASC/IAEIS= 1.68 FEM/DIFEIS= -.328 MCOURS/MAS= .266 TABILITY/MSE= .160	INT/MSE= -2.8 INT/MAS= -2.61
Revised										
	20.80	19	.348	.949	.08	.473	OCCUP= .076	OCCUP/THETA EPSILON=5.287 INT/TABILITY= 5.287 MAS/INT= 7.374 OCCUP/INT= 5.287	IAEIS/MSE= 1.270 MASC/IAEIS= 1.681	INT/MSE= -2.729 INT/MAS= 2.624
Final										
	8.31	9	.503	.972	.067	.185	INT= .028			

[a] Reported values are those which indicate a need for modification of the model.

There were some indications of structural weaknesses in the model. The coefficient of determination of .132 was much lower than acceptable, as were the squared multiple correlations for the equations for math/science occupations, interest in math/science activities, and identity achievement status. The standardized residuals for two pairs of variables (interest in math/science activities and math self-efficacy beliefs, and interest in math self-efficacy beliefs and math anxiety) indicated that the relationships between these variables were not being fit well.

The t-values for a number of paths were non-significant, indicating that these paths should be deleted. In particular, the paths which involved either identity achievement or diffusion identity status seemed to have low t-values. Modification indices indicated that adding a path between math/science interests and math anxiety and freeing the occupation variable in theta epsilon would increase the fit of the model.

It was decided to delete all the paths with t-values of less than 1.0. As a result, the diffusion and femininity variables were deleted, as were the paths between number of math courses and math anxiety, and math ability level and math self-efficacy beliefs. The overall fit information for the Revised Model was generally supportive: a non-significant X^2 value of 20.80 was obtained ($p < .348$), the goodness of fit index increased to .933, and the root mean square residual decreased slightly to .08. However, there were continuing indications of structural weakness in the model. Though the coefficient of determination increased to .473, it was still considered a low value. The squared multiple correlation for the occupation, identity achievement status and interest in math/science activities equations remained the same. In addition, the two standardized residuals which were greater than 2.0 in the Initial Model (interest in math/science activities and math anxiety and math self-efficacy beliefs) remained.

The t-values for the paths between identity status and math self-efficacy beliefs, and between masculinity and identity achievement status, were below 2.0, indicating that these paths should be deleted. Modification indices supported adding a path between math/science interests and one or more of the following variables: math ability, math anxiety, or occupations. Measurement error in the occupations variable was also indicated.

For the Final Model (see Figure 7), the identity achievement status variable was eliminated and the occupations variable was allowed to vary in theta epsilon. Once again, the overall fit information for the Final Model improved. The X^2 value decreased to 8.31 and was non-significant ($p < .503$), the goodness of fit index increased to .972 and the root mean square residual decreased to .067. The detailed fit information revealed continued structural weakness in the model, as the coefficient of determination

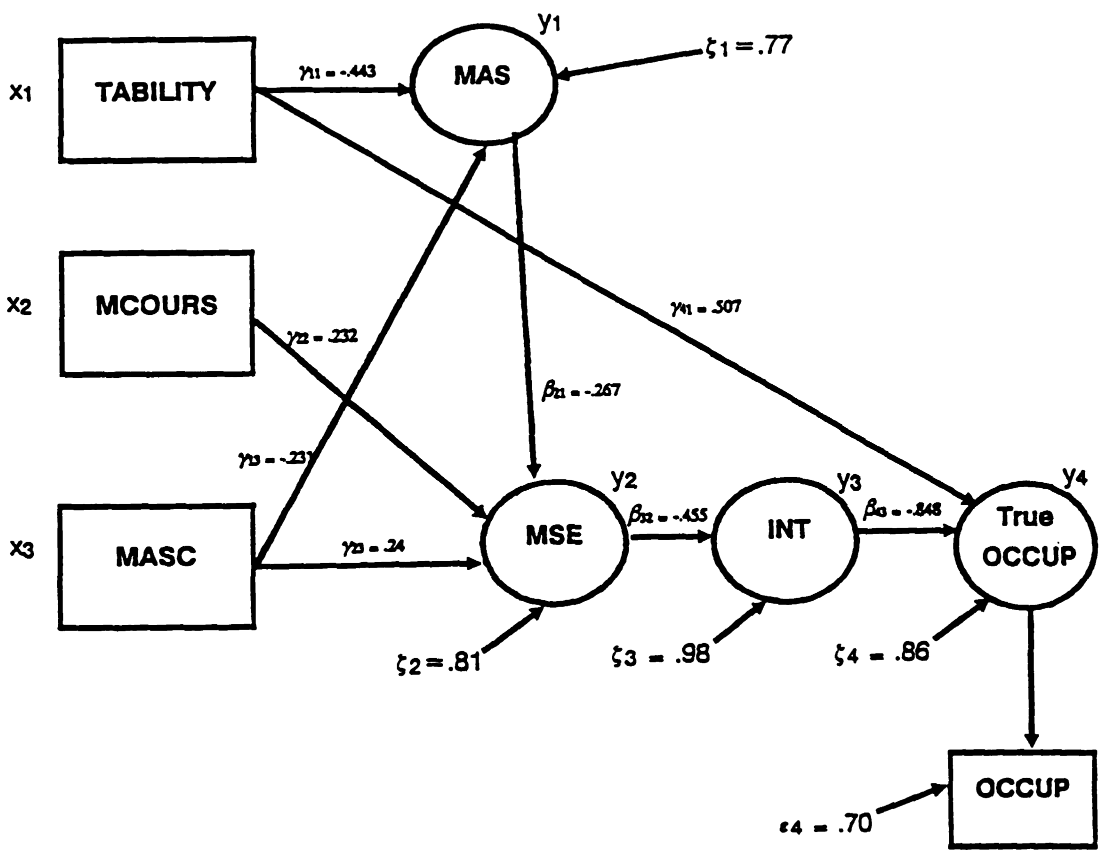


Figure 7. Final Structural Model for Males

decreased to .185. However, the only equation with a squared multiple correlation less than 2.0 was the one for interest in math/science activities. In addition, all of the standardized residuals were less than 2.0 indicating good fit between variables. None of the t-values for paths were greater than 2.0, and the modification indices were small.

No other changes were made in the model, despite the suspicion of structural weakness between variables. The Final Model for males is presented in Figure 7.

Path analysis for females. Decomposition of the direct, indirect, and total effects for the path analysis for females can be found in Table 15. R^2 for the reduced model can also be found in Table 15. All paths with p-values less than .15 were not included in the reduced model. Table 16 is a comparison of the standardized and estimated beta weights for each path included in the reduced model. Figure 8 presents the reduced model with significant paths and path coefficients for the residuals.

Masculinity, number of math courses, and math ability level all contributed significantly to the prediction of math anxiety as expected. These three variables accounted for a total of 29% of the variance ($R^2 = .29$) in this variable.

Identity achievement status was the only identity status variable which significantly predicted math self-efficacy beliefs, in addition to math anxiety, masculinity,

Table 15. Decomposition of Effects-Females

Effect	Causal Effects: Direct	Indirect	Total	R^2 (reduced model)
On OCCUP				
Of INT	-.41	.00	.41	.14
Of SES	-.03	not included in reduced model		
Of TABILITY	.21	.00	.21	
On INT				
Of MSE	-.49	.00	.49	.24
On MSE				
Of MAS	-.61	.00	-.61	.51
Of IAEIS	.18	.00	.18	
Of FOREIS	.02	not included in reduced model		
Of MOREIS	-.04	not included in reduced model		
Of DIFEIS	-.12	not included in reduced model		
Of MASC	.32	.18	.50	
Of MCOURS	.37	.10	.47	
Of TABILITY	.44	.30	.74	
On MAS				
Of MASC	-.22	.00	.22	.29
Of MCOURS	-.17	.00	.17	
Of TABILITY	-.50	.00	-.50	
On IAEIS				
Of AGE	.16	.00	.16	.12
Of MASC	.28	.00	.28	
Of FEM	.15	.00	.15	
On FOREIS	This variable not included in reduced model			
Of AGE	-.37			
Of MASC	-.09			
Of FEM	.09			
On MOREIS	This variable not included in reduced model			
Of AGE	-.27			
Of MASC	-.03			
Of FEM	.03			
On DIFEIS	This variable not included in reduced model			
Of AGE	-.23			
Of MASC	-.14			
Of FEM	-.00			

Table 16. Comparison of Beta Weights for Females

Effect	Estimated B	SE	Standardized B
On OCCUP			
Of INT	.956	.165	-.41
Of TABILITY	.023	.010	.21
On INT			
Of MSE	-.117	.016	-.49
On MSE			
Of MAS	-1.029	.127	-.61
Of IAEIS	.516	.216	.18
Of MASC	.776	.176	.32
Of MCOURS	.635	.124	.37
Of TABILITY	.082	.016	.44
On MAS			
Of MASC	-.344	.119	-.22
Of MCOURS	-.193	.086	-.17
Of TABILITY	-.056	.009	-.50
On IAEIS			
Of AGE	.014	.006	.16
Of MASC	.238	.063	.28
Of FEM	.155	.080	.15

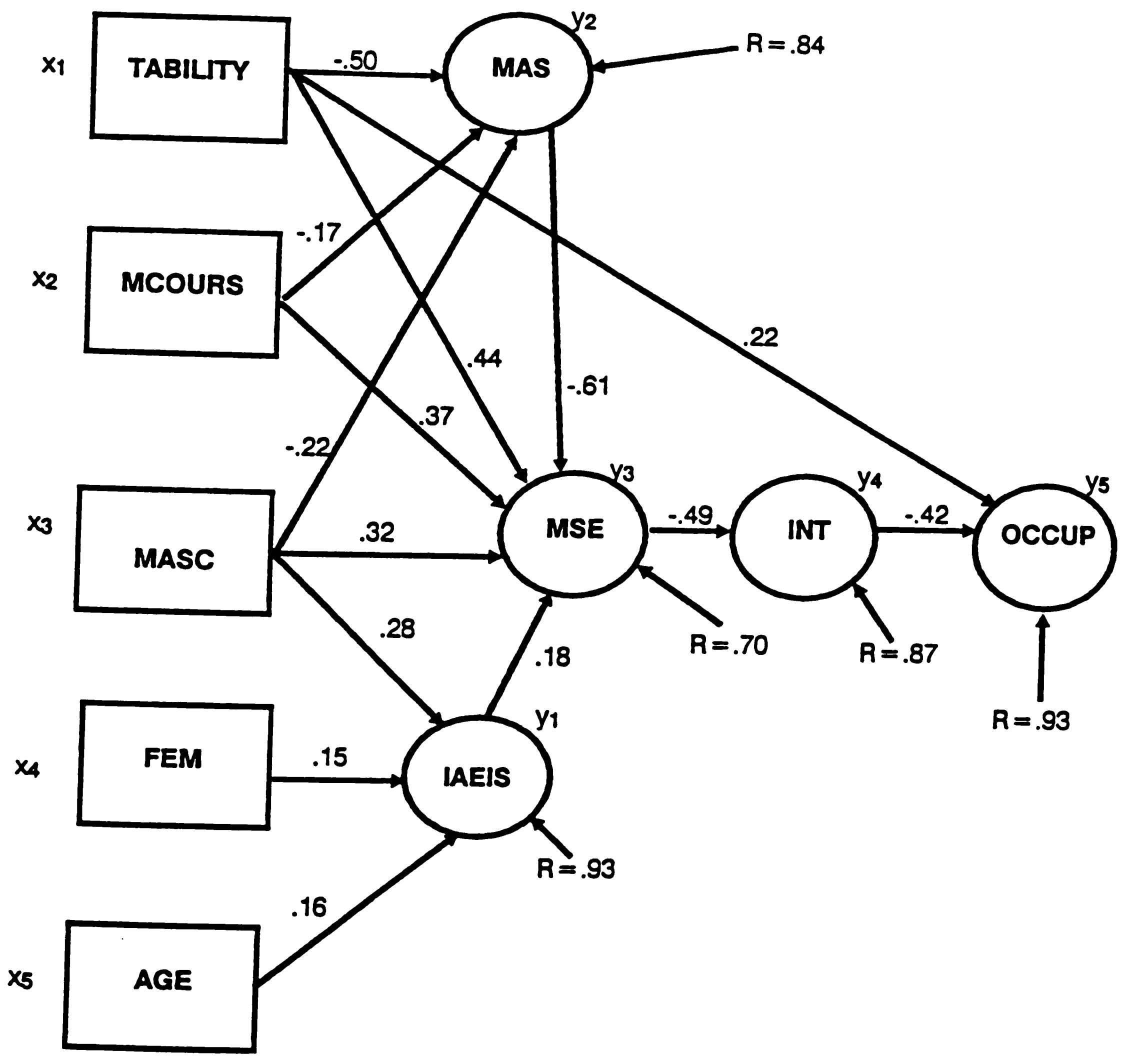


Figure 8. Reduced Path Model for Females

number of math courses and math ability level. A total of 51% of the variance (R^2 = .51) in math self-efficacy beliefs was accounted for by these variables.

