Relationship of role model exposure and encouragement to young women's interest in nontraditional careers, self-efficacy for nontraditional coursework, achievement in nontraditional subjects, and nontraditional academic choices

by

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INTRODUCTION

Women have participated in the total U.S. work force and in traditionally male fields at increasingly higher rates since the 1940's. Women currently constitute approximately 45% of the total U.S. work force (National Science Foundation [NSF], 1990a); however, they remain underrepresented in science and engineering relative to their proportion of the entire U.S. work force. Whereas women represent nearly half of the labor force, they constitue only about 16% of all scientists and engineers in the United States (National Research Council [NRC], 1991; NSF, 1990a, 1990b).

This underrepresentation is also evident in our educational institutions; women participate in science and engineering to a lesser degree than men at every educational level (Betz & Fitzgerald, 1987; Meade, 1991; NSF, 1990a). By high school, women are already less likely than men to participate in mathematics and science educational experiences, such as coursework. For instance, whereas 21% of college-bound senior men reported completing a calculus course in high school, only 15% of women did so, and while 51% of men reported completing a physics course, only 35% of women did so (NSF, 1990a). This differential rate of participation in math and science in high school results in women's lower level of participation in science and engineering programs in college (NSF, 1990a). Similarly, women's low rate of participation in science and engineering training programs as undergraduate and graduate students translates into an even lower rate of participation in those careers following college (Ivey, 1988).

The low rates of women's participation in science and engineering, both educationally and professionally, is costly for society and for women themselves. As human-resource needs for science and engineering increase in the next decade due to a growing demand for high-technology goods and services, and as the college student and young worker populations decrease, there is concern about how our society will provide a sufficient supply of scientists and engineers to meet these increased human-resource needs (NRC, 1991; Reuss & Vogel, 1989). Women incur the cost as well. Not only is their underrepresentation in science and engineering a tremendous waste of talent (McLure & Piel, 1978), it also contributes to their concentration in lower-status, lower-paying occupations, with few opportunities for advancement (Betz & Fitzgerald, 1987; Robinson & McIlwee, 1989). One way to reduce these costs to society and to women themselves would be to attract more young women to and retain them in science and engineering careers.

Several factors have been identified that may contribute to the underrepresentation of women in traditionally male fields. Paludi (1990), for example, identified two sets of factors, sociopsychological and structural, related to women's vocational development. Sociopsychological or person-centered factors, such as fear of success and failure, achievement orientation, and attributional style, are differentiated from structural or institution-centered factors, such as discrimination, sexual harassment, and the availability of role models. All of these factors have been hypothesized to act in some way as barriers to women's participation in traditionally male fields. One of these factors, the lack of role models, has been discussed as a barrier to women's attraction to and participation in nontraditional fields such as science and engineering at the college level (e.g., Betz, 1989; Betz & Fitzgerald, 1987; Little & Roach, 1974; NRC, 1991), but few studies have examined the influence of role models on women's career development prior to college, particularly during the high school years.

One possible explanation for the high rate of attrition among college women majoring in science or engineering is the lack of role models, particularly female role models, in those fields (Basow & Howe, 1979, 1980; Betz, 1989; NRC, 1991). Drawing on Freeman's (1979) null environment hypothesis, Betz (1989) discussed the null educational environment, which is an environment that fails to encourage or discourage students in the pursuit of careers. Such an environment, in effect, discriminates against women pursuing nontraditional fields because it does not account for the differential environmental or external factors influencing female and male vocational development, such as the availability of same-sex role models. In other words, the paucity of female professionals in science and engineering and the low numbers of female faculty members in those fields (NRC, 1991) are particularly detrimental to women's success in those fields because no other compensatory sources of encouragement are provided to them in college.

Role Model Information in College

In support of this null educational environment hypothesis as it relates to the availability of role models, it appears that female graduate students perceive the establishment of a same-sex student-faculty role-model relationship to be particularly important to their professional development (Gilbert, 1985). Moreover, research suggests that female role models are perceived to influence the career choices of female undergraduates to a greater extent than male role models (Basow & Howe, 1979, 1980). Female faculty role models also appear to exert a perceived positive influence on self-perceptions of career-related competency among female graduate and undergraduate students (Gilbert, Gallessich, & Evans, 1983; Stake & Noonan, 1985). Finally, there is evidence that same-sex peer modeling positively affects interest in nontraditional careers (Little & Roach, 1974) and that perceived role model influence is positively associated with nontraditionality of occupational choices (Hackett, Esposito, & O'Halloran, 1989) and persistence in nontraditional majors (Hayden & Holloway, 1985) among female undergraduates.

Role Model Information Prior to College

Given that the career aspirations of young women become restricted prior to college (Erb, 1981, 1983; Umstot, 1980) and that role model information is apparently related to female vocational development at the college level (e.g., Hackett, Esposito, & O'Halloran, 1989; Little & Roach, 1974, above), it seems appropriate to propose that role model information may be associated with female vocational development prior to college. Specifically, the availability of female role models in traditionally male fields, such as science and engineering, may be related to the attraction of young women to those fields prior to college.

There is some evidence to suggest that role model information is related to women's vocational development prior to college. First, female high school students perceive the lack of access to female role models in science and technology to be a barrier to their consideration of careers in those fields (McLure & Piel, 1978). Furthermore, female high school students who identify female science teacher models report a higher degree of commitment to science careers than female students who identify male science teacher models (Stake & Granger, 1978). There is also evidence that exposure to female models in nontraditional occupational roles is positively related to nontraditionality of career interests prior to college (Oakland & Young, 1980; O'Bryant & Corder-Boltz, 1978). Additionally, research suggests that exposure to female science role models is positively associated with liberal attitudes toward women in science prior to college (Smith & Erb, 1986; Work & Sloan, 1976), which, in turn, appear to be positively correlated with a preference for science careers among adolescent women (Erb & Smith, 1984). Finally, exposure to same-sex peer models has been shown to positively influence mathematics self-efficacy and achievement prior to college (Schunk & Hanson, 1985).

In sum, empirical evidence suggests that the availability of female role models in traditionally male fields is positively related to female vocational development, both prior to and during college. To a large extent, the research conducted to date in this area has focused on female college students, and much of this research has been, at least in part, retrospective in nature (Hackett, Esposito, & O'Halloran, 1989); that is, the relationship between role model information and female attraction to and participation in nontraditional fields has been examined by asking women to reflect on or attempt to remember past, rather than current, experiences with role models. As such, the results of retrospective investigations are potentially biased by current experiences of participants. For this reason it is preferable, when possible, to conduct prospective investigations in which participants are asked to report on current experiences. This point, when considered in combination with the evidence that role model information prior to college is related to young women's vocational development, indicates that an examination of role model influences on young women's attraction to and participation in nontraditional fields conducted at the high school level could contribute to our understanding of the relationship between role model information and women's underrepresentation in those fields.

Purpose and Hypotheses of the Present Study

As discussed above, theorists and researchers alike have identified several factors that may contribute to the underrepresentation of women in traditionally male fields, all of which merit study. One of these factors is the lack of role models in these fields. It is noted here that the present study's focus on the lack of role models in nontraditional fields should not be interpreted as an assertion that this factor is of greater importance than other factors proposed to influence women's career development. Rather, the present study represented an attempt to add to the current understanding of women's career development by examining the relationship of role model information to young women's attraction to and participation in nontraditional fields.

Despite the fact that the lack of role models in nontraditional careers has been discussed and investigated as a barrier to women's representation in those fields by several authors (Hackett, Esposito, & O'Halloran, 1989), very few studies have specifically investigated the relationship between role model information and women's attraction to and participation in traditionally male fields at the high school level. The purpose of the present study was to examine the nature of and extent to which role model information is related to interest in nontraditional careers, self-efficacy for nontraditional coursework, achievement in nontraditional subject areas, and nontraditional academic choices among female high school students. In the present study, role model information included both exposure to female role models and the self-reported nature and extent of encouragement received from various role models to pursue nontraditional careers. As part of a questionnaire administered to female high school students attending a career conference on traditionally male fields at a large midwestern university, female students were asked to respond to questions designed to assess the nature and extent of their experiences with various role models, the nontraditionality of their career interests and academic choices, their self-efficacy for nontraditional coursework, and their level of achievement in nontraditional subject areas.

It was predicted that students would rate female role models as offering more encouragement than male role models to pursue nontraditional career paths, based on Basow and Howe's (1979,

1980) findings that female role models are perceived to influence the career choices of female undergraduates moreso than male role models, and on Stake and Granger's (1978) evidence that female high school students who identify female science teacher models report a higher degree of commitment to science careers than female students who identify male science teacher models.

It was also predicted that students who reported more exposure to female role models in nontraditional fields would report more nontraditional career interests than students who reported less exposure to such female role models. This prediction was based on previous research indicating that exposure to women in nontraditional occupational roles is positively related to nontraditionality of career interests prior to college (Oakland & Young, 1980; O'Bryant & Corder-Boltz, 1978) and research indicating that exposure to female science role models is positively associated with liberal attitudes toward women in science (Smith & Erb, 1986; Work & Sloan, 1976), which are, in turn, positively correlated with a preference for science careers among adolescent females (Erb & Smith, 1984).

Third, it was predicted that students who reported more exposure to female role models in nontraditional fields would report higher levels of self-efficacy for nontraditional coursework than students who reported less exposure to such female role models. Such results would be consistent with findings reported by Gilbert, Gallessich, and Evans (1983) and by Stake and Noonan (1985) that exposure to female faculty role models is positively associated with high levels or career-related self-efficacy among female graduate and undergraduate students, and with findings reported by Schunk and Hanson (1985) that exposure to same-sex peer role models positively influences mathematics self-efficacy prior to college.

Fourth, it was predicted that students who reported more exposure to female role models in nontraditional fields would evidence higher levels of achievement in nontraditional subject areas than students who reported less exposure to such female role models. This prediction was consistent with findings by Schunk and Hanson (1985) that exposure to same-sex peer math role models positively influences levels of math achievement prior to college.

It was also predicted that students who reported more exposure to female role models in nontraditional fields would report more nontraditional academic choices than students who reported less exposure to such female role models, based upon theoretical formulations regarding the importance of exposure to female role models in women's career development (Betz, 1989; Betz & Fitzgerald, 1987; Hackett, Esposito, & O'Halloran, 1989).

Finally, it was predicted that students who reported more perceived encouragement from role models to pursue nontraditional career paths would report more nontraditional academic choices than students who reported lower levels of such encouragement from role models, based on findings that the degree of perceived positive role model influence on career choices is positively related to nontraditionality of occupational choices (Hackett, Esposito, & O'Halloran, 1989) and persistence in nontraditional majors (Hayden & Holloway, 1985) among female undergraduates.

No specific predictions were made regarding relationships between perceived encouragement from role models to pursue nontraditional career paths and other career-related variables, with the exception of its relationship with nontraditional academic choices. The relationships between perceived encouragement from role models and nontraditional career interests, self-efficacy for nontraditional coursework, and achievement in nontraditional subject areas, however, were explored in this study.

REVIEW OF THE LITERATURE

Women's Participation in the Labor Force

Women have participated in the total U.S. work force at increasingly higher rates since the 1940's. World War II marked an influx of women into jobs vacated by men serving in the military, and by 1948, women comprised approximately 28% of the U.S. work force (Betz & Fitzgerald, 1987; U.S. Department of Labor, 1989). By 1968 this figure had increased to 37%, and in 1988 women constituted about 45% of employed individuals in the United States (U.S. Department of Labor, 1989; NSF, 1990a). Furthermore, as of 1988, women made up 50% of the total U.S. professional work force, including business, management, and scientific areas (NRC, 1991). Most recent statistics indicate that women's labor force participation rates continue to increase; in 1992 women constituted 45.5% of the U.S. civilian labor force (U.S. Department of Labor, 1994). This trend is expected to continue; by the year 2005, it is estimated that women will make up more than 47% of the total U.S. labor force (U.S. Department of Labor, 1994).

