Gender Differences and Intra-Gender Differences amongst Management Information Systems Students

Sylvia Beyer
Department of Psychology
University of Wisconsin-Parkside
Kenosha, WI, 53141, USA
beyer@uwp.edu

ABSTRACT

Few women major in Management Information Systems (MIS). The purpose of this paper is to examine the reasons for women's underrepresentation in MIS. In addition to examining gender differences, an important and novel goal of this study is to examine intra-gender differences in undergraduate students, i.e., differences among female MIS majors and female students who enrolled in MIS courses as a Business elective (i.e., non-majors). This study found that women's experiences with and self-efficacy regarding computers were much lower than men's, but that they did not have more negative stereotypes and attitudes toward the field. Overall female students had more positive attitudes towards their MIS courses and instructors than male students did. One of the most interesting findings was the importance of female high school computer teachers and role models for female students. Importantly, there was very strong evidence for intra-gender differences. Female majors had much higher computer self-efficacy, computer experience, had more positive attitudes toward MIS, and were more likely to have had female computer teachers in high school compared to female non-majors. The implications of these findings for MIS are discussed.

Keywords: Underrepresentation; Gender differences; Intra-gender differences; Self-efficacy; Role models; Stereotypes

1. INTRODUCTION

The goal of this paper is to contribute to our understanding of women's underrepresentation in MIS by investigating if male and female students in MIS courses differ in social psychological variables, such as values, beliefs, and computer self-efficacy, that affect choice of major, persistence, and course performance. A major contribution of this research is that in addition to gender[1] differences it investigates intra-gender differences, i.e., differences between female MIS majors and female non-majors enrolled in MIS courses. Rather than assuming that female MIS majors are different from male MIS majors, this paper examines whether in some respects female MIS majors are more similar to male majors than female non-majors. Before explaining my approach in more detail, I will address the significance of women's underrepresentation in MIS.

1.1 Women's Underrepresentation in MIS

Although the representation of women is closer to parity in MIS than in other Information Technology (IT) majors such as Computer Science (CS), currently only 33.2% of Bachelor's degrees in MIS are conferred on women (U.S. Department of Education, 2006). This restricts the number of women qualified to enter the MIS workforce. The pipeline of women majoring in MIS needs to widen to increase the number of women working in MIS-related fields. Women's underrepresentation in MIS should be of concern for several reasons. The most pragmatic reason is a potential labor shortage problem as IT is projected to experience rapid growth through 2014 (Commission on Professionals in Science and Technology, 2006). Tapping women as an underutilized resource could alleviate this shortage. Secondly, the underrepresentation of women raises ethical issues of fairness and equal access. If MIS is inhospitable to women, this would have implications for women's economic progress, as careers in MIS are much more lucrative than female-dominated occupations (Bureau of Labor Statistics, 2004). Last, but not least, the field itself misses an important opportunity to utilize women's skills, creative talents, marketplace understanding, and perspectives, thereby decreasing the likelihood for producing truly innovative new designs and products. Under some conditions diverse groups produce more creative and effective solutions to problems than homogeneous groups do (Mannix & Neale, 2005; McLeod, Lobel, & Cox, 1996).

1.2 Scarcity of Research on Women in MIS

There is a substantial literature on female undergraduate CS majors (e.g., Beyer, DeKeuster, Walter, Colar, & Holcomb, 2005; Beyer & Haller, 2006; Beyer, Rynes, Perrault, Hay, & Haller, 2003). Some researchers have argued that applied IT fields, such as MIS, may be more female-friendly than more technical or abstract fields such as CS (Ahuja, Ogan, Herring, & Robinson, 2006). The inherent differences in the two fields and the differences in the psychological make-up of female and male students in MIS compared to CS coupled with the different atmospheres encountered in a highly technical vs. business-oriented field might present different challenges for women in CS versus MIS. Indeed, the reasons for the underrepresentation of women differ by IT discipline (Beyer, 2006; Beyer, & DeKeuster, 2006). Thus, generalizations from research findings on women in CS to women in MIS or vice versa may be inappropriate and may lead to erroneous conclusions.

The literature on gender issues in MIS is scant and focuses on women in the MIS workforce rather than gender issues in MIS education. For example, Ahuja (2002) pointed out the obstacles (e.g., lack of role models and mentors, work-family conflict) women in IT careers face. Although the career experiences, job satisfaction, and job turnover rates of male and female MIS professionals are similar (Sumner & Niederman, 2002; Sumner & Werner, 2001), men were rated as more promotable than women by their supervisors, even though there were no differences in job performance ratings of male and female employees (Igbaria & Baroudi, 1995). Baroudi and Igbaria (1994/1995) found that salary differences between men and women remained even when human capital variables were taken into account. Female MIS graduates are less likely to seek employment in MIS careers and their attrition rate is higher than that of males (Igbaria & Baroudi, 1995). These are laudable research efforts on women in MIS. However, an examination of gender issues in MIS education is imperative because it is here where a serious bottleneck in the supply of qualified women exists. The only other research on gender issues in MIS education is the work by Ahuja and her colleagues on applied IT majors (e.g., Ahuja et al., 2006).