Age, masculinity, and femininity all were significant predictors of the identity achievement status variable. These variables accounted for 12% of the variance in identity achievement status (R^2 = .12).

The math self-efficacy beliefs variable was a significant predictor of interest in math/science activities, accounting for 24% of the variance (R^2 = .24). In turn, interest in math/science activities, along with math ability level, were significant predictors of consideration of math/science careers. These two variables accounted for 14% of the variance in the occupations variable (R^2 = .14).

<u>Structural equation modeling for females</u>. The PRELIS procedure was used to create a matrix system file to be used as a data source for LISREL. Table 17 is a summary of the overall and detailed fit information for the Initial, Revised, and Final Models for the female sample.

The X^2 for the Initial Model was significant (X^2 = 56.98, df = 21, $p < .001$) indicating that the current model was not one which was plausible in the female sample. The other overall fit information was also generally non-supportive. The goodness of fit index of .918 was smaller than desired, while the root mean square residual was higher than is desirable (.092).

Table 17. Summary of Model Fit Information - Females

Model	χ^2	df	p	Goodness of Fit Index	Root Mean Square Residual	Coefficient of Determination: Structural Equation	Squared Multiple Correlations[a]: Equations	Modification Indices[a]	t-values[a]	Standardized Residuals[a]
Initial										
	56.98	21	.000	.918	.092	.449	OCCUP= .046 IAEIS= .122	INT/MAS 6.75 INT/MSE= 16.84 OCCUP/INT= 11.47 AGE/MAS= 10.70 MAS/INT= 7.24 MCOURS/INT= 8.33 TABILITY/INT= 11.47 OCCUP/THETA EPSILON=11.47	IAEIS/MSE= 1.11 MASC/MAS= -.831 FEM/IAEIS= .754 MCOURS/MAS= 1.536	INT/MSE= -4.72 MASC/INT= -3.22 TABILITY/MSE= -3.35 MASE/MAS= 2.79
Revised										
	21.34	9	.011	.951	.082	.447	OCCUP = .195	INT/MSE= 8.165 OCCUP/MSE= 3.22 MASC/INT= 8.78 MASC/OCCUP= 12.47		INT/MSE= -2.66 MASC/INT= -3.21
Final										
	8.11	8	.423	.981	.036	.519				

[a] Reported values are those which indicate a need for modification of the model.

The detailed fit information was also non-supportive of the model, and was indicative of structural weakness. The coefficient of determination was low, as were the squared multiple equations for occupation and identity achievement status. There were also numerous residuals greater than 2.00; in particular, the fit of the relationship between interest in math/science activities and math self-efficacy beliefs was particularly weak.

Low t-values between identity achievement status and math self-efficacy beliefs, masculinity and math anxiety, femininity and identity achievement status, and number of math courses and math anxiety indicated these paths should be deleted. The modification indices suggested a number of additional paths to be added to the model.

After careful consideration, the Initial Model was revised. The identity achievement status, age and femininity variables were dropped from the model. In addition, the paths between masculinity and math anxiety, and number of math courses and math anxiety were eliminated. Finally, in order to account for possible measurement error, the occupations variable was allowed to vary in the theta epsilon matrix.

Overall fit information for the Revised Model was more supportive. The X^2 value decreased to 21.34, though it was still significant ($p < .01$). The goodness of fit index increased to .951, while the root mean square residual decreased to .082.

The detailed fit information was also more supportive of the Revised Model for females. Though the coefficient of determination for the structural equations dropped slightly to .447, the squared multiple coefficient for the occupation equation increased to .195. In general, there were fewer standardized residuals greater than 2.0, however, two pairs were still greater than 2.0: interest in math/science activities and math self-efficacy beliefs, and masculinity and interest in math/science activities.

All t-values were greater than 2.0, indicating that none of the paths should be deleted. Modification indices indicated that a path should be added between masculinity and consideration of math/science occupations.

For the Final Model for females, the path between masculinity and consideration of math/science occupations was added to the model. The inclusion of this path seemed theoretically congruent and worth exploring. The overall fit information for this model was highly supportive. A non-significant X^2 of 8.11 was obtained ($p < .423$), the goodness of fit index increased to .981, and the root mean square residual decreased to a desirable value of .036.

Detailed fit information was also mainly supportive. None of the standardized residuals were greater than 2.0 and all of the squared multiple correlations for equations were greater than .325. The coefficient of determination increased slightly to .519, which still fell short of a desirable value of .70. None of the t-values were greater than 2.0 and the modification indices were all quite small (less than 4).

Given this generally supportive data, no further changes were made in the model. The Final Model is presented in Figure 9.

Post hoc analyses for females. The direct effect of masculinity scores on the consideration of math/science career aspirations was further explored. Specifically, the role of masculinity as a potential moderator of the relationship between math self-efficacy and interest in math/science activities was examined. Using a median split, the female sample was divided into high and low masculinity groups. The zero-order correlations of math self-efficacy and interest in math/science activities were calculated for both subgroups. A non-significant difference was found between the zero-order correlation of math self-efficacy beliefs and interest in math/science activities for the high masculine ($r = -.40$) and low masculine ($r = -.51$) groups, using Fisher's r to Z transformation ($z = -.87$, $p < .19$).

The role of identity achievement as a potential moderator of the relationship between math self-efficacy and interest in math/science activities was also explored. Again, using a median split, the female sample was divided into high and low identity achievement groups. The zero order correlations of math self-efficacy and interest in math/science activities were then calculated for each subgroup. A significant difference was observed between the

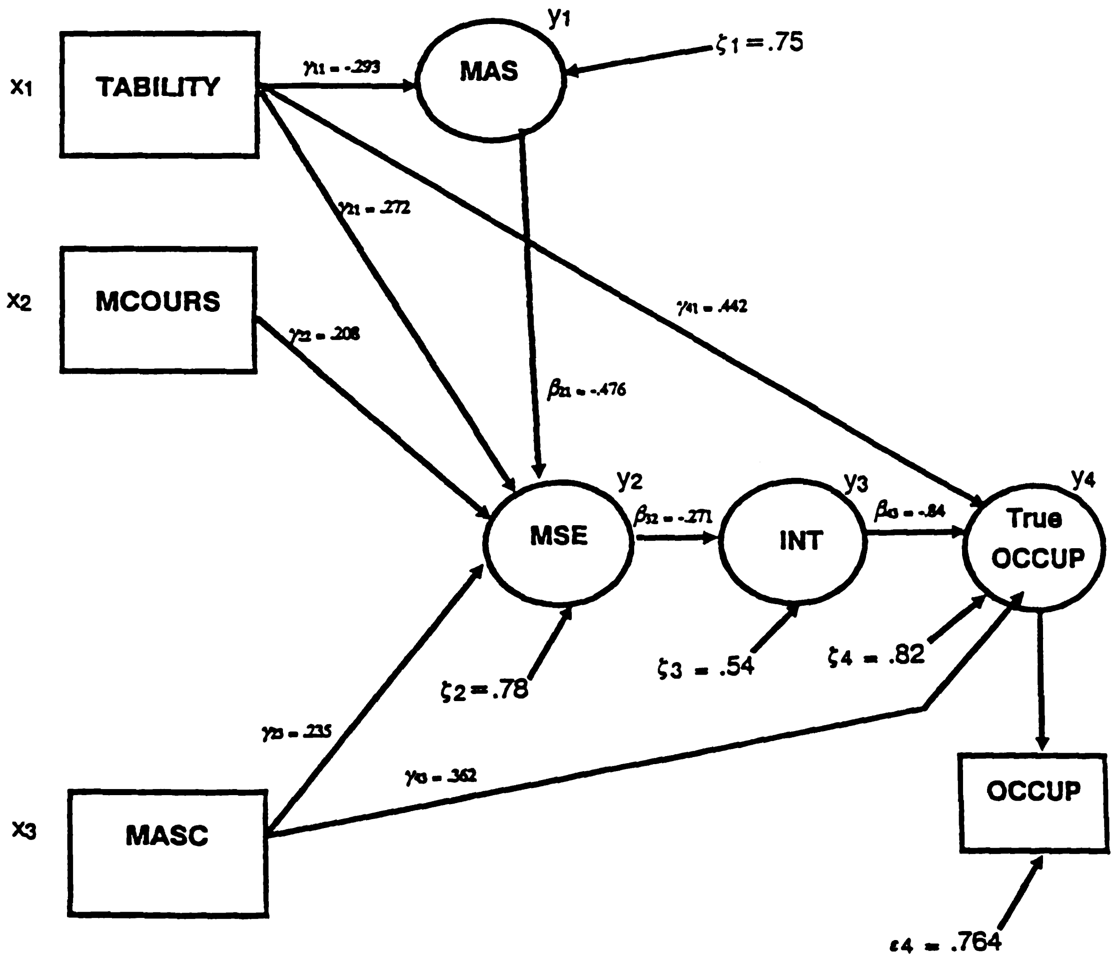


Figure 9. Final Structural Model for Females

zero order correlation of math self-efficacy beliefs and interest in math/science activities for females in the high identity achievement ($r = -.365$) and low identity achievement ($r = -.717$) groups, using Fisher's r to z transformation ($z = -2.37$, $p < .01$). When repeating the same analysis for males, no significant differences were found using Fisher's r to z transformation ($z = -.572$, $p < .284$). The zero order correlations between math self-efficacy beliefs and interest in math/science activities for males in the high identity achievement ($r = -.507$) and low identity achievement ($r = -.585$) groups were nearly equal.

The role of identity achievement as a possible mediator of the relationship between math self-efficacy and math/science interest as well as the relationship between masculinity and self-efficacy beliefs was also explored through the use of partial correlations. Partial correlations describe the relationship between two variables while adjusting for the effects of another variable. Results indicate that identity achievement did not mediate the relationship between math self-efficacy beliefs and interest in math/science activities, or the relationship between masculinity and math self-efficacy beliefs.

Sample Differences

In order to determine whether the models should be fitted separately for the high school and college sample, Box's M test was calculated (see Table 18). The results of this test indicated that the variance-covariance matrices

Table 18. Homogeneity of Variance-Covariance Matrices-Sample

Box's M	F	df	p	χ^2	df	p
321.32	2.71	105,41722	.000	285.89	105	.000

for these two groups are significantly heterogenous ($p < .001$). Thus, separate models were tested and fitted for both the college and high school samples.

In addition, univariate analyses of variance were conducted for each variable by sample type (df = 1, 141; see Table 19). Examination of mean scores revealed that as expected, high school students were younger than college students ($p < .001$). Also as expected, high school students were more likely to be in the foreclosure status than college students ($p < .002$). High school students also reported coming from significantly higher socioeconomic backgrounds than did college students ($p < .015$).

Somewhat surprisingly, college students reported significantly higher levels of math anxiety than did their younger counterparts ($p < .001$). It was also surprising that high school students had significantly higher levels of math ability than did college students ($p < .001$). As mentioned earlier, this difference may be due to measurement error. However, given that college students reported higher levels of math anxiety, and similar math/self-efficacy beliefs, math/science career aspirations, and similar levels of interest in math/science activities it may also be a true difference in the two populations sampled.

Path analysis for the college sample. Decomposition of the direct, indirect, and total effects for the path analysis for the college sample can be found in Table 20. R^2 values for the reduced model can also be found in Table 20. All

Table 19. Univariate Analysis of Variance by Sample

Variable	*M* High School	*M* College	F	Significance of F
SES	66.39	61.03	6.040	.015*
AGE	15.90	25.12	224.280	.000**
MASC	5.17	4.99	7.450	.007*
FEM	5.06	5.10	.009	.923
MCOURS	2.30	2.35	.036	.849
TABILITY	54.86	47.94	31.610	.000**
DIFEIS	2.89	2.69	.000	.982
MOREIS	3.27	3.16	.000	.986
FOREIS	2.44	1.97	10.190	.002*
IAEIS	3.91	4.00	.024	.877
MAS	2.68	3.25	13.090	.000**
MSE	6.40	6.46	.161	.688
INT	2.00	1.91	.363	.547
OCCUP	1.90	1.71	2.730	.101

Significance levels: $^{*}p < .05$; $^{**}p < .001$

paths with p values < .15 were not included in the reduced model. Table 21 presents a comparison of standardized and estimated beta weights for each path included in the reduced model. Figure 10 presents the reduced model with significant paths and the path coefficients for the residuals.