As Betz and Fitzgerald (1987) argue, although women's level of participation in the labor force is approaching that of men, the nature of women's participation differs markedly from that of men. Women tend to be concentrated in a relatively small number of traditionally female "pink collar" occupations, such as clerical workers, beauticians, nurses, librarians, elementary school teachers, and waitresses (Betz & Fitzgerald, 1987). For example, 87% of librarians and 95% of nurses were women , whereas only 18% of lawyers and judges, 17% of doctors, and 11% of architects were women in 1985 (Betz, 1989).

Given that women constitute nearly half of the total U.S. labor force, their numbers in science and engineering indicate that they remain underrepresented in those fields relative to their proportion of the entire U.S. labor force. Statistics from the National Science Foundation (1990a) indicate that women constitute only about 16% of all scientists and engineers in the United States. This underrepresentation is more pronounced among engineers than among scientists: women constituted only 4% of engineers, compared to 30% of scientists, in 1988.

Women's Participation in Science and Engineering Education

In addition to the work place, women's low rates of participation in science and engineering are evident in our educational institutions; women participate in these fields to a lesser degree than men at every educational level (Betz & Fitzgerald, 1987; Meade, 1991; NSF, 1990a). As educational level increases, the proportion of women among the total number of participants in scientific and engineering fields decreases (Meade, 1991; NRC, 1991; NSF, 1990a).

Graduate Education

In 1988, women constituted 34% of the total number of graduate students enrolled in science and engineering programs; however, the majority of these women were enrolled in psychology, the social sciences, or the life sciences; only about 10% were enrolled in engineering programs (NSF, 1990a). The percentages of women actually attaining graduate degrees in these programs vary considerably by field. In 1989, women earned 42% of the master's degrees and 34% of the doctorates granted in the sciences but only 13% of the master's degrees and 9% of the doctorates granted in engineering (NRC, 1991). In many science and engineering fields, a graduate degree is considered a requirement for entry-level positions. Additionally, women with doctorates in science and engineering participate in the labor force at higher rates than do women whose highest degree is a bachelor's degree in these fields (Betz & Fitzgerald, 1987). As such, not attaining a graduate degree may preclude female students from working in their field of study.

Undergraduate Education

Women also constitute a minority of students participating in undergraduate science and engineering programs. Despite the fact that women constitute over 50% of all undergraduates (NSF, 1992), only 3% of college-bound women, as compared to 18% of college-bound men, indicated that they planned to pursue an undergraduate engineering degree in 1988 (NSF, 1990a). The proportions of college-bound women and men who intended to major in science in 1988 were more comparable, 23% and 21%, respectively, but, within science fields, women were heavily concentrated in the social sciences (NSF, 1990a). In terms of enrollment, women make up about 15% of all engineering undergraduates (Meade, 1991), and, in terms of degrees attained, women earned about 17% of all engineering and 48% of all science bachelor's degrees granted in 1989 (NRC, 1991). Again, within the sciences, bachelor's degrees earned by women were heavily concentrated in psychology (NRC, 1991).

Secondary Education

Due to the fact that mathematics is critical to the subject matter of many scientific and engineering disciplines, a lack of adequate preparation in mathematics and science at the precollege level is a significant barrier to further participation in science and engineering in college and beyond (NSF, 1990a; 1990b). By high school, women are already less likely than men to participate in mathematics and science educational experiences, such as coursework (Betz & Fitzgerald, 1987; NSF, 1990b). For example, in 1988, college-bound senior women who filled out the Student Descriptive Questionnaire of the Scholastic Aptitude Test (SAT) completed an average of 3.6 years of mathematics and 3.1 years of natural science coursework, as compared to 3.8 years of mathematics and 3.3 years of natural science coursework for college-bound senior men (NSF, 1990a). While the differences between the number of years of study in these subjects for women and men are not significant, women reported completing less advanced coursework in both subjects. For instance, whereas more than 90% of both women and men reported completing a geometry course, only 15% of women reported completing a calculus course, as compared to 21% of men. Similarly, whereas almost all women and men reported completing a biology course, only 35% of women reported completing a physics course, as compared to 51% of men.

Costs of Occupational Gender Stratification

The low rates of women's participation in certain traditionally male fields such as science and engineering, both educationally and professionally, is costly for society and for women themselves. There is currently concern about our society's ability to provide a sufficient supply of scientists and engineers to meet increasing human-resource needs in those fields and about women's concentration in low-status, low-paying occupaitons with few opportunities for advancement.

Societal Costs

The Bureau of Labor Statistics (U.S. Department of Labor, 1990) predicts that between 1986 and 2000, human-resource needs in science and engineering will increase by 36%, due to growth in high-technology industries and use of high-technology goods and services. It is projected that several factors will combine to put our society at risk for not being able to meet these increasing human-resource needs in science and engineering (NRC, 1991; Reuss & Vogel, 1989; U.S. Department of Labor, 1994). The National Research Council (1991) discusses three demographic trends expected to contribute to an impending shortfall of U.S. scientsts and engineers: the cohort of 18- to 24-year-olds, most of whom are college undergraduates, will continue to decline in number through 2000; the percentage of students majoring in most scientific and engineering disciplines has been decreasing in recent years; and the greatest growth in the U.S. population is projected to occur among ethnic groups that until now have not significantly participated in science and engineering. Labor force projections indicate that growth in both the overall labor force and the women's labor force will slow down between 1992 and 2005 (U.S. Department of Labor, 1994). As the baby-boom generation ages, the number of workers aged 16 to 24 is expected to drop by 2,000,000 or 8% of the total labor force by 2000 (Reuss & Vogel, 1989), and, by 2010, it is expected that there will be a shortage of up to 560,000 scientists and engineers (Rubin, 1988). One way to counter the expected shortage of U.S. scientists and engineers would be to tap heretofore underutilized populations, such as women, by increasing their attraction to and participation in science and engineering (NRC, 1991).

Costs to Women

Women incur the costs of occupational gender stratification as well. Current statistics indicate that women earn only 70 cents for ever dollar a man earns, and, since 1989, women's salaries have by and large failed to show any growth (Mahar, 1993). In addition, women with two years of postgraduate education, on average, earn about five dollars an hour, or $10,400 a year, less than men with the same amount of education, and, as a group, women with a college degree earn less than do white men with a high school diploma (Mahar, 1993).

Women continue to be concentrated in lower-status, lower-paying occupations and positions with few opportunities for advancement (Betz & Fitzgerald, 1987; Mahar, 1993). High-level positions, which carry with them the highest salaries and best benefits, tend to be dominated by men in most professions, including business, medicine, law and engineering (Mahar, 1993; Robinson & McIlwee, 1989). For example, although women constitute 43% of managers in the U.S., they make up only 3% of top-level corporate executives (Mahar, 1993). Similarly, gender stratification is evident within the field of engineering. Robinson and McIlwee (1989) found a close correspondence between status and income of positions within engineering such that there is a hierarchy of prestige and earning power ranging from positions below the level of design, such as sales and manufacturing, (average annual salary about $33,400) to design (annual salary about $35,000) to management (annual salary about $49,000). In terms of their distribution across these positions, 42% of the women, but only 23% of the men, held positions below the level of design; 43% of the women held design positions, compared to 58% of the men; and 15% of the women held management posiitons, compared to 20% of the men. In other words, the women were most heavily concentrated in positions with lower earning power.

Given the evidenced harmful effects of occupational gender stratification on society as a whole and on women individually, it seems that an investment in traditionally male skills would be wise for women at this point in time (Mahar, 1993; Robinson & McIlwee, 1989). Specifically, considering the growing demand for high-technology goods and services, and the fact that starting salaries in mathematics and engineering are among the highest for bachelor's degree recipients, the physical and mathematical sciences and engineering now present themselves as particularly promising fields for women (NRC, 1991; Oberman & Collins, 1995; Robinson & McIlwee, 1989).

Barriers to Women's Participation in Nontraditional Fields

As women's rate of participation in the labor force has increased over the past several decades, increasing attention has been paid to women's career development in the career psychology literature (Betz & Fitzgerald, 1987). Much of this literature has focused on barriers to women's participation in nontraditional occupations (Betz & Fitzgerald, 1987; Kahle, 1983, 1985; McLure & Piel, 1978; Paludi, 1990; Robinson & McIlwee, 1989). Several factors have been identified that may contribute to the underrepresentation of women in traditionally male fields. Many authors (e.g., Betz & Fitzgerald, 1987; Paludi, 1990) have distinguished between person-centered, or internal, barriers and institution-centered, or external, barriers to women's vocational development. Paludi (1990), for example, identified two sets of factors, sociopsychological and structural, related to women's vocational development. Sociopsychological factors include fear of success and failure, achievement orientation, and attributional style; whereas structural factors include discrimination, sexual harassment, and the availability of role models. In a similar vein, Betz and Fitzgerald (1987) proposed two types of factors, individual and background, facilitative of women's career development. Individual factors include instrumentality, high self-esteem, high ability, and liberal sex-role values. Facilitative background factors include a working mother, supportive father, highly educated parents, and female role models. Other authors (e.g., Matyas, 1985) make no such distinction between internal and external factors and focus instead on distinctions among external or environmental factors related to women's vocational development. Matyas (1985) proposed two groups of environmental factors that influence women's attraction to science and scientific careers: educational and sociocultural. Educational factors include class experiences, mathematical training, and extracurricular activities; whereas sociocultural factors include occupational sex stereotypes and role models.

Although the distinctions among factors related to women's vocational development made by the above authors differ, all identify the lack of role models as a significant barrier to women's attraction to and persistence in nontraditional occupations. Among other factors, the lack of role models has been discussed by several authors as a barrier to women's participation in science and engineering at the college level (e.g., Betz, 1989; Betz & Fitzgerald, 1987; Little & Roach, 1974; NRC, 1991), but few studies have examined the influence of role models on women's career development prior to college, particularly during the high school years.

The Null Educational Environment

One possible explanation for the high rate of attrition among college women majoring in science or engineering is the lack of role models, particularly female role models, in those fields (Basow & Howe, 1979, 1980; Betz, 1989; NRC, 1991). The lack of academic role models is one manifestation of a null educational environment. Freeman (1979) originally proposed the concept of a null environment. In Freeman's terms, a null environment is one way "to discriminate against women without really trying" (p. 194). She questioned female and male undergraduate, graduate, and professional students about the nature and degree of perceived personal support received from faculty and significant others for their academic and professional pursuits. The results of her study indicated that both female and male students perceived a lack of positive support from faculty, but female students perceived even less positive support from faculty than did male students. Students did not report that faculty were openly discouraging of their pursuits, simply that they were failing to encourage those pursuits. Freeman also found that female students perceived less support for their academic and career pursuits from others in their environment than did male students.

These findings supported Freeman's null environment hypothesis; that is, an environment that fails to encourage or discourage students in the pursuit of careers is inherently discriminatory against women pursuing nontraditional fields because it does not account for the differential environmental or external factors influencing women's and men's vocational development, such as perceived support and the availability of same-sex role models. In other words, in the absence of other sources of positive support to pursue nontraditional careers, the paucity of female professionals in science and engineering and the low numbers of female faculty members in those fields (NRC, 1991) are particularly detrimental to women's success in those fields because no other compensatory sources of encouragement are provided to them in academia (Betz, 1989). As such, the null environment hypothesis speaks to the importance of increasing young women's attraction to and persistence in nontraditional fields such as science and engineering, as one day these young women could potentially serve as role models for future generations of female students pursuing an education in these fields.

