A Faculty Role in Women's Participation in Computing

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INTRODUCTION

The success of efforts to attract and retain more women in computing is influenced by many factors that are beyond the control of academic departments. Industry downturns, public perception about job opportunities and the desirability of a computing career, and gender stereotypes about interests and abilities are only a few contextual features that are likely to be relevant but over which computer science programs have little or no control. Nevertheless, there are ways that departments can have a measurable influence over women's representation, and several of those ways depend on faculty.

Women's portion of undergraduate enrollment in computing majors is low on average, but it varies across institutions (Cohoon, 2006). Likewise, women's portion of attrition from computer science (CS) is a disproportionately high rate—32% annual attrition of women from the major. Comparing women's attrition rate to men's attrition rate in the same department shows that on average, undergraduate women switched out of the CS major at a rate six points higher than their male classmates. However, just as some departments enroll higher proportions of women, there are also some undergraduate computing departments that retain men and women at comparable rates. The first part of our discussion examines the faculty behaviors that distinguish undergraduate departments that retain women.

Women's portion of graduate enrollment in computer science and computer engineering (CSE) is also low, but similar to undergraduate programs, it varies by department—from 8% to 33%. The second part of our discussion examines the faculty behaviors that distinguish graduate departments that enroll women.

In this article, we take a department-level approach to identifying factors that are related to the gender-balance of post-secondary computing. We examine the considerable role that members of a department's faculty play in bringing about similar outcomes for men and women. First, we discuss faculty actions that can affect retention in undergraduate computer science programs, and secondly, we discuss faculty recruitment of women into graduate CSE programs.

BACKGROUND

Until recently, research on women's participation in post-secondary computer science was scant. As a result, much of the background literature for investigations on this topic consists of research on women's participation in science, technology, engineering, and mathematics (STEM). Overall, this body of literature shows strong evidence for the important role that faculty play in women's participation in STEM disciplines. For example, a comprehensive review of intervention programs designed to promote women and underrepresented minorities in STEM found positive outcomes when faculty play an active role in recruiting and supporting students (Building Engineering and Science Talent, 2004). Women in fields with high status rewards, such as computer science, are less likely to experience the supportive environments that they find satisfying (Hearn & Olzak, 1981). In addition to being dissatisfied, women who find the classroom climate in engineering to be unsupportive tend to have low class participation (Salter & Persaud, 2003). However, supportive interactions with individual faculty can compensate for an environment that might otherwise be unsatisfying (Hearn & Olzak, 1981). Further evidence identifies some specific supportive faculty behaviors and the benefits they offer women students.

Mentoring activities range from social and emotional support to instrumental support (e.g., showing students how to write grant proposals and get articles published, writing letters of recommendation, etc.). These activities increase students' academic self-confidence, academic success, and career commitment in STEM fields. For example, a survey of more than 300 graduate students at a single university (Ulku-Steiner, Kurtz-Costes, & Kinlaw, 2000) showed that when faculty provided students with both affective support (such as sensitivity to students' non-academic commitments) and instrumental support (such as finding financial aid), students' academic self-confidence and career commitment increased. The association between mentoring and these outcomes was strongest for women in disciplines where the majority of faculty members were men. This was the group of women who had the lowest level of self-confidence. The boost in confidence that mentoring provides could be one reason for the measurable improvement in academic performance and continued enrollment at an institution associated with mentoring. The mentored students in this university's three-year study earned 0.3 of a grade point average higher than non-mentored students who entered the study institution at the same time with the same sex, ethnicity, and high school GPA (Campbell & Campbell, 1997). The mentored students in this study were also less likely to drop out of their institution. The evidence from these studies demonstrates that mentoring students is one way that faculty members can improve student outcomes. Whether the outcomes benefit women in particular is not clear.

There is evidence that instrumental mentoring benefits women graduate students in STEM fields. A national study of chemistry, computer science, electrical engineering, and physics graduate students showed advisor support was related to female enrollment (Fox, 2001). Women's representation was higher in programs where women reported more advisor support than reported by women in other programs. This support included instrumental mentoring activities such as advisor help with "learning to design research, to write grant proposals, to coauthor publications, and to organize people" (Fox, 2001, p. 659). The women in departments where these mentoring-type interactions were more common also had higher expectations of graduating than women in departments where it was less common for faculty to provide such help. This association between graduate women's participation in STEM disciplines and instrumental mentoring by faculty demonstrates one way that faculty members can influence the gender composition of their programs.

Another way faculty members influence the gender balance of STEM programs is through role modeling. Role modeling is frequently confused with mentoring, but is actually a different function. In contrast to the more active mentoring, being a role model involves serving as an example of the attitudes and behaviors related to a role. Furthermore, role models do not need to personally interact with students to be effective. Their importance lies in the assumption that observing a person similar to oneself in a role increases one's ability to imagine oneself in a similar role. The paucity of women role models has often been cited as an important reason for the small number of women students in computing (Teague, 2002; Townsend, 1996).

Unlike mentors (Cohoon, Gonsoulin, & Layman, 2004), role models are most effective when they are socially similar to the observer. For example, course retention was higher for first-year women who were taught mathematics and science by female faculty (Robst, Keil, & Russo, 1998). This finding is particularly interesting because the impact of faculty gender was greatest in classes where there were few women students, as is often the case in CS. Similar results from a study of graduate students show that being the same sex as the observer is important but not sufficient for role models to be effective (Etzkowitz, Kemelgor, Neuschatz, & Uzzi, 1994). Interviews with faculty and graduate students in physics, chemistry, electrical engineering, and computer science at a single research university found that characteristics other than sex were important. In particular, women graduate students wanted to model themselves after women who balanced work with their personal lives. Thus, it appears that being female is not an adequate condition for effective role