Perceptions of Information Technology Careers among Women in Career Development Transition

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Many women come to computer science and information technology (IT) from nontraditional paths. This study examines attitudes toward computer/IT careers among women, mostly employed, who are considering career options. Most of the 42 women in this questionnaire study were attending career transition workshops conducted by non-profit organizations. Specifically the study focuses on computer usage and personal knowledge of women in IT in relation to attitudes toward computer/IT jobs, aspects of the IT work environment, and preparation for computer/IT careers. Consistent with recent studies, the women have positive attitudes toward computers and IT. Computer usage is positively associated with perceptions of creativity and variety in IT careers. The findings suggest there may be value in marketing computer/IT careers as creative activities and marketing computer/IT careers to women who are already in the work force.

Women are underrepresented in computer and information technology jobs. The 2000 United States Census found women were nearly half of the total workforce in the United States economy but only 30% of the workforce in information technology (IT) (Smith, 2004). The underrepresentation of women in IT is also occurring in other countries, such as Australia (e.g., Trauth, Nielsen, & von Hellens, 2003). In fiscal year 2006 the National Science Foundation allocated $14 million for college recruitment of women and minorities for computer science (Foster, 2005) to address this disparity. While obtaining an undergraduate degree in computer science or IT is the traditional path to enter these careers, it is not the only path.

Turner, Bernt, and Pecora (2002) remind us that "the field of information technology is a roadway with many on-ramps" (p. 16). They suggest IT professionals and educators need a better understanding of those who enter IT and computer science nontraditionally. They note, "for many successful women, interest and talent in IT emerged gradually and developed over time" (p. 16).

The study reported here builds on and extends the literature on women's perceptions of IT and computer science careers. In the literature, researchers have surveyed women who are computer science and IT professionals, undergraduate college students who are IT majors, computer science majors, other majors, or undeclared majors, and young women and girls in high school or earlier educational settings. The research we report is an exploratory study of IT and computer science careers as perceived by women in career development transitions. The women in this study were not IT professionals, students majoring in IT, or women who had

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decided on a career move to IT or computer science. The participants in this study were women, employed and unemployed, who were considering career options at different stages of their lives.

RELATED LITERATURE

Why are women underrepresented in the computer and IT work force? Researchers studying the problem have identified or postulated a variety of contributing factors. Some factors are socio-cultural or societal, such as sex role stereotyping, perceived gender appropriate goals and careers, or inaccurate stereotypes of the IT professional. Both IT and computer science have been, and remain, male-dominated professions. The issue of women succeeding in masculine organizational cultures is not unique to IT and computer science, however. The underrepresentation of women in IT suggests that contextual barriers to IT careers may be more problematic than in some other male-dominated careers. Smith (2004) found that among undergraduate IT majors, women perceived significantly more potential career barriers (i.e., job search, job performance, life-job balance) than did men.

Other studies focused on the individual's interests, behaviors and aptitudes, for example, and her educational and familial experiences. Abernathy (1999) suggested positive experiences with computers are the best predictors for future computer-related activities, including enrollment in computer science courses. Grupta and Houtz (2000) reported a "strong positive correlation between the time that girls spend on computers and their attitude toward computers" (p.7).

In earlier decades studies found significant gender differences in computer usage. It can be argued that differences in computer usage between girls and boys have been significantly reduced or eliminated in this era of the Internet, e-mail, instant messaging, and music downloads. In a study of 430 high school and college students, Creamer, Burger, and Meszaros (2004) found no differences in usage, determining that "on many dimensions, women and men are more alike than different" (p.72). They concluded that the lower interest in IT by women "cannot be explained by a lack of computer use or stereotypical views about computer users" (p. 73). In a study conducted in Sweden, Enochsson (2005) found young girls have as much interest in computers and use computers as much as young boys. Ray, Sormunen, and Harris (1999), in a survey of college students, found women actually had more positive attitudes toward computers than did men.

Unfortunately for the IT and computer science professions, for many young women, interest in computers does not translate into an interest in IT or computer science as careers. Creamer, Burger, and Meszaros (2004) found young women who were very interested in computers and used them regularly did not view IT as a career option. Foster (2005) noted that, according to the Higher Education Research Institute, from 1998 to 2004, "women's interest in computer science fell 80 percent" (p. A32). The Higher Education Research Institute (Sax et al., 2004) reported nationwide that first year college women expressed little interest in computer science as a major, only .3%.

