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In this issue:

Factors Affecting Women's Decisions to Pursue an IS Degree: A Case Study

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Factors Affecting Women's Decisions to Pursue an IS Degree: A Case Study

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Abstract

The declining participation of women in the computer-related professions is a concern to academia and business. There appears to be a complex set of factors influencing the selection of a major and completing the degree. A case study of 25 undergraduate women explored, in detail, the events, conditions, and relationships that affected the decision of women to pursue the study of Computer Information Systems. Four themes were identified: (a) Influence by male role models, (b) positive introduction to computers/technology in the home and school, (c) a natural affinity for problem solving, figuring out how it works and meeting the challenges of an always-changing field, need to prove they can do it, and (d) greater opportunity for higher salary.

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1. INTRODUCTION

Declining participation of women in the computer-related professions is a prominent concern in both the academic and business arenas. The overall waning enrollment numbers in computer-related programs demonstrate an increasing gap between male and female enrollment numbers. As the number of women who graduate declines, so will the number of women entering into the IT workforce.

Factors related to reasons why women are not attracted to an IT course of study range from the association of IT with the traditionally male dominated mathematics and engineering disciplines to speculation as to whether women possess the "intrinsic aptitude" for science at all (Furger, 1998; Cuker et al., 2002; Margolis & Fisher, 2002).

In response to research results and recommendations, a multitude of programs such as mentoring, course redesign to be more "female friendly," and introducing computers to girls at an early age have been initiated to increase the appeal of CIS to females (Gürer & Camp, 2002; Rich et al., 2004). Although these programs and others have met with some success, the number of women entering CIS degree programs continues to fall and computer science continues to struggle with its failure at attracting and retaining women. Little research has been uncovered that specifically concentrated its focus on why women initially decide to study CIS and what would entice women to study CIS.

This study explored why women decide to enter into a CIS degree program and hopefully uncover information that may lead to reducing the gender gap in CIS, which in

turn may impact the gender imbalance in the workplace.

2. LITERATURE REVIEW

Although the IT field has seen small increases in 2008, the enrollment figures are still low and the proportion of women who selected a IT major are even more dismal than the overall IT percentages; numbers have dropped to levels unseen since the early 1970's. Interest in IT among women fell 80% between 1998 and 2004, and 93% since its peak in 1982 (See Appendix B, Table 1). Unlike most other fields, which have seen women's representation increase over time, the portion of IT degrees granted to women has not realized the promised potential of the mid 1980's when 37% of computer science bachelor's degrees went to women. According to CRA reports, only 17% of the undergraduate computer-science degrees were awarded to women in 2004, down from 19% in 2000. The percentage of bachelor degrees in CIS awarded to women has steadily declined from 37% in 1984 to 17% in 2004 (AAUW, 2000; US Dept. of Labor, 2002, 2003; CRA 2005). The declining percentage of women granted undergraduate degrees reflects the declining percentage of freshman declaring probable CIS majors (www.cra.org/govaffairs/blog/archives/000661.html; CRA 2005).

There are numerous studies concerning the disappearance of women in IT, including, but not limited to : (1) Women in Information Technology project; (2) American Association of University Women Educational Foundation Commission on Technology, Gender, and Teacher Education; (3) the Committee on the Status of Women in Computing Research (CRA-W); (4) Computing Research Association (CRA) Taulbee Survey; (5) the National Science Foundation; and (6) U.S. Department of Education (Geigner & Schambach, 1999; Green, 2000; Irani, 2004, San-karan, 1999).

These studies are in agreement that there are multiple dimensions concerning female under representation within IT, ranging from causal myths about the "natural" distribution of interest and aptitude for technology to the way gender is defined by society in terms of relations between men and women. These studies overturn a general misconception about gender differences in relation to

science and math abilities concluding that there is no difference in the aptitudes of males and females in IT related areas. It is also agreed that more research is necessary in the area of factors that influence females to enter into IT fields of study and career paths.

