Comparing Gender Differences in Computer Science and Management Information Systems Majors

Sylvia Beyer
University of Wisconsin – Parkside, USA

INTRODUCTION

Why do so few women major in computer science (CS) or management information systems (MIS)? Are the reasons for women's underrepresentation in these two disciplines the same? I will address these issues by reporting on my research on female and male undergraduates majoring in CS or MIS. I hypothesize that results from one area of information technology (IT), such as CS, do not necessarily generalize to other areas of IT, such as MIS.

Structural barriers exist that keep women from advancement in IT careers (cf. Ahuja, 2002). However, an examination of these is beyond the scope of this article, which focuses on gender differences in IT students. In 2002 only 27.6% of U.S. Bachelor's degrees in CS and 36.8% in MIS were conferred on women (U.S. Department of Education, 2002), limiting the number of women qualified to enter into the IT workforce. The problem of women's under representation in IT is not limited to the U.S. Women are underrepresented in CS majors in other Western countries such as Canada (Gadalla, 2001), Germany (Huber, Reiff, Ben, & Schinzel, 2001), Norway (Berg, Gansmo, Hestflatt, Lie, Nordli, & Sorenson, 2002), and Ireland (MacKeogh, 2003).

IT cannot afford to underutilize such a valuable and significant part of the workforce. Increasing the representation of women is imperative because "greater diversity among those who create computing technology ensures that those technologies are relevant to and usable by a wider range of people" (Roberts, 2003).

BACKGROUND

Both CS and MIS are areas within IT. CS is the more mathematically rigorous and technical major and typically has requirements of advanced physics and mathematics courses. The CS major emphasizes the design, implementation, and management of complex information systems. The MIS major has a more applied focus and concentrates on the collection, processing, and distribution of data for use in decision making in business. The underrepresentation of women is greater in CS than in MIS.

Research on women in IT often implicitly assumes that results gathered in one area of IT will generalize to other areas within IT. This article explicitly tests this assumption. Given the inherent differences in the fields of CS and MIS, students majoring in CS and MIS might differ from one another. These differences, coupled with the different academic atmospheres encountered in highly technical vs. business-oriented fields might present different challenges for women majoring in CS vs. MIS.

Previous research delineated several reasons for the small number of women in CS: Low computer self-efficacy, lack of programming and hands-on computer experience, negative stereotypes regarding the field, and lack of role models. Women have inaccurately low self-evaluations (i.e., their confidence is lower than warranted by their abilities) in domains traditionally considered masculine, including mathematics and chemistry (Beyer, 1999a, 2002), and CS (Beyer, 1999a; Beyer, DeKeuster, Walter, Colar, & Holcomb, 2005; Beyer, Rynes, Perrault, Hay, & Haller, 2003; Lips, 2004). Although women extensively use computers as tools, they have less programming experience than men (Beyer, DeKeuster, Rynes, & DeHeer, 2004; Beyer, Rynes, & Haller, 2004; Margolis & Fisher, 2001).

CS is stereotyped as very male-dominated and both men and women *incorrectly* believe that male CS majors have higher grade point averages (GPAs) than female CS majors (Beyer, 1999b). The stereo-

types about individuals in computer-related fields are unflattering: CS majors are perceived as intelligent but interpersonally deficient (American Association of University Women, 2000; Beyer, Rynes, & Haller, 2004). This has been termed the "computer nerd syndrome", "geek mythology", or "hacker mentality" (Jepson & Perl, 2002; Margolis & Fisher, 2001). CS is also incorrectly perceived as involving only programming and no creativity (Craig, Fisher, Scollary, & Singh, 1998). The perceived obsession with machines and lack of interest in people, and associations of technology with masculinity conflict with women's interpersonal orientation, that is, their tendency to value careers with opportunities for social interaction and nurturance (Cross & Madson, 1997; Zahn-Waxler, 2000). This may deter women from majoring in CS. Unfortunately, we know little about the stereotypes about MIS students.

We have at least a rudimentary understanding of what deters women from taking CS classes (see also Lagesen, 2003; Margolis & Fisher, 2001). Departmental and classroom climates in CS affect the success of students (Margolis & Fisher, 2001). Social support, faculty encouragement, and the presence of role models are more important to women's than men's decision to enroll in or leave CS (Cuny, Aspray, Cohoon, & Jesse, 2003; Margolis & Fisher, 2001). Indeed, "female students in technical disciplines, perhaps partly because of their 'outsiderness,' are especially vulnerable to poor teaching, inhospitable teaching environments (such as large classes), and unhelpful faculty" (Margolis & Fisher, 2001, p. 83). For example, female engineering students with low self-evaluations who perceived the academic environment in their department to be supportive, experienced lower levels of stress and higher self-esteem one year later than women who perceived the department as less supportive (Cross, 2001). Again, we know little about MIS students.

METHOD

All participants were enrolled at the University of Wisconsin-Parkside, a public university with an undergraduate enrollment of approximately 5000 students. In the CS sample, 108 students participated (25 females, 83 males); in the MIS sample, 135 students participated (67 females, 68 males). To make comparisons between the two IT majors possible, I assessed constructs that were found to be important in previous research on CS and extended them to MIS. I measured students' computer experience and self-efficacy; stereotypes about CS or MIS; role models; and climate in the classroom and program. Furthermore, I collected students' ACT scores (an achievement test commonly administered in U.S. high schools) and college grades. More details on the measures and statistical tests can be found in various publications (Beyer & DeKeuster, in press; Beyer, DeKeuster, Rynes, & DeHeer, 2004; Beyer, Rynes, & Haller, 2004; Beyer et al., 2003, 2005).

RESULTS AND DISCUSSION

Table 1 presents the means of the variables discussed. Throughout I will point out similarities and differences in the results of the CS and MIS samples. To assess gender differences, analyses of variance, chi-squares, and regressions were calculated. All reported gender differences are statistically significant at the $p < .05$ level or better.

Mathematical Ability, Computer Experience, and Self-Efficacy

CS students had higher mathematics ACT scores than MIS students underscoring their greater mathematics aptitude. No gender differences were found in mathematical aptitude (ACT scores) or grades in students' major for CS or MIS students. Other researchers have also found no gender differences in the grades or standardized test scores of students in mathematics-intensive majors (Cross, 2001). Male CS and MIS students had more programming experience and more experience installing RAM in a computer than did their female counterparts.

To determine whether there was a gender difference in computer self-efficacy when controlling for mathematical ability, I regressed participants' computer self-efficacy on gender, mathematics ACT score, and the interaction. As can be seen in Figure 1, female CS majors had lower computer self-efficacy than male majors regardless of their ACT scores. The same was true for MIS majors. Thus, female CS and MIS majors' computer self-efficacy