Surveying undergraduates at a Midwestern university, Smith (2005) found women received less encouragement to master computer skills than men received. Ambrose, Dunkle, Lazarus, Nair, and Harkus (1997) suggested that there would be more women in technology if young women were encouraged to develop the skill set necessary to be successfully employed in technological careers. For example, interviews with successful women in engineering found almost all of them had family support and role models. Polling tenth grade students, Furger (1998) reported 60% of girls never talked with parents about science or technology topics whereas only 45% of the boys reported never discussing such topics with their parents. Turner et al. (2002) surveyed members of Systers, a listserv for women in IT. For the 275 women who responded, fathers were cited as encouraging by 42% and high school teachers by 37%. For women who earned an undergraduate degree in IT or computer science, by far the most important influences on their career choices were family and teachers, the most frequently mentioned influence being fathers. Turner et al.

found fathers were described in very active terms, for example, "his love of engineering and software development was infectious" (p. 9). Influential mothers were described more passively, for example, as encouraging or setting an example. Adya and Kaiser (2005) concluded, "parents, particularly fathers, are the key influencers of girls' choice of IT careers" (p. 230).

On the other hand, Turner et al. (2002) found that for some women in IT, education professionals were discouraging. High school teachers were mentioned as discouraging by 17% of the women and guidance counselors by 12%. Grupta and Houtz (2000) quoted H. George Friedman, director of undergraduate computer science programs at the University of Illinois, "Somehow teachers or kids are pushing the idea that this is not a field for girls" (p. 6). Margolis and Fisher (2002) argue that "students, parents, and school counselors do not understand how students can benefit from studying computer science" (p. 37). Ray et al. (1999) suggested educators are influenced by socio-cultural assumptions about IT and computer science and "steer women away" (p. 2).

According to Othman and Latih (2006), the socio-cultural influences in Malaysia are positive for women in computer science. Women and men pursue undergraduate computer science degrees in near equal numbers. Describing two leading Malaysian universities, Othman and Latih found most key administrators and the majority of the computer science faculties were women. They concluded that because of the prevalence of female role models and mentors, for young Malaysian women "pursuing a career in CS/IT is a normal, indeed, unremarkable option" (p. 114).

Australian researchers (von Hellens & Nielsen, 2001; von Hellens, Nielsen, & Trauth, 2001) reported young women viewed IT as difficult and boring. Recent studies in the United States have been more positive. Weinberger (2004) found few college women who perceived IT as social ostracism or eliminated it as a possible major because of career and family conflicts. Creamer et al. (2004) reported young women with an interest in technology viewed IT professionals much more positively than women with no interest in technology. These young women viewed IT workers as "interesting, hardworking, and smart" (p. 74). Richard Rashid, a senior vice president at Microsoft, has suggested to educators, "You need to talk about the romance of the field. It's not all about people sitting in cubicles eating pizza and typing away endless hours on a keyboard" (Foster, 2005, p. A32).

The identification of computers with science and mathematics may have facilitated a gender difference in views of technology (Ray et al., 1999). Interviewing women IT professionals in Australia, Trauth et al. (2003) found all had supportive educational experiences in mathematics. Those interviewed attended schools that emphasized science and mathematics or grew up in national cultures where science and engineering were not male domains, such as in Scandinavian countries. Trauth et al. concluded positive experiences with mathematics were key factors for women entering IT. Surveying Malaysian women majoring in computer science/IT, Othman and Latih (2006) found 51% answered "strongly agree" when asked if they liked mathematics. In another study (von Hellens et al., 2001) found young women often were advised away from IT because mathematics and IT are "boys' stuff." The American Association of University Women (1995), noting that the subjects women study significantly affect later opportunities, called for a strong foundation in mathematics in school curricula.

Surveying women in career development transitions, we examined several questions about perceptions of computer/IT careers suggested by the literature reviewed. Do women who report high computer usage differ from those who report less computer usage in their attitudes toward computer/IT jobs, aspects of the IT work environment, and preparation for computer/IT careers? Do women who know women in computer/IT positions differ from those who do not know women in these positions in their attitudes toward computer/IT jobs, aspects of an IT work environment, and preparation for computer/IT careers?