1.3 Goals of this Research

The scarcity of research on gender issues in MIS education provides the impetus for this study, which seeks to increase our understanding of the social psychological reasons for the dearth of women majoring in MIS. Furthermore, this research aims to move beyond a simple conceptualization of women by focusing on intra-gender differences. Because women are a heterogeneous group, it is important to understand not only differences between women and men but also differences among women (cf. Trauth, Quesenberry, & Huang, 2006; Trauth, Quesenberry, & Yeo, 2005). How are women with a deep interest in MIS (i.e., majors) different from women with less interest in MIS? This paper addresses the empirical question whether female MIS majors are more similar to male MIS majors in values, computer self-efficacy, and stereotypes or whether they are more like female non-majors. To this end I compare male and female MIS majors to male and female non-majors who are enrolled in MIS courses. In a related study on CS majors and non-majors, we found substantial intra-gender differences (Beyer & Haller, 2006).

1.4 Theoretical Framework

This research is grounded in Eccles' classic model predicting educational and career choices, which uses an expectancy x value framework (e.g., Eccles, Barber, & Jozefowicz, 1999). According to the model, social psychological variables such as stereotypes and classroom experiences affect expectancies of success (self-efficacy). People's values also affect course selection and are influenced by stereotypes and role models. Research has shown that these variables influence educational and career choices (e.g., Eccles, 1994; Eccles et al., 1999; Lips, 1992; Simpkins, Davis-Kean, & Eccles, 2006). Eccles' framework predicts that female majors and female non-majors differ in computer self-efficacy and values due to their varying levels of computer experience. This study addresses the empirical question of whether female MIS majors are more similar to male MIS majors in computer self-efficacy, values, stereotypes of MIS, computer experience, exposure to role models, and experiences in classrooms and with instructors, or whether they are more like female non-majors. In essence, do gender differences override differences between majors and non-majors or vice versa? The following literature review emphasizes gender differences research because quantitative research on intra-gender differences in MIS is non-existent (for quantitative research on differences among women in CS see Beyer & Haller, 2006).

1.5 Values and Stereotypes

People's values are of prime importance when deciding on a major (Eccles, 1994). For example, gender differences in enrollment patterns and grades in math can be explained by gender differences in how much students value math and their math self-perceptions (Correll, 2001; Eccles et al., 1999; Simpkins et al., 2006; Watt, 2006). Subjective task value is influenced by enjoyment, instrumentality for long-range goals, and encouragement from significant others (Eccles, 2005). Research by Eccles (1994; Eccles et al., 1999) and others (Herring, Ogan, Ahuja, & Robinson, 2006) suggests that the value systems of many women include a desire to have a "balanced" life. Large-scale studies of college students' career interests show that women's interpersonal orientation draws them to science practitioner careers (e.g., medicine, veterinary medicine, clinical psychology) rather than research science or technology careers (Astin & Astin, 1992; Simpkins & Davis-Kean, 2005). Even mathematically gifted females gravitate towards occupations that involve working with people (Lubinski, Benbow, Shea, Eftekhari–Sanjani, & Halvorson, 2001). This people orientation conflicts with stereotypes about computer-related fields. Although stereotypes about MIS are unlikely to be as negative as those about CS (American Association of University Women, 2000; Beyer, 1999a; Beyer, Rynes, & Haller, 2004; Eccles et al., 1999; Goode, Estrella, & Margolis, 2006; Margolis & Fisher, 2001; Siek, Connelly, Stephano, Menzel, Bauer, & Plale, 2006), the mere fact that MIS is male-dominated may deter women. Females who excel in male-dominated areas are stereotyped as masculine and fear that they will be unpopular (Kessels, 2005).

1.6 Computer Self-efficacy and Experience

Expectancies of success (i.e., self-efficacy) are critical in educational and occupational choices. Women have low self-efficacy, believing they have little natural ability in male-dominated domains such as mathematics, chemistry, and CS. This self-efficacy is inaccurately low when compared to their actual abilities or performance (Beyer, 1990, 1998, 1998/1999, 1999b, 2002; Beyer & Bowden, 1997; Beyer & Haller, 2006; Beyer, Rynes, & Haller, 2004; Durndell & Haag, 2002; Ehrlinger, & Dunning, 2003; Robinson, Ahuja, Herring, & Ogan, 2006). Computer self-efficacy is affected by computer experience (Nelson & Cooper, 1997). Hence, one reason for women's low computer self-efficacy may be that they have less programming experience than men (Beyer, DeKeuster, Rynes, & DeHeer, 2004; Beyer & Haller, 2006; Beyer, Rynes, & Haller, 2004; Katz, Aronis, Allbritton, Wilson, & Soffa, 2003).