Lack of Role Models

Freeman's (1979) conception of the null environment gave rise to a body of literature on the relationship between role models and women's career development. Broadly, a role model is frequently defined as an individual whose life and activities have influenced life decisions of the respondent (Basow & Howe, 1980). As related to students' career development in particular, a role model is often conceptualized as "someone whose life and activities influenced the students in their career choice" (Basow & Howe, 1979, p. 240). Types of individuals typically thought to serve as role models in women's career development include college professors, elementary and secondary teachers, parents, other family members, other significant adults, and peers (Basow & Howe, 1980; Betz & Fitzgerald, 1987; Hackett, Esposito, & O'Halloran, 1989; Kahle, 1983, 1985). Social learning theory suggests that there are two processes by which role models may provide important information to individuals: direct interaction and indirect identification (Bell, 1970). Direct interaction includes behavior between the role model and individual, while indirect identification may include perceptions of similarity between role model and self, imitation of the role model, or assimilation of the attitudes or values of the role model.

It has been well-documented that role models play an important part in women's career development at the college level and that a lack of role models is a major barrier to such development (Basow & Howe, 1979, 1980; Betz & Fitzgerald, 1987; Gilbert, 1985; Hackett, Esposito, & O'Halloran, 1989; Hayden & Holloway, 1985; Stake & Noonan, 1985). Among female college students, the presence of role models is associated with higher levels of career-related competency (Gilbert, Gallessich, & Evan, 1983; Stake & Noonan, 1985), interest in nontraditional careers (Little & Roach, 1974), nontraditionality of occupational choices (Hackett, Esposito, & O'Halloran, 1989), and persistence in nontraditional majors (Hayden & Holloway, 1985). The importance of role model information prior to college has been less well-documented, but there is some evidence to suggest that the presence of role models before college is facilitative of female vocational development (McLure & Piel, 1978; Oakland & Young, 1980; O'Bryant & Corder-Boltz, 1978; Schunk & Hanson, 1985; Smith & Erb, 1986).

Role Model Information and Women's Career Development

Sex of Role Models

There has been some debate in the role modeling literature concerning the relative influence of same-sex versus opposite-sex role models on the career development of women. In reviewing research on the imitation of same-sex versus cross-sex models, Maccoby and Jacklin (1974) concluded that children do not systematically imitate same-sex models over cross-sex models. On the other hand, Stake and Granger (1978) presented a review of empirical evidence suggesting that, beyond the preschool years, students may be more likely to imitate a same-sex model than an opposite-sex model. Given that identification is one component in the role modeling process and that individuals will more likely emulate models they perceive as more similar to themselves, it seems that women's career development may be more strongly influenced by female rather than male role models (Basow & Howe, 1980; Gilbert, 1985). Indeed, some research supports this contention.

Gilbert, Gallessich, and Evans (1983) investigated the relationship between sex of faculty role models and professional development among graduate students. Doctoral students responded to a questionnaire designed to measure various aspects of graduate student experience including career commitment, career aspirations, self-esteem, and instrumentality. They found that female students who identified female faculty role models reported significantly higher levels of all of these variables than did female students who identified male faculty role models. They also reported higher levels of satisfaction with their student roles than students who identified male faculty role models.

Basow and Howe (1979, 1980) conducted two studies in which they investigated perceived encouragement from role models to pursue nontraditional careers among college students by administering the Role Model Influence Scale (Basow & Howe, 1979), which asks respondents to rate a variety of people (mother, father, male and female teacher, male and female friend, male and female adult) on the degree to which these individuals encourage or discourage the student's career choice while in college. Results indicated that the career choices of female students were significantly more affected than were those of male students by mothers, female teachers, and female friends. Women were also significantly more encouraged by female role models than by male role models. Mothers and female teachers were shown to most strongly encourage the career choices of female students.

In addition, Stake and Granger (1978) examined same-sex and opposite-sex teacher model influences on science career commitment among high school seniors. They found that female students who identified a female science teacher as their primary science role model reported a significantly higher degree of commitment to science careers than did female students who identified a male science teacher as their primary science role model.

In summary, it appears that female role models have a greater influence than male role models on the career aspirations, career choice, and career commitment of women.

<u>Role Model Information in College</u>

Among college women, it appears that perceived encouragement from role models is associated with career salience and educational and career plans. Hackett, Esposito, and O'Halloran (1989) examined the relationship between perceived encouragement from role models to pursue nontraditional careers and four aspects of women's career development: career salience, level of educational aspirations, college major choices, and occupational choices. They administered a slightly revised version of the Role Model Influence Scale (Basow & Howe, 1980) to senior college women from several majors at a small western women's liberal arts college. The results of their study indicated that perceived encouragement from rolemodels was predictive of career-related aspirations and choices. Specifically, perceived encouragement from female teacher role models was most strongly positively related to career salience and level of educational aspirations. Also, women who reported encouragement from their fathers and other adult males were more likely to be considering nontraditional occupations than women who reported discouragement or neither encouragement or discouragement from those models.

Most of the studies on the relationship between role models and women's career development have focused on the influence of college faculty members who serve as role models. In support of Freeman's (1979) null academic environment hypothesis as it relates in particular to the availability of role models, it appears that female graduate students perceive the establishment of a same-sex student-faculty role-model relationship to be particularly important to their professional development. Gilbert (1985) investigated the level of importance female and male students attributed to having a role model relationship for their professional development. She found that female students who had a female role model rated their relationship with that model as significantly more important to their professional development than did male students who had a male role model, indicating that the presence of role models is particularly valued by women.

Stake and Noonan (1985) examined the influence of professorial models on the career confidence and motivation of college students. These researchers looked at changes in students' career confidence and motivation across a seven-month period in which the students were exposed to faculty models. Their results indicated that female students who identified a woman as the most important faculty model who they wanted to emulate experienced the greatest gains in career confidence and motivation across the seven-month period. Stake and Noonan interpreted these results as a demonstration that both the establishment and quality of the faculty-student role-model relationship are facilitative of women's career development.

It also appears that role model information is related to persistence in nontraditional fields. Ivey (1988) found that the number of female graduates from science and engineering programs who eventually pursued careers in those fields correlated directly with the number of female faculty members in the programs from which they graduated, indicating that the presence of female role models facilitates persistence in nontraditional fields among women. Additionally, Hayden and Holloway (1985) found that the presence of role models appears to be positively related to persistence in nontraditional fields. These researchers followed engineering students' academic progress and found that students with a family member employed in the field of engineering evidenced a significantly higher rate of retention in their program than did students with no family member employed in engineering.

Finally, there is some evidence that same-sex peer modeling is related to interest in nontraditional careers. Little and Roach (1974) presented a series of videotaped films in which female students modeled interest in nontraditional occupations to female undergraduates with undeclared majors and then asked the students who had viewed the tapes to indicate preferences for occupations. The career preferences of students who viewed the tapes were compared with those of a control group (students who did not view the tapes). Little and Roach found that students who viewed the tapes indicated a higher level of interest in nontraditional occupations than students who did not view the tapes, suggesting that the availabilty of same-sex peer models facilitates nontraditionality of occupational preferences among female undergraduates.

As a whole, the above research indicates that, at the college level, the presence of role models, particularly female role models, is facilitative of several aspects of female career development: career aspirations, confidence, commitment, and choice, as well as interest and persistence in nontraditional fields. Some theorists have proposed, however, that the process of career development begins much earlier than college (Gottfredson, 1981; Krumboltz, 1979; Super, 1980). Gottredson (1981), for example, presented a developmental theory of career aspirations in which she asserted that occupational preferences begin to form as early as the preschool years. Also, evidence suggests that the career aspirations of young women appear to become restricted prior to college (Erb, 1981,1983; Umstot, 1980). Given this information, and the above evidence that role model information is faciltative of women's vocational development in college, it seems appropriate to propose that role model information may be a factor of some importance to women's career development prior to college. Specifically, the availability of female role models in traditionally male fields such as science and engineering may be related to the attraction of young women to those fields prior to college.

Role Model Information Prior to College

There is some evidence to suggest that the availability of female role models in traditionally male fields is facilitative of women's career development in those fields prior to college. First, female high school students perceive the lack of access to female role models in traditionally male fields to be a barrier to their consideration of careers in those fields. McLure and Piel (1978) proposed that the high school years mark a critical period in the development of career interests and choices. They surveyed a nationwide sample of high school senior women, asking them about their perceptions of facilitating factors and barriers which might encourage or discourage their interest in science and technology. Twenty percent of the participants reported that a lack of female role models in science and technology was one of the three most important reasons they would not pursue a career in those fields. These researchers suggested that a lack of access to successful female role models in science may result in the perception among female high school students that science careers are too difficult for them, and, as such, successful female role models in science should be made more accessible through discussions, references to female scientists in class materials and by teachers, and information provided to parents.

It also appears that exposure to female role models in nontraditional occupational roles is related to nontraditionality of career interests prior to college. Smith and Erb (1986) investigated the effects of exposure to female science career role models on junior high school students' attitudes toward women in science. Over a two-month period, as part of their regular science instruction, one group of students, the experiemental group, was visited by at least three women science career role models, studied at least six women who had made important contributions in science, and read about at least six young women who used science in their work. Another group, the control group, received the same science instruction as the experiemental group but were not exposed to the above female science role models. At the end of the two-month period, results showed that students in the experimental group had significantly more positive attitudes toward women in science than students in the control group. These researchers (Erb & Smith, 1984) had previously found that positive attitudes toward women in science are correlated with preferences for a science career among early adolescents. Considered together, these studies suggest that exposure to female role models in nontraditional occupational roles positively influences interest in nontraditional careers.

Similarly, Oakland and Young (1980) examined the influence of exposure to female science role models on knowledge of and interest in science careers among adolescent girls. They employed a two-day, two-hour per day, workshop for eighth-grade girls in which female college students majoring in science described their science areas and provided career information. At the end of the workshop, the girls' knowledge of and interest in science careers increased as compared to before the workshop.

O'Bryant and Corder-Boltz (1978) also found that exposure to female models in nontraditional occupational roles is related to nontraditionality of career interests prior to college. These researchers examined the effects of exposure to female models in traditional and nontraditional roles via commercials, over a one-month period, on stereotyping of women's work roles and preferences for various occupations among elementary school students. They found that children who saw women portrayed in nontraditional roles had significantly lower scores on an occupational stereotyping test at post-test than did children who saw women portrayed in traditional roles. Perhaps more importantly, though, girls who saw women portrayed in nontraditional roles in the commercials evidenced a significant increase from pre- to post-test in the nontraditionality of their own career preferences.

Finally, exposure to same-sex peer role models appears to be related to self-efficacy and achievement prior to college. Schunk and Hanson (1985) had one group of elementary school students who had experienced difficulty learning subtraction, the experimental group, observe a same-sex peer demonstrate acquisition of subtraction skills. Another group who had experienced difficulty learning subtraction, the control group, did not observe the peer model. Following the intervention, children in the experimental group had higher levels of mathematical self-efficacy and achievement than children in the control group, indicating that exposure to the same-sex peer role models increased mathematical self-efficacy and achievement.

