

Schema Disjunction Among Computer Science Students

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INTRODUCTION

In her book *Why So Slow?: The Advancement of Women*, Virginia Valian describes a schema as “a set of implicit, or nonconscious, hypotheses about ... differences.” (Valian, 1998). Individuals use schemas about particular social groups to guide their interpretations of and behavior toward members of those groups. However, problems can arise when multiple conflicting schemas are applied to the same person. This phenomenon, *schema disjunction*, is particularly well illustrated by the situation of female undergraduate computer science majors.

Extensive interviews with introductory computer science students of both genders reveal a significant discontinuity between their schema of women and their schema of successful computer scientists. Despite professing conscious egalitarian beliefs about the ability of women to do computer science, many students unconsciously hold disjunct schemas that help facilitate an environment hostile to novice women and may deter them from pursuing computer science careers (Pedersen-Gallegos, Laursen, Seymour, Donahue, Crane, DeAntoni, et al., 2004).

Valian argues that, starting in childhood, we acquire *schemas* through observation of adult behavior toward others. Schemas are generally more inclusive than stereotypes and carry fewer negative connotations: They are not necessarily unfair or

pejorative. In fact, schemas are a normal way that humans use categorization to negotiate our environments. However, Valian also explains that schemas can become unjustly misrepresentative of individuals due to errors that creep in during their development. These errors are then reinforced during maintenance and application of those erroneous schemas. These generalized beliefs about certain types of people are often unarticulated, and may be even consciously disavowed by those who hold them. Yet people can still operate unconsciously on the basis of ingrained schemas while remaining unaware of them.

Because schemas color our interpretations of people we interact with, they also shape how we behave towards those people. We treat each other, and ourselves, in accordance with our schematic expectations. When these expectations are unfairly pejorative, they can have a damaging impact on the self-concepts and lives of the people to whom they are applied, often resulting in a self-fulfilling prophecy. Echoing Cooley's (1902) classic notion of the “looking-glass self,” Valian describes this phenomenon with a focus on gender schemas:

All of us—boys and girls, men and women—become in part what others expect us to become, thereby confirming hypotheses about the different nature of males and females. While no one is infinitely malleable, no one is completely

indifferent to others. One way we learn who we are is through others' responses to us. As men and women, we also develop expectations for our own behavior, based on characteristics we believe we possess. We then explain our successes and failures in terms of those abilities and traits. (Valian, 1998)

BACKGROUND

The report *Attracting and Retaining Women in Information Technology Programs* reports on a study done for the National Science Foundation by Ethnography and Evaluation Research at the University of Colorado at Boulder. To illuminate some of the obstacles to achieving gender equality in the field of computer science, we undertook in-depth qualitative interviews with a wide variety of computer science (CS) students and faculty (Pedersen-Gallegos et al., 2004). Interview subjects included students who were just beginning their studies and those who were nearing completion of a CS major or minor. All interviews were tape-recorded and transcribed *verbatim* into *The Ethnograph*, a computer program that allows for multiple, overlapping and nested coding of a large volume of transcribed documents, and supports analysis to a high degree of complexity. This discussion draws primarily on data from 70 introductory students, including both under-

graduates who had persevered in the discipline and those who had left it or chosen alternative programs. All uncited quotations in this article come directly from those interviews.

THE INTERVIEWS

We asked the students we interviewed to tell us what they thought made a successful computer scientist. We also gleaned their impressions about what women are like through their conjectures about why there are so few women in the discipline. Questions about gender issues were asked only at the end of interviews with students, so as to make a clear distinction between gender issues and more generic learning issues. One of the most striking findings, especially among students at the introductory levels, was that although most students professed egalitarian beliefs about women's rights and abilities to be computer scientists, the characteristics they considered schematic of a computer scientist were often antithetical to those included in their schema of a woman.

Comparing the novice students' descriptions of computer scientists to their implied beliefs about women, we can see how the schemas of these two groups stand in opposition to each other, as illustrated in Table 1.

Table 1. Students' schema for computer scientists and for women

Students' Schema for Computer Scientists:	Students' Schema for Women:
Highly intelligent	Find CS difficult or intimidating
Inherent passion for CS	Natural interest in arts and humanities
Early experience with math, science, computers	Inexperienced with math, science, computers
Self-motivated, independent learners	Communal and social learners
Logical, analytical thinkers	Less spatial and abstract thinkers
Poor social skills - "Nerd" image	Concerned with social image
Competitive and driven	Less competitive, more nurturing
Focused on prestigious, challenging careers	Less concerned with career success
Can handle the long, stressful hours of a programming job	Want more balanced career, opportunity to raise a family
Represented among faculty/discipline	Underrepresented among faculty/discipline

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