1.7 Role Models and Encouragement

Experiences in K-12 school settings are crucial. Receiving encouragement in high school is an important predictor of females' eventual interest in CS (Huber, Reiff, Ben, & Schinzel, 2001; Zarrett, Malanchuk, Davis-Kean, & Eccles, 2006) and engineering (Blättel-Mink, 2002). Role Model days for students at the secondary level can increase female participation in majors (Lagesen, 2002, 2006). Female faculty (cf. Sharpe & Sonnert, 1999 for math) and parents (Goode et al., 2006) also play an important modeling role. Female scientists, engineers, and computer scientists are more likely than their male counterparts to have parents in the same field (Astin & Astin, 1992; Blättel-Mink, 2002; Ogan, Robinson, Ahuja, & Herring, 2006; Sax, 1994; Teague, 2002; Zeldin & Pajares, 2000). For these reasons, I assessed students' prior experiences with role models and computer teachers in high school.

1.8 Experiences in MIS Courses and with Instructors

Students' experiences in their MIS courses should affect their decisions to major in MIS and retention rates. These experiences are also likely to affect their success in their MIS classes.

1.9 Hypotheses

Based on this literature review, I hypothesize gender differences in values, computer self-efficacy, computer experience, role models, and experiences in MIS courses. In addition, I anticipate intra-gender differences, i.e., differences between female majors and female non-majors. Since little quantitative research on intra-gender differences exists, the hypotheses for intra-gender differences are tentative. Because female majors have more experience with computers and MIS, they should have more positive beliefs about MIS and greater computer self-efficacy than female non-majors. I also expect female majors to differ from female non-majors in values and role models.

2. METHOD

I distributed surveys to 159 Business majors enrolled in MIS classes at the University of Wisconsin-Parkside, a public university with an enrollment of approximately 5000 undergraduates. I surveyed Business majors with a concentration in MIS (21 females and 47 males) and Business majors with a concentration outside of MIS (53 females, 38 males). At the time of the study, the Business major required a concentration in one of six fields. The MIS concentration consisted of six upper-division, semester-long courses in MIS in addition to one CS course. All Business majors with a concentration outside of MIS were required to take an MIS course for non-majors. For simplicity I refer to students with or without a concentration in MIS as "majors" and "non-majors", respectively. Participating students were enrolled in either an MIS course for those in the MIS concentration ("MIS majors") or in an MIS course for students with a concentration outside of MIS ("non-majors"). Participants received $2 to fill out surveys assessing educational and career goals; computer experience; self-efficacy; stereotypes about MIS; stress; role models, and attitudes towards MIS courses and instructors. I used a combination of existing instruments and items created specifically for this research.

Students' math ACT scores were used to assess mathematical ability and preparation. To assess career goals, students filled out a modified version of the Values Important to Career Selection Scale (Lips, 1992). I added items to gauge students' beliefs about MIS careers. I asked for information on computer usage and experience. I assessed how comfortable participants are with computers by asking if they had ever opened up a computer to install hardware and assessed attitudes towards computers. To gauge students' confidence regarding computer skills, they rated how difficult specific computer tasks would be for them (e.g., creating a database). To assess stereotypes of MIS majors, students rated the personality characteristics of MIS majors. Seven items from the Role Conflict Scale (Lips, 1992) assessed students' opinions of the compatibility of work and family for women in MIS. Students indicated if they had any MIS role models or mentors. The knowledge and sex of their high school computer teachers was also assessed. Students completed the 10-item Rosenberg Self-esteem Scale (Rosenberg, 1965). The survey included items assessing family orientation (e.g., I would never let my career take priority over my family) and a 14-item stress scale (Cohen, Karmarck, & Mermelstein, 1983). I constructed 17 questions assessing students' attitudes towards their MIS courses and instructors. The survey assessed perceived gender discrimination by using modifications of items used by (Cross, 1997).

3. RESULTS

I report on the results for two sets of analyses: 1. To assess intra-gender differences I conducted one-way analyses of variance (ANOVAs) for females with major status (MIS major or non-major) as independent variable. 2. To assess gender differences I performed 2 (gender) x 2 (major status: MIS major or non-major) ANOVAs. Of interest is whether there are significant gender differences (main effects of gender) or statistical interactions between gender and major status. Interactions between gender and major status indicate that a gender difference depends on whether the students are majors or non-majors. For example, a gender difference might be significant for majors, but not non-majors (or vice versa). Significant interactions are followed up with separate one-way ANOVAs for majors and non-majors using gender as independent variable. Table 1 gives the means Differences that are significant at p = .05 or better are presented. A few interesting marginal results (p = .07 or better) are presented but identified as borderline. "Students" refers to both majors and non-majors.