In sum, empirical evidence suggests that the availability of female role models in nontraditional fields is facilitative of women's attraction to and participation in those fields, both prior to and during college. To a large extent, the research conducted in this area has focused on female college students, and much of this research has been, at least in part, retrospective in nature (Hackett, Esposito, & O'Halloran, 1989); that is, the relationship between role model information and women's attraction to and participation in nontraditional fields has been examined by asking women to reflect on or attempt to remember past, rather than current, experiences with role models. As such, the results of retrospective investigations are subject to bias from current experiences of participants. For this reason it is preferable, when possible, to conduct prospective investigations in which participants are asked to report on current experiences, in this case, with role models. This point, when considered in combination with the above evidence that role model information prior to college is related to women's vocational development, suggests that an examination of role model influences on women's attraction to and participation in nontraditional fields conducted at the high school level could contribute to our understanding of the relationship between role model information and women's underrepresentation in those fields.

METHOD

Participants

Participants in this study were female high school students (grades 9 through 12) between the ages of 14 and 18 from across the state of Iowa, primarily from rural high schools, who registered for a career conference at a large upper midwestern university which was geared toward educating young women about careers in science, mathematics, and engineering. The size of the final sample (N=324) was determined by the number of conference registrants who agreed to participate in the study by completing and returning the questionnaire prior to the conference. The response rate was 54%. Sixty-four percent of the participants reported living in a town or city, while 34% reported living in the country or on a farm. The remaining 2% reported living in a suburb of a town/city. Ninety-seven percent of the participants were European American, 1% were Hispanic American, less than 1% were Native American, and the remaining 2% were of some other ethnicity.

Measures

The measures used in this study were a subset of those used in a larger study. As such, only those measures that were used to obtain data for this study are described below.

Role Model Information

Exposure. Three separate self-report measures were used to obtain information about experiences with role models in science, mathematics, and engineering. The first measure asked how many people the student knew in each of the following categories: female science teachers, female math teachers, female scientists, and female engineers. The second measure asked how many female math and science teachers the student had as instructors in grades six through 12. These two measures combined represented a measure of exposure to female role models in nontraditional careers.

Encouragement. The third measure was the Role Models Influence Scale (RMIS) (Basow & Howe, 1980), which was used as a measure of the nature and degree of perceived encouragement from various role models to pursue nontraditional career paths. The RMIS consists of 12 Likert-type items that ask respondents to rate a variety of people (mother, father, sister(s), brother(s), male teacher(s), female teacher(s), male friend(s), female friend(s), male adult(s), female adult(s), man (men) employed in science or mathematics, and woman (women) employed in science or mathematics) on the degree to which they encourage or discourage the respondent's decision to major in science or mathematics in college. Students responded to the items on a 7-point scale (-3 = negative influence, 3 = positive influence) (see Appendix A). The possible range of scores is -36 to 36, with low scores indicating discouragement from role models to pursue a college major in science or mathematics and high scores indicating encouragement from role models to pursue a college major in science or mathematics. Because the RMIS has typically been analyzed at the item level, estimates of reliability for the entire instrument have not been established (Hackett, Esposito, & O'Halloran, 1989). The RMIS has strong face validity. Additionally, the perceived encouragement from several role models to pursue nontraditional careers as measured by the RMIS has been found to be a significant predictor of various career and educational variables, such as career salience, educational aspirations, and nontraditionality of college major and occupational choice (Hackett, Esposito, & O'Halloran, 1989). Finally, two new variables were created from the RMIS for use in unplanned analyses. The number of female role models (FCOUNT) and male role models (MCOUNT) from the RMIS reported to offer some degree of perceived encouragement to pursue nontraditional careeer paths were calculated in order to determine what, if any, relationship these variables may have with the present study's dependent variables.

Nontraditional Academic Choices

The extent to which students have made nontraditional academic choices was measured by asking them to list all of the high school math and science classes they had taken, were currently taking, and planned to take before completing high school. For each participant, the total number of courses listed was a measure of nontraditionality of academic choices, NT-Choice, with high scores indicating a high degree of nontraditionality of academic choices and low scores indicating a low degree of nontraditionality of academic choices.

Achievement in Nontraditional Subjects

Achievement in nontraditional subject areas was measured by asking participants to report grades received in each of the math and science courses they had completed in high school. A nontraditional course grade point average (NT-GPA) was calculated for each participant by dividing the total number of quality points by the number of math and science classes completed. Quality points were assigned to each course grade as follows: "A"=4, "B"=3, "C"=2, "D"=1, "F"=0. The possible range of scores was 0 to 4, with low scores indicating low levels of achievement in nontraditional subjects and high scores indicating high levels of achievement in nontraditional subjects.

A weighted nontraditional course grade point average (WNT-GPA) was also calculated for each participant to reflect the fact that, as the number of math and science courses taken increases, the overall difficulty of all math and science courses taken increases. WNT-GPA was created in order to reward those students who had maintained a high level of achievement in math and science across several courses in high school. This variable was calculated by dividing the sum of academic quality points by the number of years in high school. As such, it factors course load per year into achievement, giving more weight to larger course loads, but it does not discriminate between numbers of years in high school. For example, using WNT-GPA, the grades earned by a freshman who had taken three math and science courses in her first (and only) year in high school would be given the same amount of weight as the grades earned by a senior who had taken a total of 12 math and science courses during her high school career. The grades earned by the same freshman, however, would be given more weight than the grades earned by a senior who had only taken a total of three math and science courses during her high school career.

Self-Efficacy for Nontraditional Coursework

Math Self-Efficacy. Self-efficacy for math-related coursework was measured using the math-related courses subscale of the Mathematics Self-Efficacy Scale (MSE) developed by Betz and Hackett (1983). The math-related courses subscale of the MSE consists of 16 items designed to measure respondents' confidence in their ability to complete each of 16 math-related courses with a grade of "B" or better. Respondents rated their confidence on a 10-point Likert-type scale (1 = no confidence at all, 10 = complete confidence) (see Appendix B). The possible range of scores was 16 to 160, with low scores indicating low levels of confidence and high scores indicating high levels of confidence in one's ability to complete math-related courses with a "B" or better. For this study, the wording of one of the items was changed from "basic college math" to "college algebra" for purposes of clarification based upon the particular labels applied to this level of math coursework in the high schools from which our participants come.

Betz and Hackett (1983) reported an internal consistency reliability (coefficient alpha) of .93 and a range of item-total correlations from .33 to .73 for the math-related courses subscale of the MSE. Pilot data from female high school students across the state of Iowa (N=69) indicated high internal consistency (coefficient alpha = .93) of scores on the math-related courses subscale of the MSE with this population. In terms of validity, MSE scores have been superior to other indicators of mathematics preparation and achievement as predictors of choosing a math-related college major (Hackett, 1985; Hackett & Betz, 1989).

Science Self-Efficacy. Self-efficacy for science coursework was measured using a method similar to that used to measure math self-efficacy. Respondents were asked to rate their confidence in their ability to complete seven science courses (human anatomy, botany, environmental studies, engineering, genetics, physics, and chemistry) with a grade of "B" or better using a 10-point Likert-type scale (1 = no confidence at all, 10 = complete confidence) (see Appendix B). The possible range of scores was 7 to 70, with low scores indicating low levels of confidence and high scores indicating high levels of confidence in one's ability to complete science coursework with a "B" or better. Pilot data from high school females across the state of Iowa (N=69) yielded an internal consistency reliability (coefficient alpha) of .85 for this measure of science self-efficacy.

Career Interests

Consideration of various occupations was measured using a modified version of the General Occupational Theme-Self-Efficacy Scale (GOT-SE) (Lapan, Boggs, & Morrill, 1989). The GOT-SE was developed as a measure of self-efficacy for the educational requirements and required duties of occupations across six General Occupational Themes (Realistic, Investigative, Artistic, Social, Enterprising, and Conventional). Lapan, Boggs, and Morrill (1989) reported Pearson correlations between GOT self-efficacy ratings and GOT interest scores on the Strong Campbell Interest Inventory (SCII) ranging from nonsignificant to .64. Highest correlations (.44 to .64) were found between self-efficacy ratings and SCII interest scores on the Realistic and Investigative themes.

For this study, the instructions of the GOT-SE were slightly modified in order to measure the degree to which students are considering occupations across the six GOTs, rather than their self-efficacy for occupations in those themes. Thirty occupations were omitted from the original 83 occupations listed on the GOT-SE, as determined below, and three occupations (Electrical, Civil, and Chemical Engineer) were added to the list to better reflect the particular interests of the population being studied. Respondents indicated the degree to which they were considering a career in each of 56 occupations using a 10-point Likert-type scale (1 = not considering at all, 10 = considering very strongly) (see Appendix C). The number of occupations that contributed to each of the GOT scores were as follows: Realistic (7 items), Investigative (15 items), Artistic (8 items), Social (6 items), Enterprising (7 items), and Conventional (6 items), bringing the total number of items scored across the six themes to 49. Thus, not all of the 56 items included in the questionnaire used for this study contributed to the GOT scores used in the study's analyses; items were retained in the six themes based on their contribution to the internal consistency of the GOT scales and their relevance to the interests of the population of study. All of the 6 original GOTs were reduced in number of items except the Investigative dimension, as all of the occupations included in that GOT are related to science and engineering. Pilot data from female high school students from across the state of Iowa (N=69) yielded the following internal consistency coefficients for the six GOTs on this measure:

Realistic (.61), Investigative (.80), Artistic (.70), Social (.62), Enterprising (.78), and Conventional (.74).

Mother's and Father's Occupation

Given that previous research suggests childrens' career plans are related to the employment statuses and careers of their parents (Dambrot & Vassel, 1983; Jagacinski, 1987; Smith, 1980; Tamir & Gardner, 1989; Trice, 1990), mother's and father's occupation were coded along a single dimension according to the level of mathematical skill or knowledge required for his or her particular occupation for use in exploratory analyses. Parental occupations were assigned a value of "1" through "6", with "1" representing the lowest level of mathematical skill and "6" representing the highest level of mathematical skill required for a particular occupation (see Appendix D). The values assigned to mother's and father's occupation were labeled MMCODE and FMCODE, respectively. The scale used to assign these codes was developed by the U.S. Department of Labor and appears in The Complete Guide for Occupational Exploration (Farr, 1993), which organizes job titles into increasingly specific groups of related occupations based on a data base of over 12,000 occupational titles. If a parent was not employed outside the home, his or her occupation was assigned a value of "0" on this dimension. If a parent was deceased and/or no information was provided about his or her occupation, the occupation was considered to be missing and no value was assigned.

Mother's and Father's Level of Education

Given that career choices appear to be related to parental level of education (Jagacinski, 1987), mother's and father's highest level of education were assigned a value of "1" through "6" as follows: 1 = less than high school, 2 = high school, 3 = technical or vocational school, 4 = Bachelor's degree, 5 = Master's degree, 6 = Doctoral degree.

Procedure

Because this study was part of a larger research project being conducted using the same group of students, only those procedures relevant to the collection of data for use in this study are described below. Approximately 7 weeks prior to the scheduled date of the career conference, registration brochures, which included a list of events and speakers scheduled for the conference, as well as a registration form, were mailed to approximately 6300 individuals who have contact with high school students across the state of Iowa. These individuals, math, science, agriculture, and industrial technology teachers and area coordinators of Talented and Gifted programs, announced the upcoming conference to their students and provided interested students with registration forms. The conference was also announced in several state science journals and newsletters (see Appendix E). Registration involved signing up to attend a number of individual and panel presentations and a departmental or campus tour during the course of the conference, according to the particular interests of the student.

A questionnaire, invitation to participate in the study, consent form, and postage-paid return envelope were mailed to each student who registered for the conference. A chance to win one of three $50 gift certificates from the university book store was offered as an incentive for participation. Two weeks after the initial questionnaire packet was mailed, post cards were seent to nonrespondents reminding them to complete and return the questionnaire.