Masculinity, number of math courses, and math ability level all contributed significantly to the prediction of math anxiety. Together, these variables accounted for 22% of the variance (R^2 = .22).

Two identity statuses contributed significantly to the prediction of math self-efficacy beliefs and were included in the reduced model: foreclosure and identity achievement. Other variables which contributed significantly to the prediction of math self-efficacy beliefs included math anxiety, masculinity, numbers of math courses, and math ability level. These six significant predictors accounted for 57% of the variance in math self-efficacy (R^2 = .57).

Age, masculinity and femininity all contributed significantly to the prediction of identity achievement status, accounting for 16% of the variance in that variable (R^2 = .16). Only age contributed significantly to the prediction of the foreclosure status, accounting for a mere 6% of the variance (R^2 = .06).

Math self-efficacy beliefs contributed significantly to the prediction of interest in math/science activities, accounting for 28% of the variance on the interest variable

Table 20. Decomposition of Effects-College Sample

Effect	Causal Effects Direct	Indirect	Total	R^2 (reduced model)
On OCCUP				
Of INT	-.39	.00	-.39	.13
Of SES	.03	not included in reduced model		
Of TABILITY	.23	.00	-.23	
On INT				
Of MSE	-.53	.00	-.53	.28
On MSE				
Of MAS	-.65	.00	-.65	.57
Of IAEIS	.18	.00	.18	
Of FOREIS	.16	.00	.16	
Of MOREIS	-.10	not included in reduced model		
Of DIFEIS	-.12	not included in reduced model		
Of MASC	.44	.19	.63	
Of MCOURS	.28	.13	.41	
Of TABILITY	.49	.26	.75	
On MAS				
Of MASC	-.23	.00	-.23	.22
Of MCOURS	-.20	.00	-.20	
Of TABILITY	-.40	.00	-.40	
On IAEIS				
Of AGE	.27	.00	.27	.16
Of MASC	.24	.00	.24	
Of FEM	.23	.00	.23	
On FOREIS				
Of AGE	-.24	.00	-.24	.06
Of MASC	-.06	not included in reduced model		
Of FEM	-.07	.00	-.07	
On MOREIS	This variable not included in reduced model			
Of AGE	-.26			
Of MASC	-.12			
Of FEM	-.04			
On DIFEIS	This variable not included in reduced model			
Of AGE	-.19			
Of MASC	-.10			
Of FEM	-.12			

Table 21. Comparison of Beta Weights-College Sample

Effect	Estimated B	SE	Standardized B
On OCCUP			
Of INT	-1.076	.204	-.39
Of TABILITY	.025	.012	.23
On INT			
Of MSE	-.118	.015	-.53
On MSE			
Of MAS	-1.034	.098	-.65
Of IAEIS	.493	.223	.18
Of FOREIS	.405	.209	.16
Of MASC	1.112	.183	.44
Of MCOURS	.450	.124	.28
Of TABILITY	.090	.019	.49
On MAS			
Of MASC	-.367	.125	-.23
Of MCOURS	-.205	.079	-.20
Of TABILITY	-.042	.012	-.40
On IAEIS			
Of AGE	.023	.007	.27
Of MASC	.219	.071	.24
Of FEM	.248	.084	.23

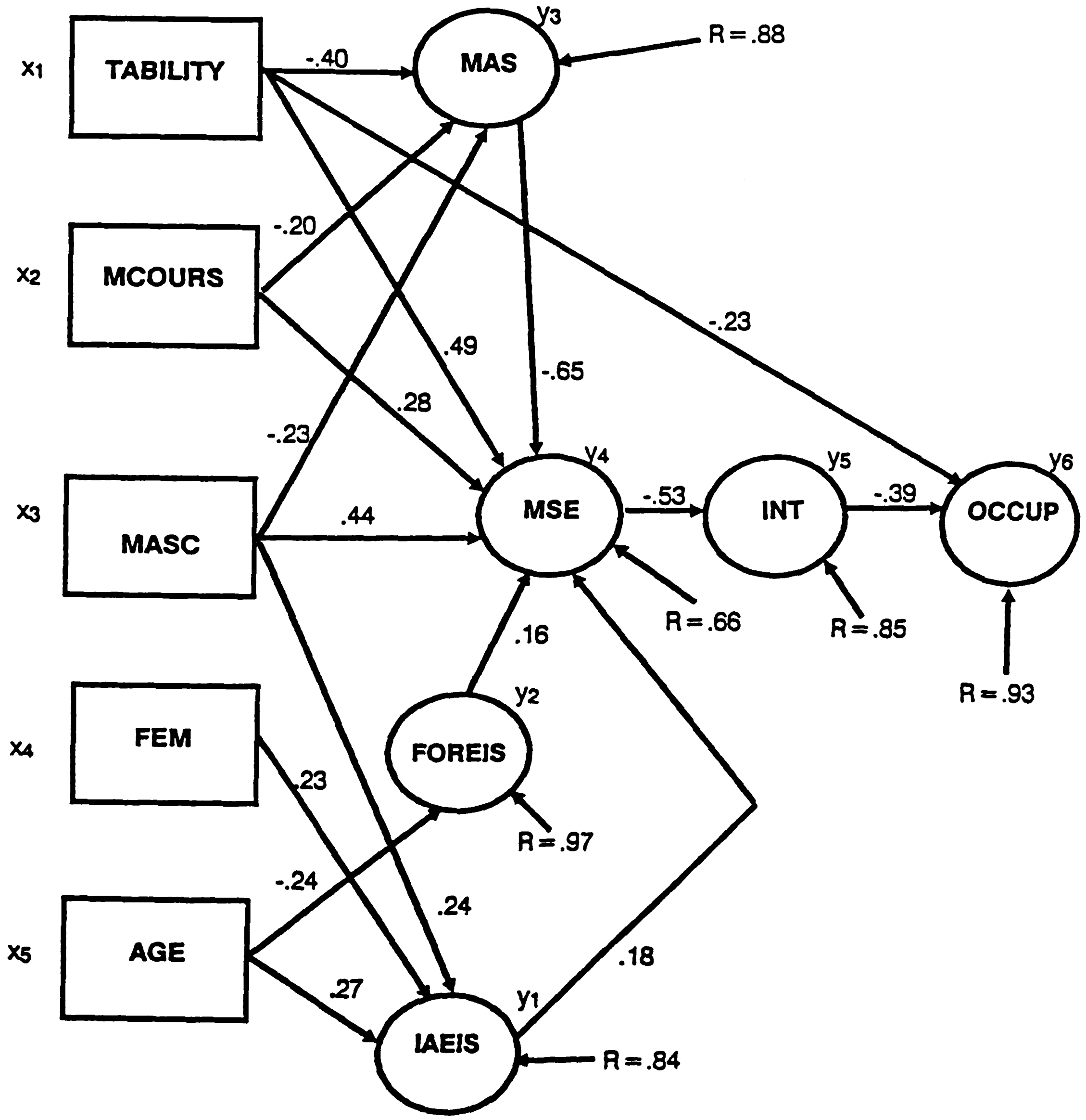


Figure 10. Reduced Path Models for College Sample

(R^2 = .28). In turn, interest in math/science activities along with math ability contributed significantly to the prediction of consideration of math/science occupations. These two variables accounted for 13% of the variance in math/science occupations (R^2 = .13).

Structural equation modeling--college sample. The PRELIS procedure was used to create a matrix system file to be used as a data source for LISREL. Table 22 is a summary of the overall and detailed fit information for the Initial, Revised, and Final Models for the College Sample.

The overall tests of fit were, in general, non-supportive of the Initial Model. The test of the Initial Model produced a significant X^2 (X^2 = 48.16, $p < .014$), a relatively small goodness of fit index of .908, and a high root mean square residual of .105. Detailed fit information was also non-supportive and indicative of structural weaknesses in the model. The coefficient of determination of .600 was somewhat lower than desirable and there were four squared multiple correlations that were also quite low. In addition, a number of standardized residuals were greater than 2.0.

The modification indices and t-values were suggestive of possible changes in the model. These changes included deleting the paths between (a) the identity statuses and math self-efficacy beliefs, (b) the number of math courses and math self-efficacy beliefs, (c) the number of math courses and math anxiety, (d) masculinity and both identity

Table 22. Summary of Model Fit Information-College

Model	χ^2	df	p	Goodness of Fit Index	Root Mean Square Residual	Coefficient of Squared Multiple Determination: Structural Equation	Correlations[a]: Equations	Modification Indices[a]	t-values[a]	Standardized Residuals[a]
Initial	48.16	29	.014	.908	.105	.600	FOREIS= .076 OCCUP= .053	INT/MSE= 11.515	IAEIS/MSE= 1.099 FOREIS/MSE= 1.218 MASC/IAEIS= 1.36 MASC/MAS= .281 MCOURS/MAS= .025 MCOURS/MSE= .779 TABILITY/MSE= -.698	INT/MSE= -4.30 MASC/INT= -3.11 INT/MAS= 2.911 TABILITY/FOREIS= 2.60
Revised 1	27.35	12	.007	.916	.135	.487	OCCUP= .053	INT/MSE= 11.431 OCCUP/THETA EPSILON=6.086		INT/MSE= -4.29 MASC/INT= -3.107 INT/MAS= 7.374
Revised 2	21.00	11	.033	.933	.111	.554		MSE/OCCUP= 13.88 INT/MASC= 10.990 OCCUP/MASC= 14.51		INT/MSE= -3.141 MASC/INT= -3.531
Final	4.65	10	.913	.983	.032	.60				

[a] Reported values are those which indicate a need for modification of the model.

achievement status and math anxiety, and (e) math ability and math anxiety. Inclusion of a path between interests and math self-efficacy beliefs was also indicated.

For the Revision 1 Model, many of these suggestions were incorporated. Specifically, the age, identity achievement status, foreclosure status, and number of math courses variables were eliminated. The overall fit information for this model was slightly more supportive. While the X^2 value decreased to 27.35 ($p < .007$) and the goodness of fit index increased to .916 as desired, the root mean square residual increased to .135. Detailed fit information remained unsupportive of the structural integrity of the model. The coefficient of determination for the structural equations decreased to .487, and the squared multiple correlations for the equations remained the same. There were still a number of high standardized residuals, though fewer than in the Initial Model.

All of the t-values for the paths in the Revised 1 Model were greater than 2.0. The modification indices were suggestive of adding a path between math self-efficacy beliefs and interests in order to improve the fit of the model. In addition, the modification indices all indicated that measurement error may exist in the occupations variable.

For the Revised 2 model, it was decided to free the occupations variable in the theta epsilon matrix in order to account for measurement error. Resulting tests of overall

fit were encouraging. The X^2 value, though still significant, decreased to 21.00 ($p < .033$), the goodness of fit index increased to .933, and the root mean square residual decreased to .111. The detailed fit information was also more supportive. The coefficient of determination for the structural equations increased to .554. None of the squared multiple correlations for the equations were less than the .203 value obtained for occupations. The t-values were all greater than 2.00 for the paths in the model. A modification index of 14.51 indicated that adding a path between occupation and masculinity would increase the fit of the model.

It was decided to add a path between masculinity and occupation for the Final Model for the college population. The overall fit information for the Final Model was highly supportive. The X^2 decreased to 4.65 and was non-significant at the $p < .913$ level. The goodness of fit index increased to a highly supportive .983 and the root mean square residual decreased to a desirable value of .032. The detailed fit information was also generally supportive, though still suggestive of possible structural weaknesses in the model. The coefficient of determination increased to .62 and the squared multiple equations for the equations were all greater than .43. None of the standardized residuals were greater than 2.0. The t-values were all greater than 2.00 and the modification indices were small (less than 1.4). Thus, no other changes were made in the model. The Final Model is presented in Figure 11.

Path analysis for the high school sample. Decomposition of the direct, indirect, and total effects for the path analysis for the high school sample can be found in Table 23. R^2 for the reduced model can also be found in Table 23. All paths with p-values less than .15 were not included in the reduced model. Table 24 presents a comparison of the standardized and estimated beta weights for each path included in the reduced model. Figure 12 presents the reduced model with significant paths and path coefficients for the residuals.