3.1 Ability, Educational and Career Goals, and Values

There were no gender differences in act mathematics scores, $f(1, 72) = 1.18$, $p = .28$, or in grade point average (gpa) in MIS classes, $f(1, 148) = 1.61$, $p = .21$. Although there was no gender difference in interest in MIS, $f(1, 129) < 1$, female majors were more interested in MIS than were female non-majors, $f(1, 58) = 31.47$, $p = .0001$. There was a boader-

Variables	Non-MIS Majors		MIS Majors	
	Women	Men	Women	Men
Math ACT score	23.3	21.3	21.0	21.0
MIS GPA	3.4	3.3	3.2	3.0
Interest in MIS	3.4^{4}	3.3	6.0^{4}	6.3
Having a job with a high salary is important	4.1^{b}	4.6^{b}	4.4	4.4
Having a job where I can work with people is important	3.4	3.6	3.0	3.2
MIS careers allow one to help people	3.7	3.5	3.7	3.4
It's important to be able to combine career and family	4.3^{a}	4.0^{a}	4.4^{a}	3.9^{a}
My career will give meaning to my life	4.2^{1}	4.5	3.2^{1c}	5.0^{c}
I'd never let my career take priority over my family	5.7^{a}	4.9^{a}	5.5^{a}	5.4^{a}
Age at first computer use	10.4^{b}	12.8^{b}	10.0^{b}	12.5^{b}
Computer use for personal enjoyment (hours/week)	3.7^{d1}	6.3^{d}	5.5^{d1}	11.1^{d}
Percentage of students with programming experience	15^{b4}	34^{b}	81^{b4}	98^{b}
Percentage of students who had ever opened up computer	11^{d2}	50^{d}	40^{d2}	72^{d}
MIS is a good career because one can master challenging tasks	4.2^{a}	3.9^{a}	4.3^{a}	4.1^{a}
I'm sure I could learn a computer language	5.4^{a}	6.3^{a}	6.6^{a}	6.7^{a}
Confident I could write a program in a high-level language	1.8^{a4}	2.3^{a}	4.2^{a4}	4.8^{a}
Confident I could write a complex computer program	1.7^{a4}	2.1^{a}	3.7^{a4}	4.5^{a}
I have lots of self-confidence for working with computers	5.0^{a}	5.5^{a}	5.0^{a}	5.9^{a}
I don't feel threatened when others talk about computers	5.2^{b}	6.0^{b}	4.9^{b}	5.9^{b}
Confident I could teach someone a software package	4.7^{1}	5.0	5.7^{1}	6.1
Confident I could discuss strengths of software packages	3.8^{1}	3.9	4.8^{1}	5.3
Confident I could debug a computer program	2.0^{4}	2.2	4.3^{4}	4.6
Confident I could understand someone's program	2.3^{4}	2.4	5.0^{4}	4.9
MIS students are hardworking	5.6^{d1}	5.0^{d}	6.2^{d1}	5.4^{d}
MIS students are interesting	4.6^{a}	4.3^{a}	5.1^{a}	4.4^{a}
MIS students enjoy socializing	4.0^{2}	3.7	4.9^{2}	4.5
MIS students enjoy athletic activities	2.9^{1}	3.2	3.7^{1}	3.9
Difficult for women to combine career and family	2.6	2.3	2.6	2.6
People in MIS enjoy being around other people	3.8	3.8	4.4	4.0
MIS professionals spend as much time with people as computers	4.4	4.4	5.1	4.3
MIS is a good career because one can master challenging tasks	4.2^{a}	3.9^{a}	4.3^{a}	4.1^{a}
Doing well in MIS enhances career opportunities	5.5^{1}	5.3	6.2^{1}	5.9
Rewards of an MIS career are worth the sacrifices	4.5^{3}	4.4	5.8^{3}	5.5
MIS is one of the most demanding and difficult careers	3.6^{2}	3.6	4.5^{2}	4.5
MIS is a good career because one can advance quickly	3.4^{1}	3.4	3.9^{1}	3.6
MIS is a good career because one can have a feeling of accomplishment	3.8^{4}	3.8	4.5^{4}	4.4
MIS is a good career because one is more employable	3.7^{1}	3.6	4.4^{1}	4.2
Rated knowledge of high school computer teachers	5.1^{a}	4.5^{a}	5.3^{a}	4.6^{a}
Sex of high school computer teachers	3.9^{2}	4.0	5.2^{2b}	3.0^{b}
Percentage of students who had a role model in MIS	16^{2}	0	67^{2d}	12^{d}
Atmosphere in MIS program is somewhat impersonal	3.2	3.1	2.7^{a}	3.6^{a}
Social atmosphere is very friendly	4.8	4.7	5.5	4.9
MIS faculty are sensitive to interests and needs of students	4.8^{a}	4.2^{a}	5.1^{a}	4.5^{a}
MIS faculty take pride in the program	5.1^{a1}	4.8^{a}	5.8^{a1}	5.1^{a}
I feel overwhelmed by the work in this class	2.8	2.8	3.6	3.2
Other students in this class are too competitive	2.3^{a1}	3.0^{a}	3.3^{1}	2.7
The lab is a good place to socialize with other students	3.3^{1}	3.6	4.3^{1b}	2.9^{b}
There is gender discrimination in the MIS program	2.0	1.9	2.4	1.7
Female MIS students aren't taken seriously by male faculty	2.3^{a}	1.8^{a}	2.3^{a}	1.8^{a}
The ability of female MIS students is often underrated	3.1^{b}	2.3^{b}	3.3^{b}	2.4^{b}
Faculty question female students' commitment	2.3^{a}	1.8^{a}	2.2^{a}	1.7^{a}

Table 1. Means for selected variables.