Analyses

Degree of Encouragement from Female and Male Role Models to Pursue Nontraditional Career Paths

A correlated groups t-test was used to test the hypothesis that students would rate female role models as having greater influence than male role models, regardless of direction, on their decisions to pursue nontraditional majors, defined as science or mathematics majors. Item scores on the Role Model Influence Scale (RMIS) were converted to absolute values before total scale scores were calculated in order to perform this analysis.

Relationship Between Exposure to Female Role Models and Career Interests

A simple correlation was calculated between scores on exposure to female role models in nontraditional careers and scores on each of the six General Occupational Theme subscales of the measure of career interests (Realistic, Investigative, Artistic, Social, Enterprising, and Conventional). These correlational analyses were used to test the hypothesis that students who reported more exposure to female role models in nontraditional fields would report more nontraditional career interests, defined as realistic and investigative occupations, than students who reported less exposure to such female role models. It was predicted that there would be a significant positive correlation between Exposure and Realistic scores and between Exposure and Investigative scores.

Relationship Between Exposure to Female Role Models and Self-Efficacy

Correlational analyses were used to test the hypothesis that students who reported more exposure to female role models in nontraditional fields would report higher levels of math self-efficacy and science self-efficacy, than students who reported less exposure to such female role models. It was predicted that there would be a significant positive correlation between Exposure and Math Self-Efficacy scores and between Exposure and Science Self-Efficacy scores.

Association Between Exposure to Female Role Models and Achievement

Correlational analyses were used to test the hypothesis that students who reported more exposure to female role models in nontraditional fields would evidence higher levels of achievement in nontraditional subjects, as measured by nontraditional course G.P.A. (NT-GPA) and weighted nontraditional course G.P.A. (WNT-GPA), than students who reported less exposure to such female role models. It was predicted that there would be a significant positive correlation between Exposure and NT-GPA scores and between Exposure and WNT-GPA scores.

Relationship Between Role Model Information and Academic Choices

Simple correlations were calculated between Exposure scores and scores on the measure of nontraditionality of academic choices, NT-Choice, and between Role Model Influence Scale (RMIS) scores and NT-Choice scores. These correlational analyses were used to test the following hypotheses: 1) students who reported more exposure to female role models in nontraditional fields would report more nontraditional academic choices than students who reported less exposure to such female role models; and 2) students who reported more perceived encouragement from role models to pursue nontraditional career plans would report more nontraditional academic choices than students who reported lower levels of such encouragement from role models. Again, NT-Choice was calculated as the sum of the number of high school math and science courses students had taken, were taking, and planned to take. It was predicted that there would be a significant positive correlation between Exposure and NT-Choice scores and between RMIS and NT-Choice scores.

Additional Analyses

The relationships between perceived encouragement from role models to pursue nontraditional career paths and each of nontraditional career interests, math and science self-efficacy, and achievement in nontraditional subjects were explored by calculating simple correlations, respectively, between RMIS and Realistic and between RMIS and Investigative scores, between RMIS and Math Self-Efficacy and between RMIS and Science Self-Efficacy scores, and between RMIS and NT-GPA and RMIS and WNT-GPA scores. It was expected that all of the above correlations would be significantly positive.

The relationships between perceived encouragement from role models and, respectively, nontraditional career interests, self-efficacy for nontraditional coursework, achievement in nontraditional subjects, and nontraditional academic choices were further explored by calculating a measure of encouragement from female role models, RMIS-F, and a measure of encouragement from male role models, RMIS-M. The RMIS-F measure consisted of the total of all the items from the RMIS that are designed to measure encouragement from female role models (items 1, 3, 6, 8, 10, and 12; see Appendix A). The RMIS-M measure consisted of the total of all the items from the RMIS that are designed to measure encouragement from male role models (items 2, 4, 5, 7, 9, and 11; see Appendix A). Simple correlations were calculated between each of these measures (RMIS-F and RMIS-M) and each of the following measures: Realistic, Investigative, Math Self-Efficacy, Science Self-Efficacy, NT-GPA, WNT-GPA, and NT-Choice.

The relationships between the number of female and male role models from the RMIS reported to offer some degree of perceived encouragement to pursue nontraditional career paths and each of the four dependent variables were explored by calculating simple correlations between both FCOUNT and MCOUNT and each of the following measures: GOT-R, GOT-I, MSE, SSE, NT-

GPA, WNT-GPA, and NT-Choice. The relationships between the level of mathematical skill required for mother's and father's occupations and the four dependent variables were also explored by calculating simple correlations between both MMCODE and FMCODE and each of the following measures: GOT-R, GOT-I, MSE, SSE, NT-GPA, WNT-GPA, and NT-Choice. In addition, the relationships between mother's and father's level of education and the dependent variables were examined by calculating simple correlations between both MOTHERED and FATHERED and each of the following: GOT-R, GOT-I, MSE, SSE, NT-GPA, WNT-GPA, and NT-Choice. Also, based on previous research indicating that nontraditional career-related self-efficacy is a significant predictor of nontraditional career interests (Betz & Hackett, 1981; Lapan, Boggs, & Morrill, 1989; Lent, Lopez, & Bieschke, 1991), achievement in nontraditional subjects (Lent, Brown, & Larkin, 1986, 1987), and nontraditional academic choices (Betz & Hackett, 1983; Hackett, 1985; Hackett & Betz, 1989), the relationships between math and science self-efficacy and each of these variables were explored by calculating simple correlations between both MSE and SSE and each of the following measures: GOT-R, GOT-I, NT-GPA, WNT-GPA, and NT-Choice.

Finally, in an effort to determine the contribution of selected variables to the prediction of various theoretically important variables, three criterion variables, nontraditional academic choices (NT-Choice), achievement in nontraditional subjects (NT-GPA and WNT-GPA), and nontraditional career interests (GOT-R and GOT-I), were regressed on various of the following predictor variables: Math and Science Self-Efficacy (MSE and SSE), highest level of mother's and father's education (MOTHERED and FATHERED), level of mathematical skill required for mother's occupation (MMCODE) and father's occupation (FMCODE), perceived encouragement from female and male role models (RMIS-F and RMIS-M), and the number of female and male role models from the RMIS reported to offer some degree of encouragement to pursue nontraditional career paths (FCOUNT and MCOUNT).

RESULTS

Differences in Degree of Perceived Encouragement from Female and Male Role Models to Pursue Nontraditional Career Paths

Before any analyses were performed on measures derived from the RMIS, score distributions for each item on that scale were examined in order to determine if two separate scores, one for encouragement and one for discouragement to pursue nontraditional career paths, should be used for all measures derived from the RMIS, rather than using one score, which could have possibly resulted in negative and positive influence scores canceling each other out on total scale scores. Examination of these item score distributions revealed that they were unimodal and that very few scores fell below zero. The percentages of item scores that fell below zero on items one through 12 ranged from .3% to 3.1%. As such, it was determined that one score for each measure derived from the RMIS would be used in the current study's analyses and would reflect perceived encouragement to pursue nontraditional career paths.

The current study predicted that students would rate female role models as offering more encouragement than male role models to pursue nontraditional majors. A correlated groups t-test compared the absolute values of perceived encouragement from female role models and perceived encouragement from male role models as measured by the RMIS. The t-test was significant, $t(316) = 6.86$, $p < .0001$, with students rating female role models as offering more encouragement ($M = 8.92$, $SD = 4.61$) to pursue nontraditional majors than male role models ($M = 7.81$, $SD = 4.52$). The effect size for the difference between means, as measured by Cohen's d, was .39.

Relationship Between Exposure and Career Interests

It was predicted that students who reported more exposure to female role models in nontraditional fields would report more nontraditional career interests than students who reported less exposure to such female role models. A simple correlation was calculated between Exposure and Realistic scores and between Exposure and Investigative scores, both of which were non-significant ($p > .05$), $r(307) = .09$ and $r(300) = .06$, respectively. These nonsignificant correlations failed to support the hypothesized relationship between exposure to female role models in nontraditional fields and nontraditional career interests.

Relationship Between Exposure and Self-Efficacy

The present study predicted that students who reported more exposure to female role models in nontraditional fields would report higher levels of self-efficacy for nontraditional coursework than students who reported less exposure to such female role models. In order to test this hypothesis, a simple correlation was calculated between Exposure scores and each of the following: Math Self-Efficacy and Science Self-Efficacy. The correlation between Exposure and Math Self-Efficacy was non-significant ($p > .05$), $r(308) = .09$. The correlation between Exposure and Science Self-Efficacy, however, was significant, $r(304) = .11$, $p < .05$. The effect size associated with this correlation, as measured by Cohen's d where $d = 2r / \sqrt{1 - r^2}$, was .22, which is defined as a small effect size (Rosenthal & Rosnow, 1991). Contrary to the current study's predictions, then, there was no relationship between exposure to female role models in nontraditional fields and math self-efficacy, but there was, as predicted, a positive relationship between exposure and science self-efficacy. The effect size of the latter relationship, though, was small.

Relationship Between Exposure and Achievement in Nontraditional Coursework

It was predicted that students who reported more exposure to female role models in nontraditional fields would evidence higher levels of achievement in nontraditional coursework than students who reported less exposure to such female role models. To test this hypothesis, a simple correlation was calculated between Exposure scores and scores on both measures of achievement in nontraditional coursework, NT-GPA and WNT-GPA. Contrary to the current study's predictions, the correlation between Exposure and NT-GPA was non-significant ($p > .05$), $r(291) = .02$, as was the correlation between Exposure and WNT-GPA, $r(301) = .10$, failing to confirm a positive relationship between exposure to female role models in nontraditional fields and achievement in nontraditional coursework.

Relationship Between Role Model Information and Academic Choices

It was predicted that there would be a significant positive relationship between both measures of role model information (Exposure and Encouragement) and nontraditional academic choices (NT-Choice), such that students who reported more nontraditional academic choices would report 1) more exposure to female role models in nontraditional fields and 2) more perceived encouragement from role models to pursue nontraditional career plans than students who reported less nontraditional academic choices. Contrary to these predictions, the correlations between Exposure and NT-Choice and between Encouragement and NT-Choice were both non-significant ($p > .05$), $r(314) = .06$, and $r(315) = .03$, respectively.

Additional Analyses

Described below are additional analyses which were performed in an effort to better understand the nature of the relationships among the variables examined in this study. In addition to further exploration of the relationships between measures of encouragement from role models and this study's dependent measures, the relationships between other potentially important variables (the number of female and male role models from the RMIS reported to offer some degree of encouragement to pursue nontraditional career paths, the level of mathematical skill required for mother's and father's occupation, and mother's and father's highest level of education) and dependent measures were investigated. Also, the relationships between self-efficacy for nontraditional coursework and the other three dependent variables were explored, due to the fact that previous research suggests that career-related self-efficacy has predictive power for these other dependent variables (e.g., Betz & Hackett, 1981; Hackett & Betz, 1989; Lent, Brown, & Larkin, 1986).

Total Perceived Encouragement from Role Models

It was expected that there would be a significant positive relationship between total perceived encouragement from role models and each of the following: nontraditional career interests, math and science self-efficacy, and achievement in nontraditional subjects. As expected, the correlations between total encouragement and both measures of nontraditional career interests, GOT-R and GOT-I, were significant and positive, $r(307) = .20$, $p < .001$ and $r(300) = .18$, $p < .01$, respectively. The effect sizes associated with these correlations, as measured by Cohen's d, were .41 and .37, respectively, both of which approach medium effect sizes (Rosenthal & Rosnow, 1991). Also as expected, the correlations between total encouragement and Math and Science Self-Efficacy were significant and positive, $r(308) = .24$, $p < .001$ and $r(304) = .24$, $p < .001$, respectively, $d = .49$ in both cases. The correlations between total encouragement and both measures of achievement in nontraditional subjects, NT-GPA and WNT-GPA, however, were not significant ($p > .05$), $r(293) = .09$ and $r(302) = .10$, respectively.