Masculinity, number of math courses, and math ability level all contributed significantly to the prediction of math anxiety, as expected. These three variables accounted for a total of 38% of the math anxiety variance (R^2 = .38).

Identity achievement status was the only identity status variable which significantly predicted math self-efficacy beliefs. Math anxiety, masculinity, number of math courses and math ability level were also predictive of math self-efficacy beliefs. A total of 46% of the variance (R^2 = .46) in math self-efficacy beliefs was accounted for by these variables.

Masculinity was the only significant predictor of the identity achievement status variable. This variable accounted for 8% of the variance in identity achievement status (R^2 = .08).

Math self-efficacy beliefs was a significant predictor

Table 23. Decomposition of Effects - High School

Effect	Causal Effects: Direct	Indirect	Total	R^2 (reduced model)
On OCCUP				.18
Of INT	-.46	.00	-.46	
Of SES	-.11	not included in reduced model		
Of TABILITY	.32	.00	.32	
On INT				.33
Of MSE	-.57	.00	-.57	
On MSE				.46
Of MAS	-.54	.00	-.54	
Of IAEIS	.23	.00	.23	
Of FOREIS	-.02	not included in reduced model		
Of MOREIS	-.09	not included in reduced model		
Of DIFEIS	-.14	not included in reduced model		
Of MASC	.30	.23	.53	
Of MCOURS	.38	.10	.48	
Of TABILITY	.43	.30	.73	
On MAS				.38
Of MASC	-.31	.00	-.31	
Of MCOURS	-.19	.00	-.19	
Of TABILITY	-.55	.00	-.55	
On IAEIS				
Of AGE	.04	not included in reduced model		.08
Of MASC	.29	.00	.29	
Of FEM	.03	not included in reduced model		
On FOREIS	This variable not included in reduced model			
Of AGE	-.07			
Of MASC	-.08			
Of FEM	.10			
On MOREIS	This variable not included in reduced model			
Of AGE	-.22			
Of MASC	-.25			
Of FEM	.15			
On DIFEIS	This variable not included in reduced model			
Of AGE	-.11			
Of MASC	-.38			
Of FEM	-.10			

Table 24. Comparison of Beta Weights - High School

Effect	Estimated B	SE	Standardized B
On OCCUP			
Of INT	-1.333	.212	-.46
Of TABILITY	.044	.012	.32
On INT			
Of MSE	-.156	.019	-.57
On MSE			
Of MAS	-.942	.127	-.54
Of IAEIS	.627	.224	.23
Of MASC	.614	.170	.30
Of MCOURS	.574	.119	.38
Of TABILITY	.073	.014	.43
On MAS			
Of MASC	-.368	.097	-.31
Of MCOURS	-.164	.072	-.19
Of TABILITY	-.057	.008	-.55
On IAEIS			
Of MASC	.226	.064	.29

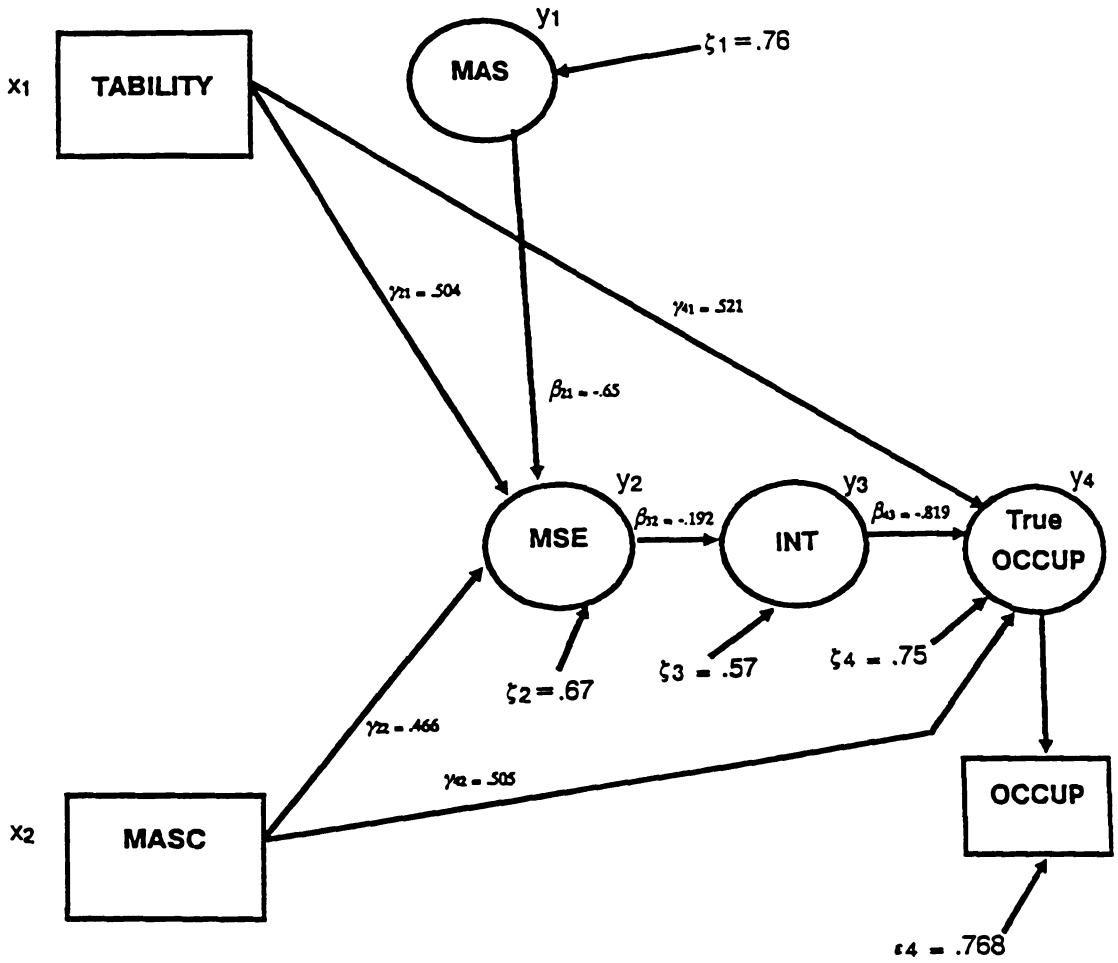


Figure 11. Final Structural Model for the College Sample

of interest in math/science activities, accounting for 33%of the variance (R^2 = .33). In turn, interest in math/science activities, along with math ability level, were significant predictors of consideration of math/science careers. These two variables accounted for 18% of the variance in the occupations variable (R^2 = .18).

Structural equation modeling--high school sample . The PRELIS procedure was used to create a matrix system file to be used as a data source for LISREL. Table 25 is a summary of the overall and detailed fit information for the Initial, Revised, and Final Models for the high school sample.

The X^2 for the Initial Model was significant (X^2 = 50.13, df = 13, $p < .001$) indicating that the current model was not one which was plausible in the high school sample. The other overall fit information was also generally non-supportive. The goodness of fit index of .918 was smaller than desired, while the root mean square residual of .12 was higher than is desirable.

The detailed fit information was also non-supportive of the model, and was indicative of structural weakness. The coefficient of determination was low, as were the squared multiple correlations for the occupation and identity achievement status equations. There were also numerous residuals greater than 2.00; in particular, the fit of the relationship between interest in math/science activities and math self-efficacy beliefs was exceptionally weak.

Low t-values between identity achievement status and

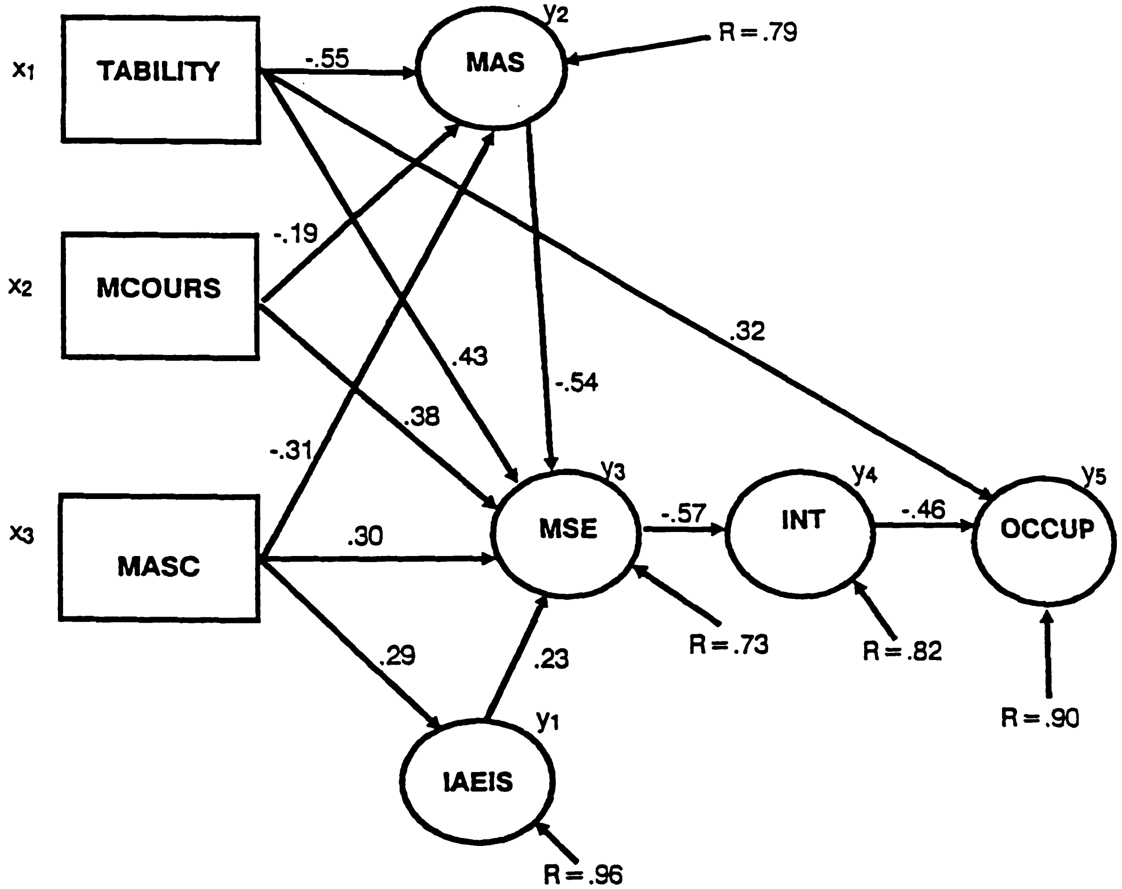


Figure 12. Reduced Path Model for the High School Sample

math self-efficacy beliefs, number of math courses and math anxiety, and math ability and math self-efficacy beliefs signify that these paths should be deleted. The modification indices suggested that there was measurement error in the occupations variable, and that a path between math ability and interest in math/science activities should be added in order to improve the overall fit of the model.

In the Revised Model, the occupations variable was allowed to vary in theta epsilon in order to account for measurement error. In addition, the identity achievement status variable was dropped from the model. The paths between number of math courses and math anxiety, and between math ability and math self-efficacy beliefs were also eliminated. Overall fit information for the Revised Model was supportive. Though the X^2 value decreased to 24.82, it remained significant ($p < .003$). The goodness of fit index increased to .947, while the root mean square residual decreased to .081.

The detailed fit information was also supportive of the Revised Model for high school students. The coefficient of determination for the structural equations increased slightly to .552, and the squared multiple equations for occupations were all greater than .354. Though, in general, there were fewer standardized residuals greater than 2.0, one pair remained greater than 2.0: interest in math/science activities and masculinity.

All t-values were greater than 2.0, with the exception

Table 25. Summary of Fit Information - High School

Model	χ^2	df	p	Goodness of Fit Index	Root Mean Square Residual	Coefficient of Determination: Structural Equation	Squared Multiple Correlations[a]: Equations	Modification Indices[a]	t-values[a]	Standardized Residuals[a]
Initial										
	50.13	13	.000	.918	.12	.468	OCCUP= .105 IAEIS= .098	OCCUP/THETA EPSILON=21.410 TABILITY/INT= 21.410	IAEIS/MSE= 1.73 MCOURS/MAS= 1.61 TABILITY/MSE= 1.52	MSE/MAS= -3.57 INT/MSE= -4.52 MASC/INT= -3.37 TABILITY/INT= 4.84 MSE/IAEIS= 2.99 MSE/MSE= 3.622 INT/MAS= 3.714 TABILITY/MSE= 2.71
Revised										
	24.82	9	.003	.947	.081	.552		MAS/OCCUP= 13.127	MSE/MASC= 1.935	MASC/INT= -3.082
Final										
	10.88	8	.209	.976	.039	.599			MSE/MASC= 1.835	

[a] Reported values are those which indicate a need for modification of the model.

of the path between math self-efficacy beliefs and masculinity (t = 1.935). Modification indices indicated that a path should be added between masculinity and consideration of math/science occupations.