METHOD

In this section we describe the women who participated in the study, how the study was conducted, the development of the questionnaire, and the measures developed to address the research questions.

PARTICIPANTS

The women who participated in this study were a convenience sample obtained from three organizations in a Midwestern city. Of the 42 participants, over 75% (32) were women who attended workshops for guidance and career transition assistance at one of two not-for-profit organizations whose missions included helping women with life and career transitions. Ten participants were in a community college course designed to improve job-oriented computer skills.

Ages of the participants ranged considerably with 14% between 18 and 25, 33% between 26 and 35, 38% between 36 and 45, and 15% over 45. Almost half (49%) were married. The educational level was above average with over half (51%) being college graduates. However, 32% had only a high school degree or technical training and no college experience. Over 70% were employed. Annual household income ranged from less than $10,000 (12%) to over $60,000 (34%). Only household income data were obtained.

PROCEDURE

With organizational approval, women were offered the opportunity to participate in this study during career transition workshops at the two not-for-profit organizations and in a course-related project at the community college. Participation was voluntary and without remuneration. Women who chose to complete the questionnaires placed the completed questionnaires in envelopes and inserted the envelopes into a data collection box. Upon completion of the data collection for the study, questionnaires were reviewed for completeness and consistency. All questionnaires obtained were included in the study.

INSTRUMENT

The questionnaire was developed based on the review of the literature and discussions with women in IT. The instrument assessed computer usage, attitudes toward computer/IT jobs, perceptions of the IT work environment, and preparation for computer/IT careers. Questionnaire items were created, refined, and administered to a small sample of women in IT to ensure clarity. The questionnaire included 5 demographic questions, 8 computer usage questions, 12 attitudinal items, and 1 knowledge question. The five-point Likert-type attitudinal items are shown in Table 1. Computer usage items determined the participants' computer use at home, work, and school, as well as their Internet use at home, work, and school. These items were also measured using the five-point "strongly agree" to "strongly disagree" response alternatives. The attitudinal and computer usage items were constructed such that smaller values indicated positive agreement with statements. The knowledge question, described in the next section, asked if the participant knew any women working in IT.

MEASURES

The independent variables used to answer the research questions were a computer usage index and personal knowledge of women in computer/IT. To construct the computer usage index, we correlated the eight statements concerning use of computers and the Internet. From the resulting inter-item correlation matrix we identified four items for the index. Cronbach's alpha for internal consistency of these items was .775. While .8 and above is considered the standard for developed inventories, in exploratory work an alpha of .6 is acceptable (Israel, 1992). Table 2 shows the four items in the index and correlations. The value for computer usage was the sum of these four items, where the lower number indicated greater usage.

To determine if participants had female role models in computers/IT, the questionnaire asked a simple dichotomous question, "Do you know

Table 1. Means and Standard Deviations of Attitudinal Statements

Statement	Percent Agree	Percent Disagree	Percent Neutral	Mean[a]	SD
16. There are many different types of jobs in Computer/Information Technology careers.	92	8	0	1.58	1.01
17. Working in Computer/Information Technology careers requires a strong math and science background.	58	20	22	2.39	1.05
18. Computer/Information Technology careers can be very creative.	88	5	7	1.83	.86
19. Most women would NOT choose a career in Computer/Information Technology careers because of the amount of training involved.	24	73	3	3.68	1.25
20. Most women would NOT choose a career in Computer/Information Technology industry because they have not had a lot of computer experience.	37	56	7	3.29	1.33
21. Computer/Information Technology careers are better suited for men.	10	90	0	4.40	.99
22. I would enjoy a career that involves a lot of problem solving.	79	12	9	2.00	1.10
23. I can get used to a job that sometimes requires long work hours.	69	17	14	2.29	1.18
24. I would enjoy a career that involves a fast-paced, ever-changing work environment.	81	12	7	2.05	.99
25. I would not mind working with a boss who is younger than me.	81	14	5	2.02	1.05
26. I would enjoy a career that involves a predominately male working environment.	52	22	26	2.62	1.12
27. I was encouraged to take math and science classes in school.	48	42	10	2.81	1.14

Note. Scale was five points from (1) Strongly agree to (5) Strongly Disagree. The Percent Agree column includes both Agree and Strongly Agree responses. Percent Disagree includes both Disagree and Strongly Disagree responses.
[a] N ranged from 40 to 42.

women who currently work in Computer/ Information Technology positions?" The response alternatives were "yes" and "no."