Notes: Intra-gender differences are denoted by number superscripts ^{1} $p < .05$ ^{2} $p < .01$ ^{3} $p < .001$ ^{4} $p < .0001$.
Gender differences are denoted by letter superscripts ^{a} $p < .05$ ^{b} $p < .01$ ^{c} $p < .001$ ^{d} $p < .0001$

line interaction between gender and major for the importance of earning a high salary, $f(1, 153)= 3.33$, $p = .06$, and a significant effect of gender, $f(1, 153) = 3.87$, $p = .05$. Earning a high salary was less important to female than male students but this depended on major status. For non-majors the gender difference was highly significant, $f(1, 88)= 10.29$, $p = .002$, but for majors there was no gender difference, $f(1, 65) < 1$. In terms of selecting a career, women valued working with people as much as men did, $f(1, 154) = 1.35$, $p = .25$, and were as likely as men to believe that an MIS degree enables one to help people, $f(1, 154) < 1$. However, women valued being able to combine a career and family more, $f(1, 154) = 3.98$, $p = .05$. There was an interaction between gender and major for the belief that one's career will give meaning to one's life, $f(1, 152) = 5.97$, $p = .02$. While there was no gender difference for non-majors, $f(1, 88) < 1$, among majors, men were more likely than women to believe that their career will give meaning to their life, $f(1, 64) = 13.29$, $p = .001$. In addition, female non-majors were more likely than female majors to believe that their career will give meaning to their life, $f(1, 71) = 4.65$, $p = .03$. Women more than men did not want their career to take priority over their family, $f(1, 153) = 4.26$, $p = .04$. Thus, women clearly valued a balanced work-family life more than men did and female majors valued work-life balance more than female non-majors did.

3.2 Computer Experience and Self-efficacy

I hypothesized that there would be significant gender differences and intra-gender differences for computer experience and self-efficacy. These hypotheses were confirmed. Females were younger than males when they first used a computer, $F(1, 156) = 6.70$, $p = .01$. Male students spent more time using computers for enjoyment, $F(1, 152) = 12.72$, $p = .0001$, had more programming experience, $F(1, 156) = 9.73$, $p = .002$, and had opened up a computer more frequently than did female students, $F(1, 155) = 25.30$, $p = .0001$. However, female majors spent more time on computers for enjoyment, $F(1, 68) = 4.74$, $p = .03$, had more experience in programming, $F(1, 72) = 46.83$, $p = .0001$, and were more likely to have opened up a computer than female non-majors, $F(1, 71) = 8.38$, $p = .005$.

Female students felt less sure than male students that they could learn a computer language, $F(1, 95) = 4.57$, $p = .04$, write a program in a high-level language, $F(1, 154) = 3.85$, $p = .05$, write a complex program, $F(1, 154) = 4.76$, $p = .03$, and overall had less confidence working with computers, $F(1, 95) = 5.43$, $p = .02$. Male students were more likely than female students to deny feeling threatened by computers, $F(1, 95) = 8.00$, $p = .006$. However, female majors compared to female non-majors had more confidence that they could teach the use of a software package, $F(1, 71) = 4.54$, $p = .04$, discuss strengths of software packages, $F(1, 71) = 5.49$, $p = .02$, write a program in a high-level language, $F(1, 71) = 38.76$, $p = .0001$, write a complex program, $F(1, 71) = 34.15$, $p = .0001$, debug a program, $F(1, 71) = 31.31$, $p = .0001$, and understand someone else's program, $F(1, 71) = 54.35$, $p = .0001$.

3.3 Stereotypes and Attitudes towards MIS

There was no gender difference in the perception that women cannot combine family and career in MIS, $F(1, 152) < 1$. Female students were more likely than male students to believe that students majoring in MIS are hard-working, $F(1, 154) = 12.79$, $p = .0001$, and interesting, $F(1, 154) = 6.05$, $p = .02$, and were more likely to believe that MIS careers allow one to master challenging tasks, $F(1, 146) = 3.86$, $p = .05$. Female majors believed more than female non-majors that MIS majors enjoy socializing, $F(1, 71) = 7.53$, $p = .008$, that they are hard-working, $F(1, 71) = 4.38$, $p = .04$, and that they enjoy athletics, $F(1, 57) = 6.02$, $p = .02$. Female majors were marginally more likely than female non-majors to feel that MIS professionals enjoy being around other people, $F(1, 71) = 3.49$, $p = .07$, and that MIS professionals spend as much time working with people as they do with computers, $F(1, 71) = 3.82$, $p = .06$. Female majors were more likely than female non-majors to think that doing well in MIS courses enhances career opportunities, $F(1, 70) = 5.45$, $p = .02$, that the rewards of a computer-related field are worth the sacrifices, $F(1, 71) = 11.41$, $p = .001$, that MIS is one of the most demanding and difficult careers, $F(1, 69) = 6.35$, $p = .01$, that MIS is a good career because one can quickly advance on the career ladder, $F(1, 69) = 5.61$, $p = .02$, get a feeling of accomplishment, $F(1, 70) = 14.48$, $p = .0001$, and be more employable, $F(1, 68) = 6.28$, $p = .02$. Thus, female majors exhibited more positive attitudes towards MIS than did female non-majors.