Perceived Encouragement from Female and Male Role Models

The relationships between perceived encouragement from role models and the current study's dependent variables were further explored by calculating simple correlations between two measures of encouragement, perceived encouragement fromfemale role models (RMIS-F) and perceived encouragement from male role models (RMIS-M), and each of the dependent variables (nontraditional career interests, self-efficacy for nontraditional coursework, achievement in nontraditional subjects, and nontraditional academic choices). Table 1 shows the results of these calculations. As can be seen in this table, significant positive relationships were found between measures of encouragement from both female and male role models and each of the following: nontraditional career interests (GOT-R and GOT-I) and math and science self-efficacy (MSE and SSE), and between perceived male role model influence and one measure of achievement in nontraditional subjects (NT-GPA).

Other Potentially Important Variables

The relationships between other potentially important variables, namely, the number of female and male role models from the RMIS reported to offer some degree of perceived encouragement to pursue nontraditional career paths, the level of mathematical skill required for mother's and father's occupation, and mother's and father's highest level of education, and this

Table 1. Correlations between measures of encouragement from female and male role models and dependent measures

Measure[a]	Correlation (df)	p-value	ES[b]
	Encouragement from Female Role Models (RMIS-F)		
GOT-R	.20 (307)	.0005	.41
GOT-I	.19 (300)	.0010	.39
MSE	.21 (309)	.0002	.43
SSE	.21 (305)	.0002	.43
NT-GPA	.05 (294)	.4400	
WNT-GPA	.08 (303)	.1800	
NT-Choice	.02 (316)	.6700	
	Encouragement from Male Role Models (RMIS-M)		
GOT-R	.19 (309)	.0009	.39
GOT-I	.16 (302)	.0040	.32
MSE	.25 (310)	.0001	.52
SSE	.24 (306)	.0001	.49
NT-GPA	.13 (294)	.0300	.26
WNT-GPA	.11 (304)	.0600	
NT-Choice	.03 (317)	.5500	

[a]GOT-R=Realistic career interests, GOT-I=Investigative career interests, MSE=Math Self-Efficacy, SSE=Science Self-Efficacy, NT-GPA=Grade Point Average for nontraditional coursework, WNT-GPA=weighted Grade Point Average for nontraditional coursework, NT-Choice=nontraditional academic choices.

[b]Cohen's d; Effect sizes are shown only for p-values < .05.

study's dependent variables were examined. Simple correlations were calculated between measures of potentially important variables (FCOUNT, MCOUNT, MMCODE, FMCODE, MOTHERED, and FATHERED) and dependent measures (GOT-R, GOT-I, MSE, SSE, NT-GPA, WNT-GPA, and NT-Choice). Table 2 shows the results of these precedures. As can be seen in this table, significant positive correlations were found between 1) FCOUNT and GOT-R, 2) MCOUNT and GOT-R, 3) MMCODE and both of SSE and NT-GPA, 4) FMCODE and all of SSE, NT-GPA, and NT-Choice, 5) MOTHERED and all of MSE, SSE, and NT-GPA, and 6) FATHERED and all of MSE, SSE, NT-GPA, and NT-Choice.

Math and Science Self-Efficacy

To examine the relationships between self-efficacy for nontraditional coursework and this study's other dependent variables, simple correlations were calculated between math and science self-efficacy (MSE and SSE) and measures of these other dependent variables (GOT-R, GOT-I, NT-GPA, WNT-GPA, and NT-Choice). Table 3 shows the results of these procedures. As can be seen in Table 3, significant positive correlations were found between MSE and all but one of the other dependent measures (GOT-R), while SSE correlated significantly and positively with all of the dependent measures.

Regression

In an effort to determine the contribution of selected variables to the prediction of various theoretically important variables, regression analyses were performed. Given that correlational analyses revealed significant relationships between measures of encouragement from role models and two of this study's theoretically important variables (nontraditional career interests and achievement in nontraditional subjects), and given that, as in previous research, math and science self-efficacy were found to be significantly related to nontraditional career interests, achievement in nontraditional subjects, and nontraditional academic choices, regression analyses were performed in order to determine if encouragement from role models contributed to the prediction of these dependent

Table 2. Correlations between potentially important independent variables and dependent variables

	Independent Variable					
	Number of Role Models		Mathematical Skill Level for Parental Occupation		Level of Parental Education	
Dependent Variable	Female (FCOUNT)	Male (MCOUNT)	Mother (MMCODE)	Father (FMCODE)	Mother (MOTHERED)	Father (FATHERED)
Nontraditional Career Interests						
GOT-R	.12*	.17**	.08	.11	.10	-.05
GOT-I	.06	.08	.04	.02	.07	.02
Math and Science Self-Efficacy						
MSE	-.08	-.04	.11	.08	.13*	.13*
SSE	-.07	-.05	.15*	.14*	.23***	.26***
Achievement in Nontraditional Subjects						
NT-GPA	-.08	.02	.13*	.13*	.12*	.16**
WNT-GPA	.02	.07	-.03	.08	.04	.05
Nontraditional Academic Choices						
NT-Choice	.06	-.01	.07	.16**	.10	.13*

* $p < .05$; ** $p < .01$; *** $p < .001$

Table 3. Correlations between self-efficacy for nontraditional coursework and other dependent measures

Measure	Correlation (df)	p-value	ES[a]
	Math Self-Efficacy (MSE)		
GOT-R	.01 (302)	.8229	
GOT-I	.21 (296)	.0002	.43
NT-GPA	.52 (289)	.0001	1.22
WNT-GPA	.22 (298)	.0001	.45
NT-Choice	.28 (311)	.0001	.58
	Science Self-Efficacy (SSE)		
GOT-R	.19 (298)	.0013	.39
GOT-I	.26 (293)	.0001	.54
NT-GPA	.41 (284)	.0001	.90
WNT-GPA	.12 (294)	.0336	.24
NT-Choice	.28 (307)	.0001	.58

[a]Cohen's d; Effect sizes are shown only for p-values < .05.

variables, holding math and science self-efficacy and any of the other potentially important variables constant. As such, five measures of three continuous criterion variables, nontraditional career interests (GOT-R and GOT-I), achievement in nontraditional subjects (NT-GPA and WNT-GPA), and nontraditional academic choices (NT-Choice), were regressed on various of the following measures of continuous predictor variables: Math and Science Self-Efficacy (MSE and SSE), highest level of mother's and father's education (MOTHERED and FATHERED), level of mathematical skill required for mother's and father's occupation (MMCODE and FMCODE), encouragement from female and male role models (RMIS-F and RMIS-M), and the number of female and male role models from the RMIS reported to offer some degree of encouragement to pursue nontraditional career paths (FCOUNT and MCOUNT). With the exception of RMIS-F and RMIS-M, which were included in all three models, predictor measures were included in each of the regression models only if simple correlations (calculated previously) yielded evidence that the particular criterion measure was significantly related to the predictors on which it was being regressed.

Table 4 shows the results of these regression analyses. As can be seen in Table 4, the regression procedures yielded significant overall F-values for four of the five criterion measures included in these analyses: GOT-R, GOT-I, NT-GPA, and NT-Choice, indicating that the particular predictor measures included in the regression models collectively accounted for a significant portion of the variance in these criterion measures. Although the overall F-values for these four regression analyses were found to be statistically significant, the amount of variance in each of the criterion measures collectively accounted for by its predictor measures was small, with the exception of the variance in NT-GPA, much of which was accounted for by MSE alone. In general, then, a great deal of the variance in these criterion measures was unaccounted for.

For each of these criterion measures, the individual contribution of each predictor measure to the prediction of the criterion measure, holding all other predictor measures constant, was examined using t-tests on the regression coefficients of the predictors in each model. The results of these procedures for the four models that yielded significant overall F-values are shown in Table 5. First,

Table 4. Overall F values for multiple regression analyses on five measures of three criterion variables

Measure	F (df)	p-value	R^2 (Adj. R^2)
	Nontraditional Career Interests		
GOT-R	4.17 (5,223)	.0012	.09 (.07)
GOT-I	4.29 (4,224)	.0023	.07 (.05)
	Achievement in Nontraditional Subjects		
NT-GPA	11.60 (8,220)	.0001	.30 (.27)
WNT-GPA	2.11 (4,224)	.0807	.04 (.02)
	Nontraditional Academic Choices		
NT-Choice	3.82 (6,222)	.0012	.09 (.07)

Table 5. Regression analyses for the prediction of nontraditional career interests, achievement in nontraditional subjects, and nontraditional academic choices

Predictor Measure	Standardized Beta (Simple Correlation)	t[a]
	Nontraditional Career Interests	
	GOT-R	
SSE	.13 (.19)	1.88
FCOUNT	.04 (.12)	0.63
MCOUNT	.18 (.17)	2.67**
RMIS-F	.13 (.20)	1.11
RMIS-M	.02 (.19)	0.22
	GOT-I	
MSE	.05 (.21)	0.48
SSE	.18 (.26)	1.67
RMIS-F	.10 (.19)	0.95
RMIS-M	.00 (.16)	0.02
	Achievement in Nontraditional Subjects (NT-GPA)	
MSE	.58 (.52)	6.00***
SSE	-.10 (.41)	-0.97
MMCODE	.00 (.13)	0.01
FMCODE	.07 (.13)	1.20
MOTHERED	.04 (.12)	0.61
FATHERED	.03 (.16)	0.42
RMIS-F	-.06 (.05)	-0.69
RMIS-M	.10 (.13)	1.02
	Nontraditional Academic Choices (NT-Choice)	
MSE	.15 (.28)	1.34
SSE	.10 (.28)	0.91
FMCODE	.16 (.16)	2.36*
FATHERED	-.01 (.13)	-0.20
RMIS-F	-.07 (.02)	-0.65
RMIS-M	.07 (.02)	0.63

[a]df for t values of regression coefficients were 1,223; 1,220; and 1,222 for GOT-R, NT-GPA, and NT-Choice, respectively.

* $p < .02$; ** $p < .009$; *** $p < .0002$

in terms of nontraditional career interests, t-tests revealed that, holding other measures constant, the number of male role models from the RMIS reported to offer some degree of encouragement to pursue nontraditional career paths (MCOUNT) contributed significantly to the prediction of GOT-R, $t(223) = 2.67$, $p < .009$. In terms of achievement in nontraditional subjects, Math Self-Efficacy contributed significantly to the prediction of NT-GPA, $t(220) = 6.00$, $p < .0002$. Finally, in terms of nontraditional academic choices, the level of mathematical skill required for father's occupation (FMCODE) contributed significantly to the prediction of NT-Choice, $t(222) = 2.36$, $p < 02$. In sum, then, regression analyses revealed that, when all other predictor measures were held constant, neither measure of encouragement from role models (RMIS-F or RMIS-M) made a significant contribution to the prediction of any of the dependent variables of particular theoretical interest (nontraditional career interests, achievement in nontraditional subjects, and nontraditional academic choices).

DISCUSSION

While women have participated in the total U.S. work force and in traditionally male fields at increasingly higher rates since the 1940's, they remain underrepresented in science and engineering careers relative to their proportion of the entire U.S. work force (NRC, 1991; NSF, 1990a, 1990b). This underrepresentation begins early in women's educational careers; by high school, women are already less likely than men to participate in mathematics and science educational experiences (NSF, 1990a). Several factors have been identified that may contribute to the underrepresentation of women in traditionally male fields, but, as multifaceted as this issue is, it warrants extensive study. The present study represents one attempt to contribute to the growing body of research aimed at better understanding women's participation in traditionally male fields by examining the influence of role models on women's career development prior to college, particularly the nature of and extent to which role model information is related to interest in nontraditional careers, self-efficacy for nontraditional coursework, achievement in nontraditional subject areas, and nontraditional academic choices among female high school students.