Reasons Why Women Avoid Computer-related Majors

The Women in Information Technology project (2004) conducted a longitudinal study since 1995 to explore the perceptions and attitudes of women in high school, undergraduate, and postgraduate university programs, and in the work place. They are attempting to understand factors that influence females to select, remain in, and leave an IT career. The research takes the view that IT is a complicated socio-cultural construction attractive to certain types of people and is primarily perceived as a male domain. Factors influencing the decision to enter the IT field include high salaries and flexible working conditions (Nielsen, von Hellens, Pringle, & Greenhill, 1999; Beekhuyzen, 2005). Reasons for leaving the field include lack of clear career paths; uncertainty about long term employment, family unfriendly work practices and the perception that IT work lacks a social dimension (von Hellens, Nielsen & Beekhuyzen, 2004). The researchers agree (WINIT, 2004) with the conclusions of other studies (e.g., AAUW Tech Savvy, Margolis and Fisher) that through mentoring, interactions between professional IT organizations, professional IT women and females in CIS education, can alter perceptions of IT as a "masculinised domain." Other researchers have delved deeper into the reasons behind low female enrollment. A study by Margolis and Fisher at Carnegie Mellon University (Margolis & Fisher, 2002) found contributing reasons for the gender gap:

- Different socialization processes that men and women face growing up as they become interested in computers.
- Female students often are not provided with the same mentorship and encouragement towards the field of computer science as are their male counterparts
- Women in the major are often interested in computers because of their ability to

help people; whereas men seem to have an intrinsic love of computers.

- The male-dominated culture of computer science that creates an invisible barrier to women and results in diminished confidence levels for female students.
- The geek stereotypes that sometimes plague computer science and alienate female.

In an interview, Margolis states, "One of the major findings was that women come to the field of computing at a different pacing and with different forms of attachment. Unfortunately, the field--the expectations in the field, the culture of the field, the curriculum in the field--is very much oriented toward the appetites and the learning styles of a narrow slice of males" (Gilbert, 2002). Margolis & Fisher found that culture influenced women's confidence to a much greater extent than did gender. The researchers found that women's confidence was extremely low, and women felt they did not fit into an unbalanced computing culture in terms of gender, the range of student personalities, and professional support for women (Margolis & Fisher, 2002; Blum, Dias, Frieze, & Orit, 2006).

In a study conducted by McGrath-Cohoon, Tillberg and Shwalb (2004), women mentioned the influence of encouragement and testimonials more often than men. They were also greatly influenced by the presence of female faculty and role models. Other studies noted factors such as:

- 1) Economic situations (Furger, 1988)
- 2) Role of parents, especially mothers (Turtle, 1997)
- 3) Male designed computer games
- 4) Classroom environments
- 5) Unequal access to computers in terms of gender inequality in computing
- 6) Lower computer self-efficacy in women (Margolis & Fisher, 2002; McGrath-Cohoon, Tillberg and Shwalb 2004; Colyark & Woodward, 2007; Creamer, Lee, & Meszaros, 2007)
- 7) Parents' education levels (higher education levels were more informed and receptive of IT careers for women) (Creamer, Lee and Meszaros, 2007)

8) Decision orientation (Creamer, Lee and Meszaros, 2007)

9) Computer science courses have not caught up with the mathematics and science courses in terms of bridging the gap of gender equality (Green, 2000)

In a study by Creamer, Lee and Meszaros (2007), the model Information Technology Career Interest and Choice (ITCIC) was used to develop a set of variables as to how students make a career choice. The model demonstrated the women used in the study sample who expressed interest in IT shared five characteristics with direct impact: (a) race, (b) parental support, (c) computer use, (d) positive view about workers in the IT field and (e) information sources.

Proposed changes by Cukier et al (2002) to make existing curricula more attractive to women suggest expanding the definition of IT out of the narrow science and engineering area and crossing over into the more business-oriented disciplines will stimulate enrollment in CIS degrees, improve retention of women in the CIS disciplines, and result in the eventual increase of women entering into the IT workforce.

Cohoon maintains that retaining women in CIS programs can be helped by maintaining a stable faculty, providing female role models, promoting interaction among classmates, and developing learning communities and other forms of peer support. Also, mentoring undergraduates and communicating positive opinions of female student strengths and abilities creates a favorable environment for the female student to gain self confidence (Cohoon, 2002).

3. METHODOLOGY

The research used case studies to obtain detailed personal accounts and experiences in relation to their decision to enter into the study of CIS.