3.4 Role Models and Encouragement

Thirty-eight percent of participants knew someone with an MIS degree prior to taking an MIS class. This did not differ by gender, $F(1, 155) < 1$. Female students were more likely to rate their high school computer teachers as more knowledgeable than were male students, $F(1, 141) = 5.69$, $p = .02$. There was a highly significant interaction between gender and major status when students indicated the sex of their high school computer teachers, $F(1, 141) = 12.46$, $p = .001$, and a significant main effect of gender, $F(1, 141) = 10.80$, $p = .001$. This indicates that overall women were more likely to have had female computer teachers in high school, but this effect depended on major. While there was no gender difference for non-majors, $F(1, 84) < 1$, female majors had had more female computer teachers in high school than male majors did, $F(1, 57) = 18.73$, $p = .0001$. Furthermore, female majors had had more female computer teachers in high school than female non-majors did, $F(1, 66) = 6.96$, $p = .01$. The inter-action between gender and major for role models in MIS, $F(1, 64) = 4.75$, $p = .03$, indicates that among non-majors women were more likely than men to have had a role model to a marginal degree, $F(1, 43) = 3.64$, $p = .06$. Female majors were much more likely than males to have had a role model, $F(1, 21) = 9.06$, $p = .007$. Furthermore, female majors compared to female non-majors were more likely to have had a role model in MIS, $F(1, 29) = 7.68$, $p = .01$.

3.5 Attitudes towards MIS Courses and Instructors

There was a significant interaction between gender and major status for students' perceptions that the atmosphere in the program is impersonal, $F(1, 151) = 5.10$, $p = .03$. Among non-majors there was no gender difference, $F(1, 85) < 1$, whereas among majors, males found the atmosphere more impersonal than did females, $F(1, 66) = 5.70$, $p = .02$. There was a similar significant interaction between gender and major for students' opinion of the lab as a good place to socialize, $F(1, 131) = 7.20$, $p = .008$. Among non-majors there was no gender difference, $F(1, 69) < 1$, but among majors, females were more likely than males to find the lab a good place to socialize, $F(1, 62) = 8.40$, $p = .005$. Female students were more likely than male students to believe that MIS faculty are sensitive to the needs of students, $F(1, 152) = 5.11$, $p = .03$, and that MIS faculty and students take pride in the program, $F(1, 152) = 5.01$, $p = .03$. There was a significant interaction between gender and major for the belief that fellow students are too competitive, $F(1, 151) = 5.69$, $p = .02$. Among non-majors males were more likely than females to consider other students too competitive, $F(1, 86) = 4.57$, $p = .04$. No such difference was found for majors, $F(1, 65) = 1.79$, $p = .19$. Overall students felt there was little gender discrimination in the MIS department and there was no gender difference, $F(1, 152) = 2.12$, $p = .15$. However, female students were more likely than male students to believe that female students are not taken seriously by male faculty, $F(1, 151) = 4.49$, $p = .04$, that the ability of female students is underrated, $F(1, 152) = 8.81$, $p = .003$, and that faculty question female MIS students' commitment to their studies, $F(1, 152) = 6.00$, $p = .02$.

Compared to female non-majors, female majors found the social atmosphere in MIS marginally more friendly, $F(1, 70) = 3.56$, $p = .06$, the lab atmosphere more social, $F(1, 59) = 6.03$, $p = .02$, thought that MIS faculty and students take pride in the program, $F(1, 70) = 5.62$, $p = .02$, but were marginally more overwhelmed by the work in their class, $F(1, 70) = 3.65$, $p = .06$, and felt that peers are too competitive, $F(1, 70) = 6.10$, $p = .02$.

4. DISCUSSION

This research examined variables that could adversely affect the number of women in MIS. As with research on CS (e.g., Beyer & Haller, 2006), there were no gender differences in mathematical ability or in course grades. In addition, participants viewed MIS as a field where family life and career are compatible. If women are capable of doing as well in MIS as men, why are there so few women in the field? The present research suggests that computer self-efficacy and role models are particularly important variables to consider.