For the Final Model for high school students, the path between masculinity and consideration of math/science occupations was added to the model. The overall fit information for this model was highly supportive. A non-significant X^2 of 10.88 was obtained ($p < .209$), the goodness of fit index increased to .976, and the root mean square residual decreased to an desirable value of .039.

Detailed fit information was also mainly supportive. None of the standardized residuals were greater than 2.0 and all of the squared multiple correlations for equations were greater than .398. The coefficient of determination increased slightly to .599, which still fell slightly short of a desirable value of .70. Only the t-value for the path between masculinity and math self-efficacy beliefs was less than 2.0 indicating that this path should be dropped from the model. The modification indices were all quite small (less than 1.8).

Given this generally supportive data, no further changes were made in the model. The Final Model for the high school sample can be found in Figure 13.

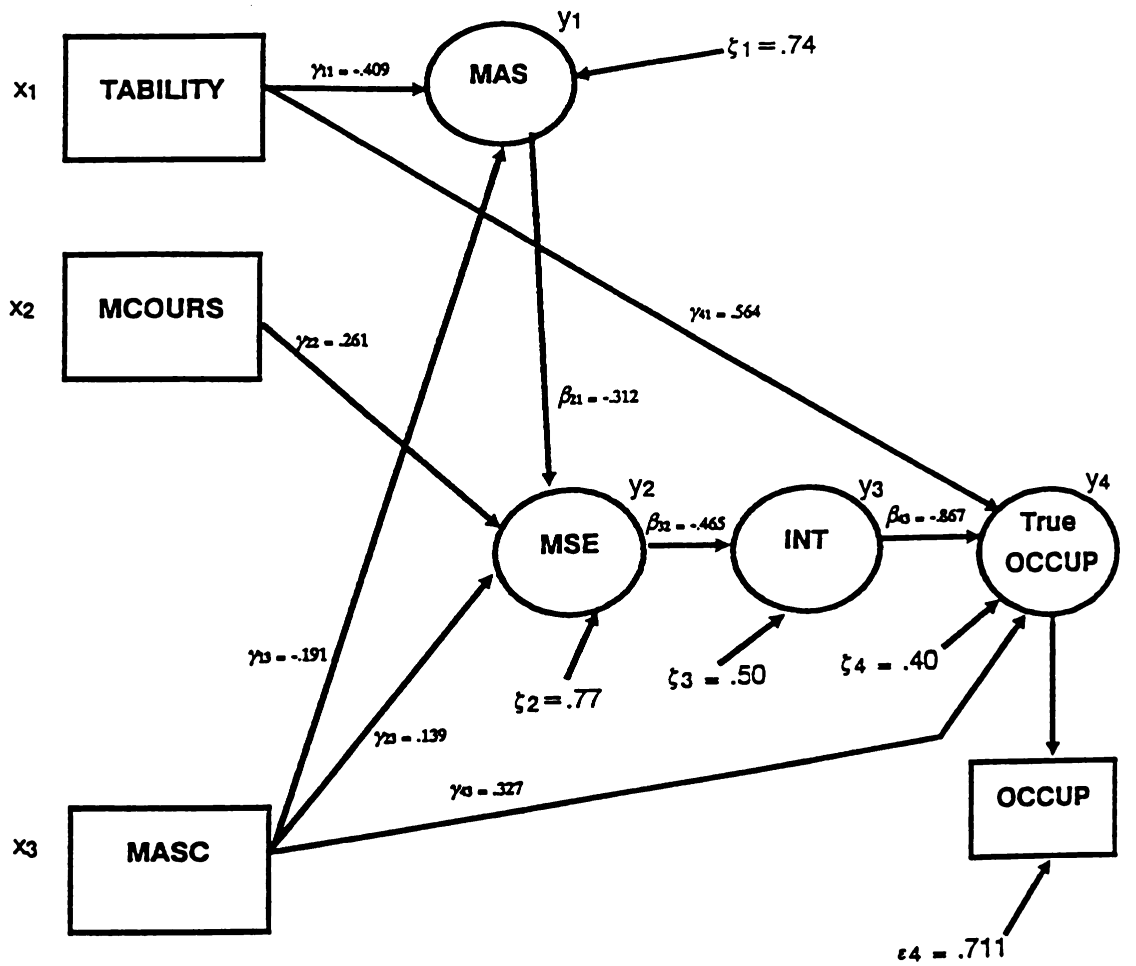


Figure 13. Final Structural Model for High School Sample

CHAPTER V

Discussion

Women with high ability levels are choosing not to enter math/science occupations at the same rate as are men (Bureau of Labor Statistics, 1990). Understanding the factors which lead to the career decisions of men and women would help to clarify this inequality. The purpose of this study was to test the adequacy of a proposed causal model of math/science career aspirations for high school and college males and females. Research studies of math self-efficacy were used as the organizing schema around which the proposed causal model was formulated. Background factors (socioeconomic status, sex-role identity, math ability, number of high school math courses) were included in the model along with factors typically examined as part of math self-efficacy models (math anxiety, interest in math/science activities). Given the importance of adequate math/science preparation prior to entering college, this study tested the adequacy of the model in a high school sample. Finally, an effort was made to explore the linkage between math self-efficacy and identity development theory. Though the results of this study were generally supportive of math self-efficacy models, they did not support the inclusion of identity status as a causal predictor of math/science career aspirations. The identity achievement status appears to be useful in explaining the relationship between math self-efficacy beliefs and interest in math/science activities for females.

Adequacy of the Proposed Causal Model of Math/Science Career Aspirations

The proposed causal model of math/science career aspirations had much in common with the final model for the whole sample. As proposed, both interest in math/science activities and ability level had a direct effect on consideration of math/science career aspirations. Math self-efficacy beliefs had a direct effect on the development of interests. Higher math self-efficacy beliefs were associated with several background variables: lower levels of math anxiety, high scores on the masculinity subscale, increased number of math courses, and high math ability level. Low math ability and low masculinity scores were associated with increased levels of math anxiety.

Contrary to the proposed model, socioeconomic status was not a significant predictor of math/science occupational aspirations for the whole sample (or any subsample), supporting the results of Rotberg, et al. (1987). It may be, however, that the failure of socioeconomic status to predict occupational aspirations was due to the large amount of missing data on that variable.

Furthermore, the identity achievement status variable initially contributed significantly to the prediction of math/science career aspirations through math self-efficacy beliefs. But once the path between age and math-self efficacy beliefs was included as part of the model, identity achievement status no longer significantly predicted math self-efficacy beliefs. The direct positive effect of age on math self-efficacy beliefs was surprising, especially given that older students in this sample seem to have low levels of math ability. Perhaps as individuals grow older and become involved in further education, the belief that one can learn new tasks strengthens, regardless of ability level.

While the final model for the whole sample was generally supported by the overall and detailed fit information available, there were suggestions of structural weaknesses in the model. In particular, the squared multiple correlation for the math/science career aspirations equation was low. Inclusion of new paths or new variables seem necessary to adequately explain math/science career aspirations. Including such variables as work and personal values, career decision making strategies, outcome expectations, and the influence of family and peers may increase understanding of the factors involved in aspiring to math/science careers.

Sample Differences. The differences between the college and high school samples were found primarily in the effects of the exogenous variables on the endogenous variables. The relationships among the endogenous variables were identical for both the high school and college samples. Low math anxiety led to high math self-efficacy beliefs, which in turn led to increased interest in math/science activities and increased consideration of math/science careers. This supports the hypothesized causal ordering of variables. Math ability level and high masculinity scores were also associated with increased consideration of math/science career aspirations.

The existence of the path between masculinity and math/science occupations is surprising given prior research results (Hackett, 1985; Rotberg et al., 1987). Perhaps, as mentioned previously, for both high school and college students the characteristics associated with instrumentality are important in the consideration of math/science careers.

Somewhat unexpectedly, the number of math courses college students took in high school had no effect on either math anxiety level or math self-efficacy beliefs. It is also surprising that neither math ability level or high masculinity scores influenced the math anxiety levels of college students. Given the large amount of missing data in the math ability variable for the college sample, it is important to note that conclusions involving the math ability level are tentative.

For the high school sample, similarly to the male sample, math ability level did not influence math self-efficacy beliefs. The number of math courses, however, did have an influence. Again, it is interesting that a performance accomplishment, considered to be the most influential source of information when establishing self-efficacy beliefs, may not be considered when subjects' self-rate their math ability. Since there was little missing data in the math ability variable for high school students, conclusions about math ability for this group can be more definite.

Gender differences. In general, for both males and females, high math self-efficacy beliefs appear to lead to the development of interest in math/science activities, which in turn led to math/science career aspirations. However, in contrast to previous studies (Hackett, 1985; Rotberg, et al., 1987), high scores for females (but not for males) on the Masculinity subscale of the Bem Sex Role Inventory led both directly and indirectly to math/science career aspirations.

A number of researchers (Fassinger, 1990; Spence & Helmreich, 1981) believe that high scores on the masculinity subscale are indicative of instrumentality (instrumentality is associated with characteristics such as ambition and ability to deal proactively with one's environment). Perhaps for females, the possession of instrumental qualities enhances the appeal of non-traditional career options and thereby facilitates the consideration of math/science careers. For counselors and educators, the practical implication of this result is that high ability level and interest levels are not the only factors necessary for consideration of math/science career aspirations. If females are to consider math/science occupations, it also seems important to foster the development of instrumental values and competencies. Betz, Heesacker, and Shuttleworth (1990) found that subjects who scored higher on the masculinity (instrumentality) subscale of the Bem Sex Role Inventory had career interests which more closely matched their ability levels than did subjects who scored high on the femininity subscale. In other words, those subjects who identified themselves as have instrumental traits were better able to use their abilities when making career choices.

The concept of instrumentality seems similar to that of agency, as discussed by Betz and Hackett (1987). Their study did not find gender differences in agency of self-efficacy in regards to general career development behaviors. Perhaps for more sex-typed career search activities, such as consideration of math/science careers, gender differences will be more likely to emerge.

Furthermore, it was clear to all subjects in the directions given by the experimenter that the study was an investigation of math beliefs and math occupations. After answering the questionnaires, most of which related to math topics, subjects were asked to complete the Bem Sex Role Inventory. Perhaps the contextual cues embedded within the study affected males and females self-perceptions and ratings (Newberry, 1991).

Another possible explanation for this unexpected finding may be that the sample used in this study was different from samples used previously. The data were collected from a conservative culture which encourages and supports the development of traditional sex roles. Thus, for females from more "traditional" backgrounds, perceiving oneself as having masculine sex-typed characteristics may be necessary in order to consider math/science careers. Furthermore, the type of data analysis used may have also accounted for the unexpected findings. LISREL was not used in the previous studies, and this type of analysis offers the added advantage of exploring simultaneous relationships among variables.

It is also possible that gender typing may have a more influential role in circumscribing the career aspirations of women (Gottfredson, 1981) than those of men. However, masculinity did not moderate the relationship between math self-efficacy beliefs and interest in math/science activities. In other words, math self-efficacy beliefs for those women with higher masculinity scores were not more strongly related to interests than for those women with lower masculinity scores. It is apparent, however, that the effects of masculinity are more complex for women than they are for men in this sample. Gender differences exist in the strength of the path between math self-efficacy beliefs and interests in math/science activities. Men's math self-efficacy beliefs are more strongly related to the development of math/science interests. Thus, even those females who have high math self-efficacy beliefs aren't developing interest in math/science activities at the same level as males. It may be that other potential moderators exist which limit the development of math/science interests in females. Such moderators might include lack of appropriate role models and the nature of the math curricula.

It is also interesting to examine the role of the exogenous variables on the development of math self-efficacy beliefs and math anxiety. For females, all three exogenous variables led to the development of math self-efficacy beliefs: math ability, number of math courses, and high scores on the masculinity scale. For males, math ability level did not lead to increased math self-efficacy beliefs. This implies that males may make decisions about their math self-efficacy beliefs without considering their math ability levels. This is surprising, as performance information is hypothesized by Bandura (1977) to be the most important source of efficacy information. However, a study by Beyer (1990) indicates that gender differences exist in the accuracy of self-evaluations. Men were found to have high expectations and overly high self-evaluations of their performance of masculine tasks. Women were found to have low expectations of their performance on masculine tasks and to hold overly negative self-evaluations of their performance. Given that math problem solving is considered by many to be a masculine task, it is possible that the men in this study overestimated their beliefs about their ability to perform math tasks. Conclusions about the role of the math ability variable in this study must be tentative given the large amount of missing data in this variable. Future microanalytic studies seem necessary to further clarify how individuals make judgements about their math abilities.