Summary of the Findings

Differences in Degree of Encouragement from Female and Male Role Models to Pursue Nontraditional Career Paths

As predicted, this study found that students rated female role models as offering more encouragement to pursue nontraditional college majors than male role models. This finding was consistent with previous research that examined the relationship between encouragement from male and female role models and women's career aspirations, choices, and commitment (Basow & Howe, 1979, 1980; Gilbert, Gallessich, & Evans, 1983; Stake & Granger, 1978) and provides further evidence that female role models play an important part in women's career development.

Role Model Exposure

Contrary to the current study's predictions, in general no significant positive relationships were found between exposure to female role models in nontraditional fields and the four dependent variables used as indicators of women's attraction to and participation in nontraditional fields. These findings were inconsistent with previous studies that found significant positive relationships between exposure to female role models and women's nontraditional career interests (Oakland & Young, 1980; O'Bryant & Corder-Boltz, 1978), self-efficacy for nontraditional coursework (Gilbert, Gallessich, & Evans, 1983; Schunk & Hanson, 1985; Stake & Noonan, 1985), and achievement in nontraditional subjects (Schunk & Hanson, 1985), and with theoretical formulations regarding the importance of exposure to female role models for women's nontraditional academic choices (Betz, 1989; Betz & Fitzgerald, 1987; Hackett, Esposito, & O'Halloran, 1989). While it is possible that these findings represent an accurate portrayal of the relationship between female role model exposure and women's career development, considering the bulk of findings to the contrary, the failure of the current study to reveal significant positive relationships between exposure to female role models in nontraditional fields and all but one of the measures of the four dependent variables used as indicators of attraction to and participation in nontraditional careers was quite surprising.

One factor that could have contributed to the general lack of support for positive relationships between female role model exposure and these dependent career development variables was the way in which exposure to female role models in nontraditional fields was operationalized in the current study. This study defined role model exposure as the sum of 1) the number of people the student knows in each of the following categories: female science teachers, female math teachers, female scientists, and female engineers and 2) the number of female math and science teachers the student had as instructors in grades six through 12. As such, it is possible that the current study's operationalization of exposure to female role models in nontraditional fields may yield considerably different results from those that would be obtained from other measures of exposure, such as the number of female math and science teachers the students has had as instructors alone, not including the number of people the students knows in each of the aforementioned categories. In fact, many of the studies that have found positive relationships between exposure to female role models and women's participation in nontraditional fields focused on exposure to female college faculty members who served either as advisors or as instructors (e.g., Gilbert, 1985; Ivey, 1988; Stake & Noonan, 1985) or on some other relatively lengthy or intensive form of exposure to female role models in nontraditional occupational roles (e.g., Oakland & Young, 1980; O'Bryant & Corder-Boltz, 1978; Smith & Erb, 1986), which suggests that simply knowing a woman who is employed in a nontraditional field may not be enough for that woman to serve as one's role model.

To explore the possibility that the current study's operationalization of exposure to female role models contributed to the general lack of support for positive relationships between exposure and this study's dependent variables, post hoc correlational anlyses were employed using a redefined measure of exposure to female role models in nontraditional fields. This new measure, EXPONEW, was defined as the sum of the number of female math and science teachers the student had as instructors in grades six through 12. Simple correlations were calculated between EXPONEW and each of the dependent measures. In general, analyses revealed no new patterns in results from those obtained using the original measure of exposure. All of the correlations that were originally non-significant remained non-significant ($p > .05$), while the one correlation that was significant using the orginal measure of exposure (that between exposure and science self-efficacy) became non-significant ($p > .05$) when the new measure of exposure was used. These findings indicate that, in general, this new measure of exposure was no more closely related to this study's dependent variables than was the original measure of exposure.

Another factor which could have contributed to the failure of the current study to reveal significant positive relationships between exposure to female role models and the four dependent career development variables was the homogeneous nature of this study's sample. Specifically, the majority of this study's participants resided in rural communities, most (89%) were between the ages of 15 and 17, and almost all of them (97%) were European American. Furthermore, they constituted a group of high achievers; seventy-six percent reported earning a grade point average for nontraditional coursework of 3.50 or higher on a four-point scale, while 39% reported earning a nontraditional grade point average of 4.00. For these reasons, it is possible that the women who participated in this study are not representative of the more heterogeneous samples of women studied in previous research in this area and that the current study's findings regarding the relationship between exposure to female role models in nontraditional fields and women's attraction to and participation in those fields cannot be generalized to a larger population of women.

It may also be possible that the women in the current study have not yet reached a point in their educational development where the number and/or severity of obstacles they will face en route to a career in a nontraditional field are such that their relationships with female role models become significant or salient for them. Considering that female role models have been documented to play an important part in women's career development at the college level (Basow & Howe, 1979, 1980; Betz & Fitzgerald, 1987; Gilbert, 1985; Hackett, Esposito, & O'Halloran, 1989; Hayden & Holloway, 1985; Stake & Noonan, 1985), it may be possible that the predicted positive relationship between exposure to female role models in nontraditional fields and women's attraction to and participation in those fields will reveal itself for this group of women over the longer-term, such as when they declare a college major or when they graduate from college with a particular degree.

Encouragement from Role Models

The predicted positive relationship between total perceived encouragement from role models to pursue nontraditional career paths and nontraditional academic choices was not significant. This finding was inconsistent with previous research that indicated perceived encouragement from role models is positively related to nontraditionality of occupational choices (Hackett, Esposito, & O'Halloran, 1989) and persistence in nontraditional majors (Hayden & Holloway, 1985). However, previously conducted research examined the relationship between encouragement from role models and nontraditional choices among female undergraduates rather than among female high school students. Therefore, as noted above, the women in the current study may not yet have reached a point in their career development where their relationships with role models contribute significantly to their career choices.

When the relationship between encouragement from role models and women's career development was further explored, it was found that total perceived encouragement from role models was significantly positively related to nontraditional career interests and to self-efficacy for nontraditional coursework and that perceived encouragement from male role models was significantly positively related to achievement in nontraditional subjects. Given that very few RMIS scores fell below zero in the present study, it could be said that these scores reflected the degree of perceived encouragement participants received from persons in their social networks to pursue nontraditional career paths. In short, RMIS scores could be considered indices of social support to pursue nontraditional career paths. As discussed above, the present study failed, in general, to find support for positive relationships between exposure to female role models in nontraditional fields and women's attraction to and participation in those fields. The results of this study did, however, reveal a link between perceived encouragement from both female and male role models and the following: nontraditional career interests, self-efficacy for nontraditional coursework, and achievement in nontraditional subjects. Considered together, these findings suggest that, prior to college, social support for decisions to pursue nontraditional career paths plays a more significant part in women's attraction to and participation in nontraditional fields than does exposure to female role models in those fields, and the support received from men is as significant as the support received from women for young women's career development in nontraditional fields.

Regression Analyses

It was found that selected predictor measures, two of which were encouragement from female and male role models, collectively accounted for a significant portion of the variance in measures of nontraditional career interests, achievement in nontraditional subjects, and nontraditional academic choices. With, however, the exception of the variance in one of the measures of achievement in nontraditional subjects, much of which was accounted for by math self-efficacy, the amount of variance in each of these criterion measures collectively accounted for by its predictor measures was small. Also, t-tests on the regression coefficients of the predictors in each model revealed that neither encouragement from female or encouragement from male role models made a significant contribution to the prediction of any of these dependent variables when all other predictor measures were held constant. This finding indicates that, while encouragement from role models plays some part in women's attraction to and participation in traditionally male fields, when the role of other important variables in this realm are taken into account, it offers no additional predictive power for this attraction and participation.

Limitations and Suggestions for Further Research

As all studies do, the current study has limitations. As mentioned above, the women who participated in this study constituted a rather homogeneous group in terms of age, ethnicity, community background, and level of achievement in nontraditional coursework, which raises a concern about the generalizability of this study's results to other populations of women. For this reason, replication of the current study among diverse populations, such as among high school women of various ethnic and regional backgrounds across the United States, is necessary to determine the extent to which these findings represent relationships between role model information and other career development variables in populations other than the one sampled in this study.

Furthermore, the sample used in this study was an opportunistic one--the opportunity to learn something about the relationship between role model information and women's attraction to and participation in nontraditional fields at the high school level presented itself, but the opportunity to include a control group in the study or to set-up an experimental design did not--which adds to the caution with which this study's findings should be generalized to other populations of women. A well-controlled investigation, in which the relationship between role model information and women's attraction to and participation in nontraditional fields could be examined for both those high school women who have and those who have not expressed an interest in nontraditional careers, would greatly contribute to this area of study. Also, based on the inconsistency between this and previous studies' findings regarding the relationship between exposure to female role models and women's career development within nontraditional fields, an experimental investigation among high school women in which the degree and type of exposure to female role models in nontraditional fields could be manipulated would certainly help resolve this inconsistency. An experimental investigation of this relationship would also uncover any causal relationships between role model exposure and career development variables, an advantage that the correlational methods used in this study lack. The few investigations of this relationship that have employed experimental designs (Little & Roach, 1974; Oakland & Young, 1980; O'Bryant & Corder-Boltz, 1978; Schunk & Hanson, 1985; Smith & Erb, 1986) yielded results that indicated that exposure to female role models in nontraditional fields is facilitative of women's involvement in those fields. The current study's findings, however, raise the questions of how much and what type of exposure to these role models is sufficient to positively impact young women's attraction to and participation in nontraditional fields such as science and engineering, and at what point in their career development does this exposure become meaningful or important. It seems, then, that further experimental investigations are needed.

In addition, two of the dependent measures used in this study as indicators of participation in nontraditional fields, namely, nontraditional grade point average and nontraditional academic choices (defined as math and science courses taken, being taken, and being planned to take), have questionable utility for the population of interest in this study, high school women. As stated above, the range of nontraditional grade point average (NT-GPA) scores was quite restricted; there was a ceiling effect for this variable. Also, the range of nontraditional academic choices (NT-Choice) was restricted; approximately 70% of respondents listed between seven and nine courses for this measure, while the total range was two to 12 courses. As such, the restricted range in both of these measures could have attenuated correlations between both encouragement from and exposure to role models and these dependent measures. It seems, then, that other indicators of achievement in nontraditional subjects and nontraditional academic choices may offer more utility among high school populations such as the one of interest in this study.

Finally, the current study attempted to isolate and examine the relationship between two theoretically important variables, encouragement from role models to pursue nontraditional career paths and exposure to female role models in nontraditional fields, and women's career development within nontraditional fields at a particular point in their development, namely, during high school. There are, however, several factors other than these that have been hypothesized to contribute to the underrepresentation of women in traditionally male fields, and these other factors undoubtedly impact women's career development at various points in their lives. While a longitudinal analysis of this multitude of factors was beyond the scope of this study, such an investigation would surely contribute to our understanding of the barriers to women's participation in nontraditional fields.