Students enrolled at xxx University were selected since the institution offers a variety of academic programs of study, including an undergraduate degree in CIS; the student body includes both males and females, traditional and non-traditional students; commuting and resident students; and accepts transfer students from other academic institutions. The xxx University of participants

included 290 female students enrolled in, or having left, an undergraduate course of study in CIS during the seven academic years 1998 to 2005. From 32 respondents, 25 interviews were scheduled and completed. The participants had a broad age range from 19 to 54, and included traditional, non-traditional, transfer, commuter and resident students.

The data collected from the recorded interviews was hand coded, close read, and Key-Words-in Context method was used to search the text files for key words and phrases to identify commonalities and differences in the transcription of the data.

4. RESULTS

Factors identified as potential indicators affecting the decision of women to enter into, remain with, or leave a CIS course of study at a particular university were analyzed relative to the research questions. The responses of the 25 participants were explored to extrapolate factors influencing their initial decision to enter into, remain in to complete, or leave an undergraduate CIS degree program. Early analysis of the data resulted in a total of 112 categories.

Combining similar groups of responses and developing more inclusive definitions reduced the number of categories to 34 into which the data was coded. Fifteen recurring themes emerged and the results were collapsed into four main themes:

- a) Influence by male role models – relatives, fathers, brothers, uncles, and teachers.
- b) Positive introduction to computers/technology in the home and school – high school, tech school, and college. Early positive exposure to computers/technology when growing up.
- c) A natural affinity for problem solving, figuring out how it works. Meeting the challenges of an always-changing field, need to prove they can do it.
- d) Greater opportunity for higher salary.

Factors Impacting IT Career Decisions

Male influence

The strongest theme was that of a male relative and the influence they had on the female participants' decision to study CIS. Twenty-three of the females interviewed spoke about some instance or occurrence where a male, many naming their fathers, had the most influence on they way they viewed computers/technology, which eventually affected their decisions when it came to selecting a course of study. Male influence was very evident in the majority of the responses and was in the form of direct association and direct suggestion. Various phrases such as, "My primary exposure was due to my father who worked in the field." "My father encouraged me to take computer/programming classes on Saturday mornings when I was in grade school." Additionally, only male teachers were mentioned as having any impact on their decision.

Rounding out the male influence in the decision making process are husbands, brothers, and uncles. The participants seemed to be portraying a general sense that the males in their lives offered the freedom to explore technology, which in turn fostered an interest in the females to learn more about computers and technology.

Of the 25 interviews, only two spoke of a female influencing factor. One participant credited her mother's influence, "My mother first suggested the idea to me because she knew how much I enjoyed computers. I just never thought about the options in the computer field until she suggested it to me." A second participant noted that her sister, who was an electrical engineer/software engineer, encouraged her to enter the field. Both instances were direct suggestions and similar to direct male influence.

Exposure to Computers

A common thread in the participants' responses was the exposure they had at various sites to computers and the freedom to explore their use. There were three places that the participants spoke of: school, the workplace, and home. School had the largest number of responses with 10, and the workplace was a close second with 9 responses. As one participant pointed out,

"What really hooked me was my experiences with computers at work. I was allowed to experiment with any of the new programs that were installed and see what they could do." The women whose responses included references to their job and workplace were all non-traditional, part-time, commuting students. A non-traditional student is defined as a student taking fewer than 12 credits per term. Additionally, a common theme found in the part-time participants was that their job and the possibility of promotion, gave them the incentive to pursue an undergraduate degree in CIS.

Surprisingly, the home environment was spoken of in terms of early exposure that fostered a developing interest in computer science. Some participants spoke of an early competence and confidence that was gained in the home and carried over into school and the workplace. A participant who had the advantage of being actively involved while growing up told me, "I have always been interested in computers from an early age. I built Oscilloscopes with my father when I was nine. I took computer/programming classes on Saturday mornings when I was in grade school to further my knowledge in the information science arena."

For most participants an early experience with computers and technology was the exception and not the norm. A student in her third year of study thinks it was, "... roughly between my junior high and high school years." While another student was more exact, "I became fascinated with computers when I took a computer course during the first semester of my senior year of High School." A transfer student found her interest started after high school when she took courses at a technical school to increase her job opportunities. "I took two years of Computerized Business at a technical school and ever since then I wanted to learn more about the field."

For some of the women, interest and attraction to computers and technology was gradual and came to be a realization when they moved into the workforce. Comments included, "When I started working in the IS department at my work" and "In the early 90's while working at my current company..." Also, "In the mid 1990's when the Internet was becoming a predominant mode of com-

munication at work and PC's were the tool to use to get the job done."