For math anxiety in females, the only significant predictor was low math ability level. For males, both low math ability level and low masculinity scores were associated with high math anxiety. It may be that for males low levels of "masculinity" or instrumental behavior in general creates greater anxiety.

Finally, despite supportive overall fit information, it is important to add that serious structural problems seem to exist within the model for the male sample. In particular, the equation for interest in math/science activities seems particularly weak. Reordering the variables or including new variables seems to be appropriate. It is possible that factors which may influence the selection and consideration of math/science careers for males have been overlooked. It may be that more men consider math/science careers because that is what their parents, teachers, and society expects of them. Including a variable such as expectations of others (similar to the foreclosure identity status) may provide researchers with interesting results.

Implications for Math Self-Efficacy

When examining the results of this study for the whole sample, the results of prior math self-efficacy research were largely confirmed and extended (Hackett, 1985; Betz & Hackett, 1983). For all of the separate samples, the relationships among the math anxiety, math self-efficacy beliefs, interest in math/science activities, and consideration of math/science career aspirations was identical. Math self-efficacy beliefs led to interest in math/science activities which in turn led to increased consideration of math/science occupations. In addition, math anxiety negatively influenced the development of math self-efficacy beliefs. One exogenous variable behaved in the same manner in all the samples; math ability led directly to consideration of math/science occupations.

The relationships between the exogenous variables and the endogenous variables were not consistent for the separate samples examined. Perhaps the most unexpected result involved the behavior of the masculinity variable. In contrast to previous research (i.e., Hackett, 1985) masculinity contributed indirectly and directly to the consideration of math/science careers for females while, for males, masculinity only contributed indirectly to consideration of math/science careers. Clearly, different background variables are more salient for some groups than for others.

Some conclusions can be drawn comparing these results with other studies (Hackett, 1985; Lapan, et al., 1989) which used causal modeling techniques. These results from the current study suggest a different causal ordering of variables than suggested by the Hackett (1985) path analysis. Specifically, the masculinity scale was found to directly predict math/science career choice while math anxiety was not found to be related to consideration of math/science careers. Furthermore, these results suggest that math/science interests be included as part of the model. In contrast, the results of this study, largely confirm those of Lapan, et al. (1989), which primarily focused on the role of math self-efficacy in the development of interests. Math self-efficacy led to the development of interests in realistic and investigative fields, and math anxiety appears to be a co-effect of math self-efficacy. The primary difference between these results and the results of Lapan et al. (1989) was that math ability was not found to lead to the development of realistic and investigative interests.

Implications for Identity Development Theory

Identity status did not emerge as a significant predictor of math/science career aspirations in this study, though the identity achievement status appears to moderate the relationship between math self-efficacy beliefs and interest in math/science activities for females, but not for males. Perhaps for females who are identity achieved, their beliefs about their math ability are less salient because they have already decided upon a career path. However, females who are not identity achieved are still engaged in self-exploration. Hence, beliefs about math ability are important sources of information.

Some additional comments must be made about the behavior of the identity status variable in this sample. Identity status researchers assume that identity achievement is generally strengthened with age (i.e., Marcia, 1980), though spirals of exploration and commitment are also expected (i.e., Grotevant & Thorbecke, 1982). In examining the differences between the high school and college samples, only scores on the foreclosure status were significantly different for the two groups. As expected, high school students were more likely to be in the foreclosure status than were college students. Failure to find other significant differences seems to support the notion of spirals. Thus, one can be identity achieved in high school and then perhaps cycle back through an earlier stage of identity development while in college. This conclusion is tentative, given that the present study employed a cross-sectional design.

As in previous studies (i.e., Blustein, et al., 1989) using the Extended Measure of Ego Identity Status, the diffusion status and moratorium status were significantly correlated. A measure which better discriminates between the two statuses would allow researchers to explore more fully the relationship of identity status to other variables. For example, one might expect that those in the moratorium status would be more likely to be considering and exploring more careers than those in the diffusion status.

Examination of the R^2 values for the identity status variables in the path analysis reveals that only a small portion of the variance is accounted for by other variables. Variables other than age, femininity, and masculinity should be included in these regression equations. It also seems likely that different variables for males and females should be included in the prediction of identity status. For example, examination of the identity achievement status reveals that age, masculinity and femininity accounted for 13% of the variance in the female sample. In contrast, for the male sample, age and masculinity accounted for 32% of the variance (femininity was not a significant predictor of identity achievement status for males). Other predictors of identity status might include decision-making style and measures of the quality of parent-student attachment.

There was one gender difference in the identity statuses. Females scored significantly higher than males on the moratorium subscale ($p < .03$). This result is somewhat unexpected. However, this may suggest that women are more likely to delay making identity-related commitments.

The possibility that identity achievement mediates the relationship between masculinity and math self-efficacy beliefs was explored in a post hoc analysis. Identity achievement was not found to mediate this relationship, indicating that instrumental qualities (as indicated by the masculinity variable) have a direct effect on the development of math self-efficacy, regardless of the level of identity achievement status.

Limitations

Plausible models were fit for the whole, male, female, high school, and college samples. However, several limitations existed in this study. First of all, large amounts of missing data in the socioeconomic status variable and in the math ability variable were problematic when conducting the path analyses and testing the models. Though the path from socioeconomic status to occupations was eliminated in the reduced models for each of the five samples examined, the relationship between socioeconomic status and math/science career aspirations remains unclear. Fully 33% of the subjects had missing data for socioeconomic status. It is possible that those who do not know or who chose not to report their parents' occupations may represent a particular group in the population. Failure to include any significant portion of the population may result in bias when measuring the relationship of socioeconomic status to math/science occupations.

Similarly, the ability variable was also missing for 33% of the population. For the college sample, 50% had missing data in the ability variable as opposed to only 14%

in the high school sample. Thus, the paths which led to variables from the ability variable in 4 of the 5 models tested (excluding the high school sample) must be viewed with caution as they are based on a significantly reduced sample.

Furthermore, not using the same ability measure for both samples limits our understanding of the role math ability plays in the consideration of math/science occupations. Attempts to transform the ability scores on the Stanford Achievement Test and the American College Test to t-scores may not have resulted in a comparable variable for both the high school and college sample. Transforming these ability scores to t-scores assumed that the underlying distributions of the two tests were similar. As the Stanford Achievement Test is administered to all high school students regardless of plans for college, while the American College Test is usually only taken by those individuals considering entering college, the transformation to t-scores may underestimate ability level for the college sample. As it stands, the ability variable behaved in accordance with theoretical expectations in the final models for each of the samples.

The college sample used in this study may represent a particular type of college student. The majority of the subjects were enrolled in a career and life planning class. Students in these classes are generally uncertain of their college major and career plans. In this study, the high

school and college populations did not differ in number of math courses taken in high school, math self-efficacy beliefs, math/science interests, or math/science career aspirations. In addition, math anxiety levels were higher for the college population, and reported socioeconomic status background level was lower. It is possible that many of the college students in these career and life planning courses have already ruled out math/science careers as possibilities and that the sample examined in this study is significantly different from the general college population.

Further limiting the generalizability of the results are the characteristics of the larger population from which both the high school and college samples were drawn. The larger population primarily consists of members from a conservative religion which emphasizes higher education for males. Females are encouraged to place primary emphasis on raising their children. Additionally, the larger population is primarily Caucasian with little ethnic or racial diversity.

The inability to test the measurement portion of structural equations is unfortunate. The measurement portion of the structural equations specifies the relationship of the latent variables to the observed variables (Loehlin, 1987). Failure to include measurement error assumes that the observed variables are measured perfectly. Attempts were made in this study to allow for the possibility of measurement error by freeing variables in the theta epsilon matrix when indicated by large modification indices (SPSS, 1988).

Finally, as Fassinger (1990) describes, causal modeling techniques are methodologically difficult. She further describes the problem as "balancing the statistical demand for parsimony with the theoretical and empirical need to be heuristically inclusive," (p. 245). It is possible that the fit of the models for each sample improved because the models used few variables and hypothesized fewer paths between variables. In addition, the sample sizes for each of the subsamples (males, females, high school, college) were small and may have affected the stability of the obtained results.

Implications for practice

Math self-efficacy beliefs lead to the development of interest in math/science activities, which ultimately lead to consideration of math/science career aspirations for each of the separate samples examined. Thus, the development of accurate math self-efficacy beliefs seems particularly important when undertaking career decisions. As mentioned previously, the development of masculine sex-typed behaviors seems particularly important for women if they are to consider math science careers. In addition, learning to manage math anxiety more effectively and taking math courses seems crucial when developing math self-efficacy beliefs. Interventions designed to assist students in formulating accurate math self-efficacy beliefs would be useful, and

merit further research.

Examination of the final structural models for high school and college students seems to indicate that high school students may be more amenable to changing their math self-efficacy beliefs. High school students tend to use more background information when formulating their beliefs about math self-efficacy and math anxiety levels. Perhaps when one is younger, decisions about abilities are based upon readily apparent experiences. For example, if a high school student takes more math courses than is required, that may indicate to the student that he/she is particularly good at math. For college-age (and older) students, decisions about math self-efficacy beliefs may have already crystallized, and thus become more resistant to change.

Recommendations for future research

Further research is needed to explore and evaluate more completely the role of identity status in the consideration of math/science careers. First of all, focusing exclusively on occupational identity may be useful. It is possible that the Extended Version of the Objective Measure of Ego Identity Status (EOMEIS) may have been too broad in its approach for the questions regarding careers being asked in this study. In addition, the EOMEIS reports a high correlation between the moratorium and diffusion statuses which makes it difficult to examine these statuses separately. Melgosa (1987) developed the 28-item Occupational Identity Scale (OIS) which classifies individuals into one of the four identity statuses. The reliability and validity of this instrument appears to be adequate. Use of the OIS may shed light on the role of identity status and career aspirations. Secondly, the inclusion of another variable, fear of success, may also shed light on the role of identity status to occupational aspirations (Larkin, 1987). It also seems useful to explore the direct effect of identity status on math/science career aspirations. For example, individuals in the foreclosure status may be more likely to consider math/science careers because of the influence or expectations of family members. Finally, continuing to explore the role of identity achievement as a moderator variable is important. In particular, why is it that females who are identity achieved are more likely than males to discount their math self-efficacy beliefs when developing interests?

Results seem to indicate that other variables should be included in the prediction of math/science occupations. As mentioned previously, fear of success and identity status are two variables which may prove useful to include. Fassinger (1990) also examined math/science career choices and evaluated a causal model using LISREL. Variables she found significant in the prediction of math/science career choice included family orientation, feminist orientation, attitudes toward work roles, and attitudes toward family roles. Combining these two models may assist in explaining significantly more of the variation in math/science career choice. Finally, future models should examine the reciprocal influence of interest between math/science activities and math self-efficacy beliefs, as well as the reciprocal relationship between math anxiety and math self-efficacy beliefs. The role of outcome expectations for math activities also merits further study (Lent, et al., 1991).

Future studies using LISREL should also include larger sample sizes for subgroups in the population (i.e., males, females, high school students). Appropriate sample size estimates range from 100 for a small study (four or five variables) to 30 subjects per measured variable (Fassinger, 1987). In addition, replication of the final models fit for each sample should include estimates of measurement error. Increasing the sample size as well as the number of indicators per latent variable should assist in the fitting of a model to the sample.

In order to generalize beyond this sample, the final models should be retested on new samples and populations. In particular, sampling from college population which includes individuals considering math/science careers may be enlightening. In addition, sampling from a general population which has greater ethnic and cultural diversity would also be useful. Very few studies (i.e., Post et al., 1991) of math/science career aspirations have focused on special populations.

It is also important to continue to elaborate a math self-efficacy model. Incorporating outcome expectations into a causal model of math/science career aspirations may further illuminate gender differences relevant to women's career decision making process. In addition, understanding why males' math self-efficacy beliefs are more strongly predictive of interests in math/science activities than are females' math self-efficacy beliefs may lead to the identification of additional background variables which could be incorporated into a causal model.

