

Work in Progress – Gender and Preconceptions of Undergraduate Computer Science

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Abstract - Plummeting freshman interest in computer science and a growing gender gap motivates our qualitative study of pre-major undergraduates enrolled in an introductory computer science course. Analysis of ongoing interviews suggests potential themes in student perceptions of computer science, its attractive and unattractive features, and the sources of these preconceptions. We also examine the effectiveness of recruitment programs in challenging popular, negative stereotypes of computer science.

Index Terms - Introductory Computer Science, Major Choice, Gender, Qualitative Research

Freshman interest in the computer science major dropped an alarming 60% between 2000 and 2004 [5]. The drop among women was particularly severe (80% between 1998 and 2004), so we can expect CS's gender gap to worsen. Recent U.S. studies of CS majors suggest differences in how women and men are attracted to the field [1,2,4], and these findings have already proven valuable in guiding outreach, recruitment, and teaching practices. To complement these studies, we present preliminary findings from interviews with pre-major freshmen and sophomores enrolled in an introductory computer science course (CS 1) at a large, public research university. We focus on findings potentially relevant to the gender gap. Understanding of these student perceptions might help the department recruit CS majors more effectively.

The studied course is titled "Computer Programming I" and is a combined pre-major and service course (for engineering, informatics, and other programs). To become a CS major, students complete CS, math, and science prerequisites and pass through a competitive admissions process. Historically, only a small fraction of CS 1 students later apply to major in CS, so the course represents a significant opportunity to recruit majors, particularly women, who comprise over a quarter of the enrollment (significantly higher fraction than among CS majors).

The ongoing, interview-based study follows a survey-based study of CS 1 students in 2004 spring whose findings suggested that women are more likely than men to find the creative aspects of CS appealing [6]. Programming was among the most frequently cited aspects of CS as a positive aspect and a negative aspect. One of the goals of this interview-based phase is to obtain a richer understanding of these findings.

The first set of interviews (2005 spring) included four women and one man, who volunteered for approximately 45-

minute, individual, semi-structured interviews. Questions were broad and open-ended (*e.g.*, about what makes the CS major more/less interesting to them). Given the small, initial sample size, this paper highlights three themes emerging from preliminary interview analysis and possible directions for more focused questioning in the remaining sets of interviews.

CREATIVITY: MORE THAN ONE RIGHT ANSWER

As mentioned above, the students perceive programming as both a positive and negative aspect of CS, but the survey's short-answer format limited our understanding of what activities and attributes associated with programming students find (un-)attractive. Interviews suggest that students appreciate a certain kind of creativity in programming. In particular, three of the students described programming as a flexible activity with multiple, valid ways to meet program requirements. The male interviewee said, "...it's pretty fun how you can redesign your program and still make it work...I guess [programming is] very flexible in the sense that you can rework things and still make it work out."

Similar remarks from other interviewees suggest that this creative freedom is perceived in the context of logical, structural constraints in programming. A female interviewee said she liked that programming is "pretty easy to understand like it's pretty logical...you can do it a different way, like it's not just one way works and that's it...methods do different things and still make it work even though it's not the same structure as some else's program." This student did not observe this kind of constrained creativity in other majors she was considering.

Another female interviewee mentioned creativity's role in CS throughout her interview and echoed the above remarks, saying she liked "the fact that you get to like create stuff kind of in your own way but yet like there's still something to follow." She also emphasized the ability to exercise individual creativity in the context of set constraints: "Lots of different people in my class, we wrote the program in different ways, but there's still kind of like a set procedure for it, even though we did it differently. I kind of like that."

We are particularly interested in this preliminary theme for multiple reasons. In the 2004 spring survey, more women than men cited creativity and logic as appealing features of CS, and interview findings like the above suggest one way of interpreting what students mean by "creativity" and "logic" and how the two might be related. Furthermore, emphasizing creativity in introductory CS courses is already showing promise as a strategy for recruiting women. Guzdial *et al.*'s

gender-friendly approach to introducing computing provides extensive opportunity to exercise individual creativity [3]. We hope our study will help us better understand the effectiveness of strategies like this.

INFORMAL SOURCES OF KNOWLEDGE

We are carefully conducting interviews to elicit not only the preconceptions CS 1 students bring to the classroom but also the *sources* of these preconceptions. 2004 spring survey data showed that two thirds of the studied population do not have prior programming experience from high school or undergraduate courses. Even in cases where students took the opportunity to study programming or CS in high school, the content and depth of these courses vary widely. For these reasons, we are particularly interested in less formal sources of preconceptions about CS, *e.g.*, peers, older students, other friends, and family members.

The interviews suggest that students who have previously taken CS 1 are a common and influential source of information. Three of the women reported receiving advice directly from such students. Advice commonly took on the form of warnings about the extraordinary difficulty of the course and the required programming work: “There is like a lot of negativity about computer science like, ‘Oh oh you’re going into computer science?’ It’s like, ‘Oh, better watch out,’ you know. It’s kind of like a warning.” Another interviewee “heard the class has a really like sharp [learning] curve to it, like it’s easy easy and then it gets really hard really fast right after the first midterm, and that’s kind of scary.”

Not all of the feedback from other students was negative, but some positive statements seemed guarded in phrasing, with one woman saying she heard that CS is “stressful at times but like after you accomplish it, it’s like a great achievement,” and another saying she heard that it is “doable.”

The experience of one of the interviewed women illustrated the influence of informally exchanged advice and information. She enrolled in CS 1 mostly on the recommendation of a female friend who previously took and enjoyed the course. After enrolling, an older friend’s warnings made her think twice: “You had to have already known and be [programming] since you were little...he kind of scared me at first.” She said she probably would not have taken CS 1 had she not received her female friend’s recommendation to balance the older friend’s warnings.

Our first interviews suggest CS 1’s overall reputation is one of a very difficult, time-consuming course. We hope to clarify whether students perceive CS 1 to be *uniquely* challenging among other introductory level courses at the university. In any case, in the absence of more direct advertising and recruiting by the CS department, students appear to have ready access to and rely substantially on informally exchanged knowledge in forming impressions of CS 1 and the CS major.

RECONCILING STEREOTYPES AND EXPERIENCE

Our early interviews reveal multiple instances of students who acknowledge prevailing, negative stereotypes of CS but observe that their initial experiences do not corroborate these stereotypes. In some cases, these initial experiences were directly connected to existing interventions designed to recruit women into CS.

For example, when asked to imagine and describe characteristics of a successful computer scientist, one female interviewee started by describing the popular image of “very nerdy” computer scientists who “have no friends, because they’re always on the computer.” However, based on her recent experience at a campus-wide conference on women in science and engineering, she rejected this stereotype, observing that there are computer scientists, including women, who are “smart...very outgoing, just like a normal person.”

In future interviews and analysis, we will be looking for other examples of “mythbusting” experiences—experiences that lead students to question or even reject popular, negative perceptions of CS. We hope this will inform the design of interventions such as women’s conferences and related programs that might provide students with more of these experiences.

FUTURE WORK

Additional interviews, oversampling for women, are planned for summer and autumn quarters. In general, we hope the interviews will reveal more details of how CS 1 students perceive the CS major and related careers. The potential themes discussed above were selected on the basis of their relevance to the gender gap and preliminary evidence. We will continue to adapt our semi-structured interviews to more closely examine these and other themes. We are also considering complementing our interview study with further surveying to quantitatively capture the prevalence of certain preconceptions among women and men.

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