4.1 Career Goals, Values, Computer Experience, Self-efficacy, and Stereotypes

Previous research indicates that women value careers that allow them to help others, work with people, and provide the opportunity to combine career and family (Bowles, Babcock, & McGinn, 2005; Compeau, Higgins, & Huff, 1999; Eccles, 1994; Eccles et al., 1999; Margolis & Fisher, 2001; Sax, 1994; Tillberg & Cohoon, 2005). Females who attach great value to helping others and are family-oriented are less likely to desire a career in the sciences (Eccles, 1994) and more likely to defect from science majors (Astin & Astin, 1992). In contrast to these findings, the present study found that male and female students valued helping others to a similar degree. However, as hypothesized, women placed considerably greater emphasis that men on the ability to combine their work and family lives, a finding also reported by Herring et al. (2006). Moreover, female majors placed greater importance on work/life balance than did female non-majors.

This study found that both women's experience with and self-efficacy regarding computers were much lower than men's. This was the group of variables with the largest gender differences. A study of applied IT majors also found gender differences in computer self-efficacy (Ahuja et al., 2006). Low computer confidence may be a barrier to women's advancement in MIS. Female students spent less time on computers for enjoyment than did male students, suggesting a somewhat less intrinsic interest in computers. Importantly, in addition to gender differences, this study found extensive intra-gender differences in computer experience and self-efficacy. Female majors felt much more self-efficacious regarding computers, spent more time on computers for enjoyment, and had more programming experience than did female non-majors.

Gender differences in computer confidence and programming experience have also been found in CS majors (Beyer & Haller, 2006; Beyer, Rynes, Perrault, Hay, & Haller, 2003; Cassidy & Eachus, 2002; Keup & Stolzenberg, 2004; Lee, 2003; Lips, 2004; Sax, Hurtado, Lindholm, Astin, Korn, & Mahoney, 2004; Young, 2000) and in undeclared first-year students (Beyer, Rynes, & Haller, 2004). A German study found that girls in fifth grade already have lower computer self-efficacy than boys (Dickhäuser & Stiensmeier-Pelster, 2003). Women's lower self-efficacy in male-dominated domains is not surprising given that the parents of seven-year-old boys already believe in their greater mathematical ability than the parents of girls (Räty, Vänskä, Kasanen, & Kärkkäinen, 2002). A comparison of high school boys and girls who were doing equally well in their classes demonstrated that boys have higher success expectancies and believe they have more math talent (Watt, 2005). Parental aspirations and expectancies for children affect their self-efficacy (Pomerantz & Dong, 2006), which ultimately affects career choices (Bandura, Barbaranelli, Caprara, Pastorelli, 2001).

What is the consequence of low confidence? High confidence positively affects aspirations, educational choices, intrinsic motivation, and persistence (for a review see Beyer, 1995). For example, computer self-efficacy positively influenced affect and computer use and negatively influenced anxiety one year later (Compeau et al., 1999). In another study, computer self-efficacy was the only predictor of white women's aspirations for an IT career (Zarrett & Malanchuk, 2005). Women who had inaccurately low self-perceptions about their science ability avoided optional science courses (Ehrlinger & Dunning, 2003). These findings suggest that women's lower computer confidence has deleterious behavioral consequences, decreasing the likelihood that women will major in MIS and increasing the likelihood that female MIS majors drop out of MIS. As a consequence women miss the opportunity to enter into a highly paid field with excellent career potential. Thus, it is important that MIS instructors help increase female MIS students' computer self-efficacy. Encouragement and steering female students to activities that increase their practical skills such as internships or lab assistantships may accomplish this.

There were few gender differences in stereotypes of

MIS replicating findings for CS (e.g., (Beyer, & Haller, 2006; Beyer, Rynes, & Haller, 2004; Compeau et al., 1999). For those variables where a gender difference emerged, female students had more positive stereotypes of MIS than male students did. Female underrepresentation in MIS is not likely due to more negative stereotypes. Importantly, there was considerably more evidence for intra-gender differences than gender differences for stereotypes and attitudes towards MIS, with female majors being consistently more positive about MIS than female non-majors were.

4.2 Role Models and Encouragement

One of the most interesting findings of this study was the importance of former high school computer teachers. Female MIS majors had more female computer teachers in high school than male majors did. Furthermore, female majors had had more female computer teachers in high school than female non-majors did. Women also rated their former computer teachers as more knowledgeable than men did. Thus, competent female computer teachers in high school may serve as an inspiration for women. Similar evidence for the importance of female secondary school computer teachers was found for CS students (Beyer & Haller, 2006). Case studies of female informatics (CS) students (Huber et al., 2001) and female engineering students (Blättel-Mink, 2002) in Germany found that positive experiences with computer teachers in secondary school cemented their interest in CS or engineering, respectively. Similarly, case studies of Australian women in IT attest to the mark that positive high school experiences leave on female students (Trauth, 2002). Thus, positive exposure to computer teachers might be an important predictor of women's interest in computer-related fields.