Dependent variables focused on attitudes toward computer/IT jobs, attitudes related to characteristics of an IT work environment, and preparation for computer/IT careers. Attitude toward computer/IT jobs was assessed using a summative index constructed from four items (16, 18, 21, 22 in Table 1) where Item 21 was reverse scored. These items address different aspects of job variety: types of jobs, creativity, problem solving, and gender roles. Cronbach's alpha for the job variety index was .742.

To assess attitudes toward characteristics of an IT work environment, we constructed an IT culture index. Items 23, 24, and 25 addressed attitudes toward long hours, a fast changing work environment, and working for younger supervisors. Cronbach's alpha for this index was .636.

Four items addressed preparation for computer/IT careers. Items 17 and 27 were concerned with math and science, while items 19 and 20 dealt with training and computer experience. Only items 19 and 20 had a significant inter-item

Table 2. Inter-Item Correlations for Computer Usage Index[a]

Statement	8	9	12	13
8. I use a computer at home.	---			
9. I use a computer at work.	.314*	---		
12. I use the Internet at home.	.552**	.413**	---	
13. I use the Internet at work.	.304	.833**	.379*	---

[a] Cronbach's alpha = .775
* $p \leq .05$
** $p \leq .01$

correlation for a summative index. Cronbach's alpha for the training index was .835.

Data Analysis

For descriptive analyses, we constructed frequency distributions, means, and standard deviations. We then examined the association among items using Pearson product moment and Spearman rho correlations as appropriate. These were used in creating the summative measures for the parametric analyses.

For our computer usage independent variable, we defined high computer usage as those participants who answered "strongly agree" to each of the four items in the computer usage index. Mean differences between high computer users and the other respondents on the three dependent variables, job variety, IT culture, and training were tested using t-tests. Likewise, t-tests were used to test mean differences between participants who reported having women as role models versus those who did not. Given the exploratory nature of the study, all hypotheses were two-tailed.

Finally, we conducted several post hoc analyses using Spearman rho correlations and Mann-Whitney U tests to examine the demographic items in relation to the indexes and attitudinal items.

Results

Table 1 shows the overall responses to the attitudinal items. For this table, we combined "strongly agree" and "agree" to indicate percent agreeing with the statement. Likewise, we combined "strongly disagree" and "disagree" for the percent disagreeing. The respondents agreed there is a variety of jobs in computers and IT (92%), these jobs can be creative (88%), and these positions are not better suited for men (90%). They did not see the amount of training as an obstacle to choosing computer/IT careers (73%). The majority did not see computer experience as an obstacle (56%), but some did (37%). Most perceived a background in math and science as necessary (58%). Respondents indicated they would enjoy a fast paced, changing work environment (81%) and problem solving (79%). They could get used to working long hours (69%) and would not mind working for someone younger (81%). Respondents were divided as to enjoying working in a predominantly male environment (52% agree, 48% disagree or neutral). Responses to this item would have been more easily interpreted if we had included additional similar items, for example, "I would not mind working in a male-dominated environment."

The first research question focused on differences in perceptions between women who reported high computer usage and women who reported less usage. Overall, participants used computers extensively at home (95%) and at work (79%) as well as using the Internet (90% home, 71% work). However, only 16 (38%) met the criterion for high usage. Table 3 summarizes the results of the t-tests. The participants who most strongly affirmed their computer usage, the high computer users, expressed significantly more positive attitudes toward the variety in computer/IT jobs and toward the IT culture ($p < .05$). However, there was no difference between high computer users and low computer users on training and preparation for IT. Overall, computer usage was significantly correlated with the job variety index ($r = .351$, $p = .033$).