Influence of Money

Success at times is related to the amount of money one makes in their chosen field. Of the 25 respondents, 19 report that money influenced their initial decision to enter the field of CIS. Various statements that the study participants made concerning money in relation to their decision to enter into a CIS degree course of study included, "I figured I could make good money" and "I heard what some of the starting salaries were for programmers and that was enough for me." In most interviews there was some reference to the amount of money that can be made with a degree in CIS that would open the door either to a higher paying position or entry into the workforce.

The results from the participant responses to the interview questions indicate that some of the factors that impact women's decisions to enter into a CIS course of study are exposure to CIS in the home, school, and workplace, male influence in terms of freedom to explore technology, fascination with CIS, and the possibility of greater earning capacity.

Key Findings

Analysis of the collected data revealed that factors included:

- a) Encouraging male role models.
- b) Positive early introduction to computers /technology, in the home, school, and workplace.
- c) Demonstrations of a natural affinity to problem solve and meet challenges.
- d) Perception of financial security in the form of higher wages in the IT field.

The rapid assimilation of technology in the workplace during the 1990's was also spoken of in terms of the need to learn more about IT, how to use it, and how it works. When asked to tell the interviewer something about when they first became interested in the field of IT, participant responses indicated that women's interest and motivation to study CIS was sparked in school, and some even later, while in the workplace. The later school years, high school or college, are mentioned most often. No one

spoke of elementary school as being the start of their interest in CIS. It seems that early exploration into computers was the exception instead of the rule. Only two participants telling of early exposure to computers and technology, and both of these instances were in the home and not school.

What Sparked Interest in Computers

Many of the responses centered on enjoyment gained from solving problems and figuring out how something works. One participant found that, "I like to know how things work. I also like solving puzzles. Since computers are such a large part of society today, it would be helpful to know how they work and affect our everyday lives." Other comments made that described real joy and the word "fascination" with CIS was used repeatedly. "...just how fascinating it is" and, "... fascination with the capabilities of computers and the technology associated with them."

What seemed to interest the participants the most was the appeal of making something work, utilizing their logical thinking skills for problem solving and exploring unknown possibilities.

5. DISCUSSION

The strongest influential factor revealed by the women interviewed was the impact of male role models on their decision to enter into the study of CIS. Of the women interviewed, 92% responded that a male role model introduced them to, or encouraged them to, explore computers and technology. For the majority of the women, this male influence on their attitude toward CIS was positive and had an effect on their eventual decisions concerning the entry into the study of CIS. Given that men are often assumed to be more confident when dealing with technology, it can be argued that this positive attitude is transferred to the female when she is introduced to CIS.

Another factor that influences women's choice of a college major is early positive exposure to computers and technology. It can be argued that introducing girls at a young age to technology and CIS can counteract the influences of a culture and society that links success with commuters and technology to boys and men. This finding is

supported by an AAUW study which reported, "Existing science and technology after school programs and summer camps tend to reach out to girls in high school. These activities are important, but they may come too late. Girls seem to form beliefs about their relationships with technology when they are quite young" (Tech-Savvy, 2000).

The finding that a natural affinity to problem solve and meet challenges was a factor in the decision to study CIS is surprising and is not in agreement with some previous research. Almost half of the participants responded that they liked the excitement and challenge of using technology to solve problems and discovering how to make something work.

In support of finding that a natural affinity to problem solve and meet challenges is a factor in the decision of some women to enter the study of CIS, Trauth states, "... she learned through self-study and training courses and is motivated by the desire for new challenges" (Trauth, 2002). The basic nature of CIS is a challenge for problem resolution and it stands to reason that it would appeal to individuals gifted with these talents and be a factor in their decision process as to a course of study. As stated by one participant, "I enjoy the challenges related to being an independent women in a predominantly male oriented environment, as an example - I am a state certified welder."

Finally, the perception of financial security in the form of higher wages in the IT field was mentioned by almost every participant as a deciding factor for entering the study of CIS. As the current economy recovers, the demand for IT workers will rise. Much previous research (Cukier et. all, 2002; Woratschek & Lenox, 2002; Furger, 1998; Frenkel, 1990) has pointed to the wide variety of possibilities as a career path within IT that can utilize natural skills and ability within the field and the role this plays when deciding a course of study. With women currently accounting for 47% of the total workforce, it can be said that women with a CIS degree will have a wedge as entry into the lucrative IT job market, which is what the participants are counting on (US Dept. of Labor, 2003).