Finally, further exploration of the role agentic behaviors play in the consideration and selection of math/science career aspirations is necessary. Examination of agency in the context of gender-typed activities may increase understanding of the role gender plays in developing interests. It may also be helpful to examine the correlation between the masculinity scale of the Bem Sex Role Inventory and the measure of agency developed by Betz and Hackett (1987).

APPENDICES

APPENDIX A

Parental Consent Letter

February 28, 1991

Dear Parent:

I am presently involved in completing my dissertation at Michigan State University while on Internship at the counseling center at the University of Utah. I am interested in the development of occupational aspirations of high school students. This information is valuable for counselors and can add to our knowledge of how to help students aspire to those occupations for which they are most suited.

I would like permission for your student to participate in a study which will be conducted as part of his or her regularly scheduled class. One half of one class period will be devoted to the completion of questionnaires. Information regarding your child's level of math achievement will be obtained from standardized tests your child took while in high school. Students will not be identified by name at any time in any reports of this research. If you decide to allow your child to participate, you are completely free to withdraw consent and discontinue your child's participation at any time. If your student chooses not to participate, he/she will be given an alternative project to complete. Student participation is voluntary and your child may withdraw at any time without penalty and/or refuse to answer any questions which he/she finds invasive or objectionable. You or your child's refusal to participate in this project will not affect your child's standing in this class in any way.

This research project has received approval from the University of Utah Institutional Review Board for Research with Human Subjects. It has also been evaluated by the Granite School District.

As the results of this study are completed, I will provide the principal with a summary which will be available to you upon request. If you have any questions, please contact me at the University of Utah Counseling Center, 426 Student Services Building, 581-6826.

If you give your permission for me to access your child's test scores and for your child to participate in this study, please sign and return this form as soon as possible. Thank you very much.

Sincerely,

Kathy Bieschke
Intern
University of Utah Counseling Center

Child's Name ___________________________________
Child's Date of Birth __________________________
Parent Approval (signature) ____________________

APPENDIX B

Request for Participation Script

Hello. I am Kathy Bieschke and I am here to ask you to participate in a research project I am conducting. The purpose of this project is to examine the factors which influence career decision-making. If you choose to participate, you will be asked to complete a packet of questionnaires which will take approximately 45 minutes to complete. A standardized math test score will also be obtained from your academic record and your social security number is needed to obtain this. Completion of this packet will earn you extra credit points in this class. If you choose not to participate in the research project, you may earn extra credit points by completing an alternative project. You may also choose not to participate in either project. In any case, your instructor will not be aware of who participated in which project. He/she will only receive a list of those students eligible for extra credit; he/she will not know which students participated in the research project.

Your participation in this project is completely voluntary. You may withdraw at any time without penalty and/or refuse to answer any questions which you find invasive or objectionable. Confidentiality of the data will be maintained. Each research packet has been assigned a research number. The consent form you will be asked to sign has the same number and will be the only connection between you and the research number. Once your math test scores have been obtained, there will no longer be any need for subject name and/or social security number to be attached to the questionnaires. It is expected that consent forms will be separated from your responses to the questionnaires and that consent from will be destroyed by March 1, 1990. Until that time, the consent forms and the data itself will be kept under lock and key. Only I will have access to the data.

The following sentence will be read to high school students only: Your parents are also being asked to give their consent for your participation.

If you have any questions, I will be happy to answer them at this time.

APPENDIX C

Participant Consent Form

The general purpose of this study is to examine the factors which influence occupational aspirations. You will be asked to complete questionnaires containing items regarding general information about yourself, your attitudes about tests, and your confidence in performing math-related tasks. It should take approximately 45 minutes of your time. In addition, you will be asked for permission to obtain your math ACT and/or SAT scores or another indication of your ability in math from your academic record. To obtain these scores, your social security number is necessary.

Your instructor has granted permission to conduct this study in class and will give extra credit points to those who participate. The study poses no foreseeable discomforts or identifiable risk to your physical or psychological well-being. Your participation is voluntary and you may withdraw at any time without penalty and/or refuse to answer any questions which you find invasive or objectionable. Your status in this class will not be affected if you choose not to participate. If you choose not to participate or if you withdraw from the study, you may complete an alternative extra-credit assignment in class. Completing either the research packet or the alternative extra-credit assignment packet will earn you the same amount of extra-credit points. Students may also choose not to participate in either option. In any case, your instructor will receive a list of those students who have earned extra credit at the end of the quarter.

The information gathered from the research will be safeguarded and remain confidential through: a) the use of subject code numbers; b) limiting access to subjects' names and respective code numbers to only the study's investigator for data collection purposes; c) securing questionnaires and data under lock and key and d) retaining only coded (numbered) questionnaire packets without any record of subjects' names following the collection of math scores from your student record. Reporting of the study's results will be in terms of overall (group) findings; the data for individual subjects will not be reported.

Please sign below to indicate your willingness to participate in this study.

Print your full name: ____

Social Security Number: ____________________________________

Signature: ____

APPENDIX D

Background Information

Directions: We are interested in learning about your background. This information will help us to better understand your responses to the other questionnaires that are part of this survey. Please do not place your name on any of these materials.

1. Age: _____

2. Gender: _____ Male _____ Female

3. Marital Status: _____ Single _____ Married
   _____ Separated _____ Divorced

4. Year in school: _____ Freshman _____ Sophomore
   _____ Junior _____ Senior
   _____ Other ______________

5. What is your mother's current employment? Please identify her occupation in the space provided: ______________________________.

6. What is the highest education that your mother has obtained? Circle the most appropriate number below.

   1. some high school
   2. a high school diploma
   3. some college
   4. a college degree
   5. some graduate school
   6. a graduate degree

7. What is your father's current employment? Please identify his occupation in the space provided: _________________________.

8. What is the highest education that your father has obtained? Circle the most appropriate number below.

   1. some high school
   2. a high school diploma
   3. some college
   4. a college degree
   5. some graduate school
   6. a graduate degree

9. Please list the math and science courses you took in **high school**.
   ____

10. My academic major is ____________________________

11. My probable career choice is _____________________

12. Career Choice State (check one):

_____ I am undecided about my career.
_____ I am tentatively decided about my career.

_____ I have decided on my career.

APPENDIX E

EIS SCALE

Instructions: Please read each item and indicate to what extent it reflects your own thoughts and feelings. If a statement has more than one part, indicate your reaction to the statement as a whole. Using the scale below, place the appropriate number next to the item in the space provided.

1	2	3	4	5	6
Strongly Disagree		Disagree	Agree		Strongly Agree

_____ 1. I haven't chosen the occupation I really want to get into, and I'm just working at whatever is available until something better comes along.

_____ 2. When it comes to religion, I just haven't found anything that appeals and I don't really feel the need to look.

_____ 3. My ideas about men's and women's roles are identical to my parents'. What has worked for them will obviously work for me.

_____ 4. There's no single "life style" which appeals to me more than another.

_____ 5. There are a lot of different kinds of people. I'm still exploring the many possibilities to find the right kind of friends for me.

_____ 6. I sometimes join in recreational activities when asked, but I rarely try anything on my own.

_____ 7. I haven't really thought about a "dating style." I'm not too concerned with whether I date or not.

_____ 8. Politics is something that I can never be too sure about because things change so fast. But I do think it's important to know what I can politically stand for and believe in.

_____ 9. I'm still trying to decide how capable I am as a person and what jobs will be right for me.

_____ 10. I don't give religion much thought and it doesn't bother me one way or the other.

_____ 11. There's so many ways to divide responsibilities in marriage, I'm trying to decide what will work for me.

_____ 12. I'm looking for an acceptable perspective for my own "life style" view, but I haven't really found it yet.

_____ 13. There are many reasons for friendship, but I choose my close friends on the basis of certain values and similarities that I've personally decided on.

_____ 14. While I don't have one recreational activity I'm really committed to, I'm experiencing numerous leisure outlets to identify one I can really get involved in.

_____ 15. Based on past experiences, I've chosen the type of dating relationship I want now.

_____ 16. I haven't really considered politics. It just doesn't excite me much.

_____ 17. I might have thought about a lot of different jobs, but there's never really any question since my parents said what they wanted.

_____ 18. A person's faith is unique to each individual. I've considered and reconsidered it myself and know what I can believe.

_____ 19. I've never really seriously considered men's and women's roles in marriage. It just doesn't seem to concern me.

_____ 20. After considerable thought I've developed my own individual viewpoint of what is for me an ideal "lifestyle" and don't believe anyone will be likely to change my perspective.

_____ 21. My parents know what's best for me in terms of how to choose my friends.

_____ 22. I've chosen one or more recreational activities to engage in regularly from lot's of things and I'm satisfied with those choices.

_____ 23. I don't think about dating much. I just kind of take it as it comes.

_____ 24. I guess I'm pretty much like my folks when it comes to politics. I follow what they do in terms of voting and such.

_____ 25. I'm really not interested in finding the right job, any job will do. I just seem to flow with what is available.

_____ 26. I'm not sure what religion means to me. I'd like to make up my mind but I'm not done looking yet.

_____ 27. My ideas about men's and women's roles come right from my parents and family. I haven't seen any need to look further.

_____ 28. My own views on a desirable life style were taught to me by my parents and I don't see any need to question what they taught me.

_____ 29. I don't have any real close friends, and I don't think I'm looking for one right now.

_____ 30. Sometime I join in leisure activities, but I really don't see a need to look for a particular activity to do regularly.

_____ 31. I'm trying out different types of dating relationships. I just haven't decided what is best for me.

_____ 32. There are so many different political parties and ideals. I can't decide which to follow until I figure it all out.

_____ 33. It took me a while to figure it out, but now I really know what I want for a career.

_____ 34. Religion is confusing to me right now. I keep changing my views on what is right and wrong for me.

_____ 35. I've spent some time thinking about men's and women's roles in marriage and I've decided what will work best for me.

_____ 36. In finding an acceptable viewpoint to life itself, I find myself engaging in a lot of discussions with others and some self-exploration.

_____ 37. I only pick friends my parents would approve of.

_____ 38. I've always liked doing the same recreational activities my parents do and haven't ever seriously considered anything else.

_____ 39. I only go out with the type of people my parents expect me to date.

_____ 40. I've thought my political beliefs through and realize I can agree with some and not other aspects of what my parents believe.

_____ 41. My parents decided a long time ago what I should go into for employment and I'm following through their plans.

_____ 42. I've gone through a period of serious questions about faith and can now say I understand what I believe in as an individual.

_____ 43. I've been thinking about the roles that husbands and wives play a lot these days, and I'm trying to make a final decision.

_____ 44. My parents' views on life are good enough for me; I don't need anything else.

_____ 45. I've tried many different friendships and now I have a clear idea of what I look for in a friend.

_____ 46. After trying a lot of different recreational activities I've found one or more I really enjoy doing by myself or with friends.

_____ 47. My preferences about dating are still in the process of developing. I haven't fully decided yet.

_____ 48. I'm not sure about my political beliefs, but I'm trying to figure out what I can truly believe in.

_____ 49. It took me a long time to decide but now I know for sure what direction to move in for a career.

_____ 50. I attend the same church or synagogue my family always attended. I've never really questioned why.

_____ 51. There are many ways that married couples can divide up family responsibilities. I've thought about lots of ways and now I know exactly how I want it to happen for me.

_____ 52. I guess I just kind of enjoy life in general, and I don't see myself living by any particular viewpoint to life.

_____ 53. I don't have any close friends. I just like to hang around with the crowd.

_____ 54. I've been experiencing a variety of recreational activities in hopes of finding one or more I can enjoy for some time to come.

_____ 55. I've dated different types of people and now know exactly what my own "unwritten rules" for dating are and who I will date.

_____ 56. I really have never been involved in politics enough to have made a firm stand on way or the other.

_____ 57. I just can't decide what to do for an occupation. There are some many that have possibilities.

_____ 58. I've never really questioned my religion. If it's right for my parents it must be right for me.

_____ 59. Opinions on men's and women's roles seem so varied that I don't think much about it.

_____ 60. After a lot of self-examination, I have established a very definite view on what my own lifestyle will be.

_____ 61. I really don't know what kind of friend is best for me. I'm trying to figure out exactly what friendship means to me.

_____ 62. All of my recreational preferences I got from my parents and I haven't really tried anything else.

_____ 63. I date only people my parents would approve of.

_____ 64. My folks have always had their own political and moral beliefs about issues like abortion nd mercy killing and I've always gone along accepting what they have.

APPENDIX F

MAS

Instructions: For each statement, use the scale below to indicate the extent to which you agree or disagree with the statement.