Implications for Interventions

Keeping in mind the precautions regarding the generalizability of the present study's findings, the results of this study provide implications for interventions aimed at facilitating young women's attraction to and participation in nontraditional fields such as science and engineering. In this study, young women rated female role models as offering more encouragement to pursue nontraditional college majors than male role models. Collectively, then, students perceived that mothers, sisters, female teachers, female friends, female adults, and women employed in science or mathematics offered more encouragement than their male counterparts to pursue nontraditional career paths. This finding suggests that these particular female models can play an instrumental role in encouraging young women to pursue nontraditional careers. It may, then, be worthwhile to include these role models in interventions geared toward facilitating women's career development in these fields, such as the career conference for which participants in this study registered which was geared toward educating young women about careers in science, mathematics, and engineering. This finding also suggests that the retention of women currently employed in nontraditional fields, whether in industry or academia, is vital to the continued representation of women in these fields, as current professionals can provide key encouragement to future generations of female workers. Additionally, assuming that female professionals in nontraditional fields would be less readily accessible to young women than the other role models in the above group (e.g., mothers, sisters, friends, teachers, etc.), it would be appropriate for high school educators and advisors to provide to female students who have expressed an interest in science, mathematics, or engineering resources for contacting female professionals in those fields.

Finally, the current study found that encouragement from both female and male role models to pursue nontraditional career paths, or social support for decisions to pursue nontraditional college majors, appeared to be more closely related to students' attraction to and participation in nontraditional fields than was exposure to female role models in those fields. This finding implies that, although young women perceive female role models to offer more encouragement than male role models to pursue nontraditional careers, the encouragement received from both male and female role models is important for young women who may be considering nontraditional careers paths. Thus, it seems that, in addition to female role models, it may be worthwhile to include potential male role models in interventions geared toward facilitating women's career development in nontraditional fields.

Conclusions

The factors that contribute to the underrepresentation of women in traditionally male occupations are numerous and complex and, therefore, worthy of comprehensive and in-depth examination. The present study attempted to add to the current understanding of this underrepresentation by investigating the relationship between role model information and women's career development within nontraditional fields. This study's findings that 1) young women perceived female role models to offer more encouragement to pursue nontraditional career paths than male role models and 2) that encouragement from role models, or social support for decisions to pursue nontraditional career paths, appeared to be more closely related to women's career development within nontraditional fields during high school than was exposure to female role models in those fields offer important implications for future research and interventions. Further research in this area employing longitudinal and, ideally, experimental designs that incorporate the numerous factors hypothesized to contribute to the underrepresentation of women in traditionally male fields are needed. Although the costs associated with performing this sort of all-encompassing research are high, the costs to society at large and to women as individuals of the continued underrepresentation of women in nontraditional careers is even higher.

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APPENDIX A

ROLE MODEL INFLUENCE SCALE (RMIS)

Currently you are in the process of considering majors and career options in science or mathematics. To what degree are each of the following people or factors influencing your decision about whether or not to major in science or mathematics? A person or factor would have a "negative influence" if that person or factor discourages you in some way from pursuing a college major in science or mathematics. A person or factor would have a "positive influence" if that person or factor encourages you in some way to pursue a college major in science or mathematics. A person or factor would have a "neutral influence" on your decision to major in science or mathematics if that person or factor neither encourages nor discourages you from pursuing a college major in science or mathematics. If an item does not seem to apply to you, please circle "N/A". Do not spend too much time on any one item. We are most interested in your immediate reaction.

	negative influence		neutral influence			positve influence		not applicable
1. Mother	-3	-2	-1	0	1	2	3	N/A
2. Father	-3	-2	-1	0	1	2	3	N/A
3. Sister(s)	-3	-2	-1	0	1	2	3	N/A
4. Brother(s)	-3	-2	-1	0	1	2	3	N/A
5. Male Teacher(s)	-3	-2	-1	0	1	2	3	N/A
6. Female Teacher(s)	-3	-2	-1	0	1	2	3	N/A
7. Male Friend(s)	-3	-2	-1	0	1	2	3	N/A
8. Female Friend(s)	-3	-2	-1	0	1	2	3	N/A
9. Male adult(s) (e.g., uncle, grandfather, family friend)	-3	-2	-1	0	1	2	3	N/A
10. Female adult(s) (e.g., aunt, grandmother, family friend)	-3	-2	-1	0	1	2	3	N/A
11. Man (men) employed in science or mathematics	-3	-2	-1	0	1	2	3	N/A
12. Woman (women) employed in science or mathematics	-3	-2	-1	0	1	2	3	N/A

APPENDIX B

MEASURE OF MATH AND SCIENCE SELF-EFFICACY

Please rate your confidence in your ability to complete the following courses with a grade of "B" or better. Use the 10-point scale below, with higher numbers representing increasingly greater levels of confidence. Do not spend too much time on any one item. We are most interested in your immediate reaction.

No confidence at all 1 2 3 4 5 6 7 8 9 10 Complete confidence

	No confidence at all									Complete confidence
1. Advanced Calculus	1	2	3	4	5	6	7	8	9	10
2. Computer Science	1	2	3	4	5	6	7	8	9	10
3. Business Administration	1	2	3	4	5	6	7	8	9	10
4. Biochemistry	1	2	3	4	5	6	7	8	9	10
5. Calculus	1	2	3	4	5	6	7	8	9	10
6. Zoology	1	2	3	4	5	6	7	8	9	10
7. Accounting	1	2	3	4	5	6	7	8	9	10
8. Geometry	1	2	3	4	5	6	7	8	9	10
9. Algebra I	1	2	3	4	5	6	7	8	9	10
10. Algebra II	1	2	3	4	5	6	7	8	9	10
11. Philosophy	1	2	3	4	5	6	7	8	9	10
12. College Algebra	1	2	3	4	5	6	7	8	9	10
13. Statistics	1	2	3	4	5	6	7	8	9	10
14. Physiology	1	2	3	4	5	6	7	8	9	10
15. Trigonometry	1	2	3	4	5	6	7	8	9	10
16. Economics	1	2	3	4	5	6	7	8	9	10
17. Human Anatomy	1	2	3	4	5	6	7	8	9	10
18. Botany	1	2	3	4	5	6	7	8	9	10
19. Environmental Studies	1	2	3	4	5	6	7	8	9	10
20. Engineering	1	2	3	4	5	6	7	8	9	10
21. Genetics	1	2	3	4	5	6	7	8	9	10
22. Physics	1	2	3	4	5	6	7	8	9	10
23. Chemistry	1	2	3	4	5	6	7	8	9	10

APPENDIX C

MEASURE OF CAREER INTERESTS

Please indicate the degree to which you are considering a career in each of the following occupations by placing a number from 1 to 10 in the blank to the left of the occupation. Use the 10-point scale below, with "1" indicating "Not Considering at All" and higher numbers indicating increasing levels of interest up to "10" indicating "Strongly Considering". Do not spend too much time on any one item. We are most interested in your immediate reaction.

Not Considering at All 1	2	3	4	5	6	7	8	9	Considering Very Strongly 10

1.___Musician
2. ___Photographer
3. ___hysician
4. ___Radiology Technologist
5. ___Science Teacher
6. ___Veterinarian
7. ___Commercial Artist
8. ___Fine Artist
9. ___Biologist
10. ___Systems Analyst
11. ___Medical Illustrator
12. ___Physical Therapist
13. ___Speech Pathologist
14. ___Credit Manager
15. ___Business Education Teacher
16. ___Personnel Director
17. ___Pharmacist
18. ___Guidance Counselor
19. ___Chiropractor
20. ___College Professor
21. ___Interior Decorator
22. ___Computer Programmer
23. ___Carpenter
24. ___Mathematician
25. ___Geologist
26. ___Geographer
27. ___Forester
28. ___Sociologist
29. ___Physicist
30. ___IRS Agent
31. ___Secretary
32. ___Social Worker
33. ___Restaurant or Store Manager
34. ___Realtor
35. ___School Administrator
36. ___Dentist
37. ___Electrical Engineer
38. ___Life Insurance Agent
39. ___Reporter
40. ___Medical Technician
41. ___Bus Driver
42. ___Psychologist
43. ___Farmer
44. ___Police Officer
45. ___Electrician
46. ___Art Teacher
47. ___Chemist
48. ___Civil Engineer
49. ___Optometrist
50. ___Elementary School Teacher
51. ___Banker
52. ___Accountant
53. ___Marketing Executive
54. ___Minister
55. ___Investments Manager
56. ___Chemical Engineer

APPENDIX D

LEVELS OF MATHEMATICAL DEVELOPMENT (M CODE)

Level 6: Advanced Calculus: Work with limits, continuity, real number systems, mean value theorems, and implicit function theorems.
Modern Algebra: Apply fundamental concepts of theories of groups, rings, and fields. Work with differential equations, linear algebra, infinite series, advanced operations methods, and functions of real and complex variables.
Statistics: Work with mathematical statistics, mathematical probability and applications, experimental design, statistical inference, and econometrics.

Level 5: Algebra: Work with exponents and logarithms, linear equations, quadratic equations, mathematical induction and binomial theorem, and permutations.
Calculus: Apply concepts of analytic geometry, differentiations, and integration of algebraic functions with applications.
Statistics: Apply mathematical operations to frequency distributions, reliability and validity of tests, normal curve, analysis of variance, correlation techniques, chi-square application and sampling theory, and factor analysis.

Level 4: Algebra: Deal with system of real numbers; linear, quadratic, rational, exponential, logarithmic, angle and circular functions, and inverse functions; related algebraic solution of equations and inequalities; limits and continuity; and probability and statistical inference.
Geometry: Deductive axiomatic geometry, plane and solid, and rectangular coordinates.
Shop Math: Practical application of fractions, percentages, ratio and proportion, measurement, logarithms, practical algebra, geometric construction, and essentials of trigonometry.

Level 3: Compute discount, interest, profit and loss; commission, markup, and selling price; ratio and proportion; and percentage. Calculate surfaces, volumes, weights, and measures.
Algebra: Calculate variables and formulas; monomials and polynomials; ratio and proportion variables; and square roots and radicals.
Geometry: Calculate plane and solid figures, circumference, area, and volume. Understand kinds of angles and properties of pairs of angles.

Level 2: Add, subtract, multiply, and divide all units of measure. Perform the four operations with like common and decimal fractions. Compute ratio, rate, and percent. Draw and interpret bar graphs. Perform arithmetic operations involving all American monetary units.

Level 1: Add and subtract two-digit numbers. Multiply and divide 10's and 100's by 2, 3, 4, 5. Perform the four basic arithmetic operations with coins as part of a dollar. Perform operations with units such as cup, pint, and quart; inch, foot, and yard; and ounce and pound.

APPENDIX E

STATE SCIENCE JOURNALS AND NEWSLETTERS

Dispatch

Science Education News

ISU Counselors Newsletter

IoWoman

Iowa University Woman

Iowa Science Teachers Journal

Science Education News

Iowa State Preview

The Iowa Stater

Inside Iowa State

Diversity Newsletter

Iowa Newpaper Association

Iowa Talented and Gifted Association

OPPTAG

APPENDIX F

MEANS AND STANDARD DEVIATIONS FOR ALL MEASURES

Measure	Mean	Standard Deviation
Exposure	10.43	7.14
EXPONEW	4.28	2.40
RMIS (total)	17.43	9.22
RMIS-F	8.92	4.61
RMIS-M	7.81	4.52
FCOUNT	5.41	0.67
MCOUNT	5.53	0.67
MMCODE	2.85	1.37
FMCODE	3.58	1.22
MOTHERED	3.17	1.07
FATHERED	3.23	1.26
NT-Choice	8.16	1.68
NT-GPA	3.65	0.46
WNT-GPA	58.16	2.26
MSE	123.19	26.04
SSE	53.02	13.05
GOT-R	17.38	8.63
GOT-I	54.75	21.79
GOT-A	22.28	12.28
GOT-S	18.06	10.52
GOT-E	18.40	11.46
GOT-C	14.73	10.06