Therefore, it can be argued that the chances for a female to pursue an education in CIS can be high if a female has all of the first

three factors present: 1) male role models that welcome female participation in activities with computers and technology, 2) early introduction to technology and CIS and 3) an affinity for problem solving. Add to that 4) the possibility of a lucrative job, and you have a formula for narrowing the gender gap in the numbers of women to the numbers of men pursuing an undergraduate degree in CIS.

6. RECOMMENDATIONS

There have been numerous studies that have recommended multiple programs and interventions to broaden participation in the study of CIS. These have included programs outside of academia that involve corporate mentoring partnerships, attempts at breaking the glass ceiling for women in the IT field, and redesign for gender compatible technology product production. Programs instituted within academics have involved early intervention for exposure to technology and computers, girls-only programs, and curriculum design to be more "female friendly." All of these initiatives, and more, have met some level of success but the numbers still continue to drop and the gender gap continues to widen.

Recommendation 1: revisit some programs that were instituted and reevaluate what has worked, continues to work, or no longer is having an impact on the entry of women into, remaining in, or leaving the study of CIS in the hope of discovering why the numbers continue to fall.

Recommendation 2: further study into where the current female student in CIS is transitioning from. Are they progressive secondary school programs, transfer students from other higher academic institutions or technical schools, or from the corporate world offering educational incentives? Research concerning these questions can reveal not only those areas that are successful at funneling women into IT, and why they are successful, but can also identify areas that are being neglected as a resource for female recruitment into CIS programs.

The women that participated in this study revealed the ongoing influence that family have, particularly of male relatives, on their interest in and enthusiasm for CIS. The participant responses support what many social

and cultural studies reveal, that early positive introduction to CIS instills a sense of confidence that is an asset when confronted with barriers to entry into the study of CIS. The women of this study that expressed liking the competitive challenge and the thrill of figuring out how things work are no different than any male that would express the same traits.

The issues revolving around the gender gap within the IT field are varied and complex. Only by the continued exploration of the issues, and open dialogue in evaluating what is discovered, can we hope to shrink that gender gap and reach gender equality. The importance of continued research on the topic of women and CIS is stated succinctly by Margolis. "In this age of information technology, the issue of who is drawn into the world of computer technology and the values people bring is crucial to almost every aspect of the nation's future social, economic and political development."

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APPENDIX A: INTERVIEW QUESTIONS

A. Entry into a CIS program:

1. Tell me about you and information science.
 - a. When did you first become interested in the field?
 - b. What interested you about information science?
 - c. Did anyone play a part or spark your interest in the field?
 - d. Where were you when you became interested?
 - e. Were there certain experiences that played a part in your decision?
 - f. Were you influenced by any particular incident?
2. In your own words, can you describe why you decided to enter into a Computer Information Science (CIS) degree program?

B. Remaining in a CIS program:

1. Can you describe for me some of your experiences in the program that influenced you to stay?
 - a. Are there any incidents that influenced your decision to stay?
 - b. Has there been any one person or group of people that played a role in your decision to continue the program?
 - c. Has there been any particular subjects that you studied that played a role. in the decision to continue to pursue a CIS degree?
 - d. We you considered leaving the program at any time?

C. Leaving the program:

1. In your own words, can you describe why you decided to leave the information science (CIS) degree program?
 - a. Were there certain experiences that played a part in your decision?
 - b. Were you influenced by any particular incident?
 - c. Can you tell be me about any particular incidents that influenced your decision to leave?
 - d. Did any person or persons influence you in your decision to leave the CIS degree program?

D. Ask all participants:

1. Do you have any ideas as to what should be changed in order to have more women enter into the CIS field of study?
2. What advice would you offer to another female considering entering into the CIS field of study?

APPENDIX B: TABLE*Table 1: University Female Enrollment in Information Science Degree Major by Academic Year*

Academic Year	Enrolled Females	Enrolled Males	Total Students
1998 – 1999	63	125	188
1999 – 2000	59	171	230
2000 – 2001	44	259	303
2001 – 2002	51	288	339
2002 – 2003	33	310	343
2003 – 2004	23	298	321
2004 – 2005	7	238	245
Total	280	1689	1969