1	2	3	4	5
Strongly Disagree				Strongly Agree

1. I have usually been at ease during math tests. 1 2 3 4 5
2. I get really uptight during math tests. 1 2 3 4 5
3. I usually don't worry about my ability to solve math problems. 1 2 3 4 5
4. Mathematics makes me feel uncomfortable and nervous. 1 2 3 4 5
5. I get a sinking feeling when I think of trying hard math problems. 1 2 3 4 5
6. I have usually been at ease in math classes. 1 2 3 4 5
7. My mind goes blank and I am unable to think clearly when working mathematics. 1 2 3 4 5
8. I almost never get uptight while taking math tests. 1 2 3 4 5
9. Mathematics makes me feel uneasy and confused. 1 2 3 4 5
10. It wouldn't bother me at all to take more math courses. 1 2 3 4 5

APPENDIX G

Sample Items for the MTAI

Directions: A number of statements which people have used to describe themselves are given below. Read each statement and then circle the appropriate number below each statement to indicate how you **generally** feel. There are no right or wrong answers. Do not spend too much time on any one statement but give the answer which seems to describe how you generally feel. Use the rating scale below.

1	2	3	4
Almost Never	Sometimes	Often	Almost Always

1.	Thinking about my grade in a course interferes with my work on math tests.	1	2	3	4
2.	I freeze up on important math exams.	1	2	3	4
3.	Even when I'm well prepared for a math test, I feel nervous about it.	1	2	3	4
4.	I feel confident and relaxed while taking math tests.	1	2	3	4

The wording of these items was altered with the Publisher's consent.

APPENDIX H

MSE

Instructions: Indicate your level of confidence in your ability to successfully perform each of the following tasks using the scale below. **DO NOT ACTUALLY SOLVE THE PROBLEM.**

0	1	2	3	4	5	6	7	8	9
No Confidence at all									Complete Confidence

Math Tasks

1.	Add two large numbers (e.g., 5739 + 62543) in your head.	0 1 2 3 4 5 6 7 8 9
2.	Balance your checkbook without a mistake.	0 1 2 3 4 5 6 7 8 9
3.	Compute your income taxes for the year.	0 1 2 3 4 5 6 7 8 9
4.	Determine how much interest you will end up paying on a $675 loan over two years at 14% interest.	0 1 2 3 4 5 6 7 8 9
5.	Compute your car's gas mileage.	0 1 2 3 4 5 6 7 8 9
6.	Figure out how much lumber you need to buy in order to build a set of bookshelves.	0 1 2 3 4 5 6 7 8 9
7.	Determine the amount of sales tax on a clothing purchase.	0 1 2 3 4 5 6 7 8 9
8.	Figure out which of two summer jobs is the better offer: One with a salary but no benefits, the other with a lower salary plus room, board, and travel expenses.	0 1 2 3 4 5 6 7 8 9
9.	Calculate recipe quantities for a dinner for 41 when the original recipe is for 12 people.	0 1 2 3 4 5 6 7 8 9
10.	Figure out how much material to buy in order to make curtains.	0 1 2 3 4 5 6 7 8 9

11.	Estimate your grocery bill in your head.	0 1 2 3 4 5 6 7 8 9
12.	Figure out the tip on your part of a dinner bill split 8 ways.	0 1 2 3 4 5 6 7 8 9
13.	Figure out how much you would save if there is a 15% markdown on an item you wish to buy.	0 1 2 3 4 5 6 7 8 9
14.	Understand a graph accompanying an article on business profits.	0 1 2 3 4 5 6 7 8 9
15.	Figure out how long it will take to travel from city A to city B driving at 55 m.p.h.	0 1 2 3 4 5 6 7 8 9
16.	Set up a monthly budget for yourself.	0 1 2 3 4 5 6 7 8 9
17.	Understand how much interest you will earn on your savings account in 6 months and how that interest is computed.	0 1 2 3 4 5 6 7 8 9
18.	Work with a slide rule.	0 1 2 3 4 5 6 7 8 9

Math Problems

<u>**Instructions**</u>: Again, indicate your level of confidence in your ability to successfully perform each of the following problems using the scale above. **DO NOT ACTUALLY SOLVE THE PROBLEM.**

1.	The average of three numbers is 30. The fourth number is at least 10. What is the smallest average of the four numbers?	0 1 2 3 4 5 6 7 8 9
2.	Bridget buys a packet containing 9-cent and 13-cent stamps for $2.65. If there are 25 stamps in the packet how many are 13-cent stamps?	0 1 2 3 4 5 6 7 8 9
3.	To construct a table, Michele needs 4 pieces of wood 2.5 feet long for the legs. She wants to determine how much wood she will need for five tables. She reasons:	0 1 2 3 4 5 6 7 8 9

5 x (4 x 2.5) = (5 x 4) x 2.5
Which number principle is she using?

4. Five points are on a line. T is next to H. C is next to T. H is next to G. Determine the relative positions along the ling. 0 1 2 3 4 5 6 7 8 9

5. The formula for converting temperature from degrees Centigrade to degrees Fahrenheit is F = 9/5 C + 32. A temperature of 20 Centigrade is how many degrees Fahrenheit? 0 1 2 3 4 5 6 7 8 9

6. Fred's bill for some household supplies was $13.64. If he paid for the items with a $20, how much change should he receive? 0 1 2 3 4 5 6 7 8 9

7. The hands of a clock form an obtuse angle at _____ o'clock. 0 1 2 3 4 5 6 7 8 9

8. In a certain triangle, the shortest side is 6 inches, the longest side is twice as long as the shortest side, and the third side is 3.4 inches shorter than the longest side. What is the sum of the three sides in inches? 0 1 2 3 4 5 6 7 8 9

9. A living room set consisting on one sofa and one chair is priced at $200. If the price of the sofa is 50% more than the price of the chair, find the price of the sofa. 0 1 2 3 4 5 6 7 8 9

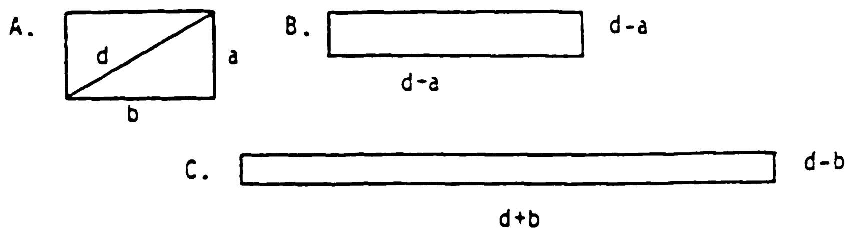
10. On a certain map, 7/8 inches represents 200 miles. How far apart are two towns whose distance apart on the map is 3 1/2 inches? 0 1 2 3 4 5 6 7 8 9

11. The opposite angles of a parallelogram are _____. 0 1 2 3 4 5 6 7 8 9

12. If 3x - 2 = 16 - 6x, what does "x" equal? 0 1 2 3 4 5 6 7 8 9

13. Sally needs three pieces of 0 1 2 3 4 5 6 7 8 9

poster board for a class project. If the boards are represented by rectangles A, B, C, arrange their areas in increasing order, (assume b > a).



14. Set up the problem to be done to find the number asked for in the expression "six less than twice 4 5/6." 0 1 2 3 4 5 6 7 8 9

15. In Starville, an operation Q on any number A and B is defined by A Q B = A x (A + B). Then 2 Q 3 equals ______. 0 1 2 3 4 5 6 7 8 9

16. There are three numbers. The second is twice the first, and the first is one-third of the other number. Their sum is 48. Find the other largest number. 0 1 2 3 4 5 6 7 8 9

17. 3 3/4 - 1/2 = _____. 0 1 2 3 4 5 6 7 8 9

18. Write an equation which expresses the condition that "the product of two numbers R and S is one less than twice their sum." 0 1 2 3 4 5 6 7 8 9

APPENDIX I

BSRI

Instructions: In this inventory, you will be presented with sixty personality characteristics. You are to use those characteristics in order to describe yourself. That is, you are to indicate, on a scale from 1 to 7, how true of you these various characteristics are. Please do not leave any characteristic unmarked.

1	2	3	4	5	6	7
Never or Almost Never True	Usually Not True	Sometimes But Infrequently True	Occasion- ally True	Often True	Usually True	Always/ Almost Always True

_____ 1. Self-reliant
_____ 2. Yielding
_____ 3. Helpful
_____ 4. Defends own beliefs
_____ 5. Cheerful
_____ 6. Moody
_____ 7. Independent
_____ 8. Shy
_____ 9. Conscientious
_____ 10. Athletic
_____ 11. Affectionate
_____ 12. Theatrical
_____ 13. Assertive
_____ 14. Flatterable
_____ 15. Happy
_____ 16. Has strong personality
_____ 17. Loyal
_____ 18. Unpredictable
_____ 19. Forceful leader
_____ 20. Feminine
_____ 21. Reliable
_____ 22. Analytical
_____ 23. Sympathetic
_____ 24. Jealous
_____ 25. Has leadership

_____ 31. Makes decisions easily
_____ 32. Compassionate
_____ 33. Sincere
_____ 34. Self-sufficient
_____ 35. Eager to soothe hurt feelings
_____ 36. Conceited
_____ 37. Dominant
_____ 38. Soft-spoken
_____ 39. Likable
_____ 40. Masculine
_____ 41. Warm
_____ 42. Solemn
_____ 43. Willing to take a stand
_____ 44. Tender
_____ 45. Friendly
_____ 46. Aggressive
_____ 47. Gullible
_____ 48. Inefficient
_____ 49. Acts as a
_____ 50. Childlike
_____ 51. Adaptable
_____ 52. Individualistic
_____ 53. Does not use harsh language
_____ 54. Unsystematic
_____ 55. Competitive

abilities

_____ 26. Sensitive to the needs of others

_____ 27. Truthful

_____ 28. Willing to take risks

_____ 29. Understanding

_____ 30. Secretive

_____ 56. Loves children

_____ 57. Tactful

_____ 58. Ambitious

_____ 59. Gentle

_____ 60. Conventional

APPENDIX J

Sample Items for the Activities Scale

Directions: Please indicate your degree of interest in each of the activities listed below by circling the number underneath the most appropriate column.

		LIKE	INDIFFERENT	DISLIKE
1.	Taking a statistics course.	1	2	3
2.	Visiting a science museum.	1	2	3
3.	Attending a lecture by a famous scientist.	1	2	3
4.	Solving computer problems.	1	2	3
5.	Attending a science fair.	1	2	3
6.	Joining a science club.	1	2	3
7.	Touring a science lab.	1	2	3
8.	Reading about a new scientific discovery.	1	2	3
9.	Solving a card/magic trick.	1	2	3
10.	Trying new computer programs.	1	2	3

APPENDIX K

Occupations Survey

Directions: For each occupation listed below, please indicate how seriously you have considered it as a possible career for yourself. Circle the most appropriate number.

	Haven't Considered	Not very Seriously			Moderately Seriously			Very Seriously		
1. Accountant	0	1	2	3	4	5	6	7	8	9
2. Chemist	0	1	2	3	4	5	6	7	8	9
3. Computer Programmer	0	1	2	3	4	5	6	7	8	9
4. Drafter	0	1	2	3	4	5	6	7	8	9
5. Engineer	0	1	2	3	4	5	6	7	8	9
6. Mathematician	0	1	2	3	4	5	6	7	8	9
7. Nurse	0	1	2	3	4	5	6	7	8	9
8. Physical therapist	0	1	2	3	4	5	6	7	8	9
9. Physician	0	1	2	3	4	5	6	7	8	9
10. Veterinarian	0	1	2	3	4	5	6	7	8	9
11. X-ray technician	0	1	2	3	4	5	6	7	8	9
12. Medical technician	0	1	2	3	4	5	6	7	8	9
13. Machinist	0	1	2	3	4	5	6	7	8	9
14. Heating/cooling technician	0	1	2	3	4	5	6	7	8	9
15. Architect	0	1	2	3	4	5	6	7	8	9
16. Welder	0	1	2	3	4	5	6	7	8	9
17. Electrician	0	1	2	3	4	5	6	7	8	9
18. Math/science										

teacher	0	1	2	3	4	5	6	7	8	9
19. Dental technician	0	1	2	3	4	5	6	7	8	9
20. Astronomer	0	1	2	3	4	5	6	7	8	9
21. Laboratory Assistant	0	1	2	3	4	5	6	7	8	9
22. Emergency Medical Technician	0	1	2	3	4	5	6	7	8	9
23. Precision-Lens Grinder	0	1	2	3	4	5	6	7	8	9

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