Women, especially majors, were more likely than males to have had a role model in MIS. In a study of applied IT majors, women were also more likely to enter IT because of role models (Ahuja et al., 2006). Female faculty play an important modeling role (cf. Sharpe & Sonnert, 1999, and Zeldin & Pajares, 2000, for mathematics). Women are greatly affected by verbal persuasions of significant others (Zeldin & Pajares, 2000). Other research has found that parents are important role models. Female scientists, engineers, and computer scientists are more likely than their male counterparts to have parents in the same field (Astin & Astin, 1992; Blättel-Mink, 2002; Sax, 1994; Teague, 2002; Zeldin & Pajares, 2000). Encouragement by significant others predicts IT aspirations (Zarrett & Malanchuk, 2005). In fact, parental support is a key factor in women's decision to major in the natural sciences (Rayman & Brett, 1993). Some researchers indicate that fathers play a critical role in their daughters' career selection (Trauth, 2002). Even co-workers and friends can serve as role models, recruiting women into CS (Tillberg & Cohoon, 2005).

Female students seem most positively affected by active mentoring. For example, a study of women in careers requiring high mathematical aptitude, reports that women valued the support and encouragement they had received from parents, teachers, and peers (Zeldin & Pajares, 2000). This support cemented their self-efficacy regarding mathematics which enabled them to weather future obstacles such as unsupportive teachers or supervisors and discriminatory behavior (Zeldin & Pajares, 2000). The sex of the person providing support and encouragement was not important, but unequivocal support was (Zeldin & Pajares, 2000). However, another study found that exposure to positive female rather than male role models in male-dominated occupations resulted in more positive self-evaluations for female students (Lockwood, 2006).

4.3 Attitudes towards MIS Courses and Instructors

Female students had more positive attitudes towards their MIS courses and instructors than male students did. Female majors were more positive towards their courses and instructors than were female non-majors, except that female majors were more likely to complain about the competitiveness of their peers. Observational research has confirmed that some male students in computer courses create a competitive and hostile atmosphere (Barker, Garvin-Doxas, & Jackson, 2002). These results for women's perceptions of their instructors and classes stand in stark contrast to findings for another IT-related major, CS. Female CS students' perceptions were much more negative than were male students' (Beyer & Haller, 2006). Female students' positive attitudes towards the MIS program and instructors are particularly interesting in that although all MIS faculty at the present institution are male, the CS faculty was half female. While female students' attitudes toward MIS courses and instructors were positive, they were more concerned about gender discrimination. Female students were more likely than male students to believe that male faculty do not take female students seriously, that the ability of female students is underrated, and that faculty question female MIS students' commitment to their studies. This may be a serious deterrent for women entering MIS.

4.4 Recapitulation of Comparison of Female Majors and Non-majors

Although there was substantial evidence for gender differences, female MIS majors did differ from female non-majors in important respects. In fact, on some variables female and male majors were more alike than female majors and female non-majors. Female majors compared to female non-majors had more computer experience, much higher computer self-efficacy, more positive attitudes towards MIS, and more positive stereotypes. Female majors also had had more female computer teachers in high school and more role models in MIS than did female non-majors. Furthermore, female majors were more positive towards their courses and instructors than were female non-majors. These results confirm the importance of examining intra-gender differences.

4.5 Limitations and Directions for Future Research

Clearly, this research on intra-gender differences is preliminary. It represents an important first step towards understanding how female majors and female non-majors differ from one another. In order to understand why women are underrepresented in MIS, we need to understand how women who break into this male-dominated major differ from those who do not. Hence a paradigm shift in our focus of attention is needed. For too long, researchers have focused on gender differences without ever comparing female non-majors to female majors. We cannot draw firm cause-and-effect conclusions from this research. We urgently need prospective, longitudinal research following women from college entrance to declaration of the MIS major to graduation.

5. CONCLUSIONS

The findings suggest possible avenues for increasing the representation of women in MIS. Female computer teachers in secondary education may play a critical role in getting women interested in MIS. Furthermore, women's computer self-efficacy needs to be increased perhaps by offering research or teaching assistantships to qualified female students.

In order to effect changes in women's representation in MIS, we need a clear understanding of the reasons for the dearth of women in MIS. Social psychological variables are excellent candidates for factors to be studied because they influence career choices. There were substantial gender differences on social psychological variables. However, in many respects female majors were more similar to male majors than to female non-majors. A better understanding of gender differences and intra-gender differences should lead to improved interventions aimed at increasing women's representation in MIS.

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7. ENDNOTES

[1]Gender refers to the psychological characteristics associated with biological sex. I avoid the term sex difference in favor of gender difference because the former implies a biological difference, whereas the latter does not make any assumptions about the genesis (i.e. biological versus learned) of the difference between females and males.

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AUTHOR BIOGRAPHY

Sylvia Beyer is Professor of Psychology at the University of Wisconsin-Parkside. In 2000, she received a grant from the National Science Foundation to study the underrepresentation of women in IT. She has published extensively on her research on Computer Science students in the Computer Science literature. She has also conducted experimental research on women's self-perceptions in male-dominated fields, which has been published in major journals within Social Psychology.

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