Table 3. Summary of Mean Differences Based on Computer Usage

Variable	Group	n	M	SD	t	df	p
Job Variety	High Computer Usage	15[a]	5.87	1.81	-2.32	35	.027
	Less Computer Usage	22	7.86	2.98			
IT Culture	High Computer Usage	16	5.38	2.36	-2.06	36	.046
	Less Computer Usage	22	6.82	1.94			
Training	High Computer Usage	16	6.44	2.87	-1.04	26.32	.309
	Less Computer Usage	22	7.32	2.12			

Note. All tests are two-tailed.

[a] This n is different because one participant omitted an item in the Job Variety index.

The second research question examined differences between women who reported knowing women in computer/IT positions with those women who did not. In the sample 30 women (75%) indicated they knew women in computer/IT positions. T-tests between these two groups comparing means on job variety, IT culture, and training found no significant differences. Post hoc we examined this variable in relation to the four summary indexes and the 11 attitudinal items using Mann-Whitney U tests and Spearman rho correlations. The only significant association ($p = .05$, two-tailed) was the correlation with Item 18. Perceiving computer/IT careers as creative was positively associated with knowing women in computer/IT positions.

Two other findings from the exploratory post hoc analyses using the demographic items are worth noting. First, participants with higher household incomes reported significantly higher computer usage ($t = -2.79$, $df = 18.3$, $p = .012$). Second, there was a significant difference between women over the age of 35 and younger women on Item 27. Younger women tended to agree they had been encouraged to take math and science in school ($M = 2.15$) whereas older women did not ($M = 3.41$), (Mann-Whitney U, $z = -2.947$, $p = .003$).

Discussion

This study adds a new voice to the literature on women and IT, the voice of women in career development transitions. We surveyed women across a broad spectrum of ages, incomes, and education levels. Most of the participants were women who attended workshops on career and job transitions. Some participants were working to improve job-related computer skills. Women who had chosen these activities were invited to participate in this study. In retrospect, we should have gathered additional information about these women in transition to more precisely define the sample. This is a limitation of this study.

We explored the attitudes of these women toward computer/IT jobs, the IT work environment, and preparation for computer/IT careers. Our findings are consistent with recent studies which have found women with positive attitudes toward computers and IT (e.g., Creamer et al., 2004; Ray et al., 1999; Weinberger, 2004; Wright, 1999). Furthermore, most of the women in this study perceived no problem with long hours and a fast-paced environment. They did not see computer and IT careers as better suited for men.

Working in a male-dominated environment was more of a concern. Interpreting this item in our survey is problematic due to our phrasing the item as "enjoy." One might find working in a male-dominated environment acceptable but not enjoyable. To what degree is the masculine culture of IT a barrier? How is the masculine culture of IT different from other careers with masculine cultures? For example, to what degree are the career barriers identified by Smith (2004) more pronounced for women in IT than for women in other organizations? We suggest research is needed to address specifically this question: Are there dysfunctional norms or roles unique to the masculine culture of IT? However, unique or not, issues associated with masculine cultures should be addressed in the training and education through which our future computer and IT professionals are socialized into their careers.

This study underscores that computer science and IT careers can be perceived, and perhaps more effectively marketed to women, as creative activities. About 90% of the women we surveyed perceived computer and IT careers as creative. Richard Rashid of Microsoft (cited by Foster, 2005) called for educators to talk more about the romance of computers and IT careers. Olsen (2000) argued that outreach programs for teenage girls should emphasize the creativity inherent in computer careers. Our finding is consistent with Kuhn and Rayman (2006) who found puzzle solving to be one of the most attractive aspects of IT. Interviewing 200 IT professionals, they "were struck" by how many interviewees saw their work as solving puzzles. As one interviewee noted, "It's like getting paid to do the crossword puzzle." (p. 50). We suggest that any multiattribute marketing model (see Wilkie & Pessemier, 1973) to increase the number of women in computer and IT careers should include beliefs about creativity, puzzle solving, and variety as attributes in the model.

We found computer usage to be positively associated with perceptions of computers and IT careers as varied and creative. Moreover, the women defined in this study as high computer users had the strongest positive attitudes toward computer/IT careers and the IT work environment. These findings are consistent with previous research that reported positive correlations between computer usage and attitudes toward computers (Abernathy, 1999; Grupta & Houtz, 2000) and technology-related careers (Creamer et al., 2004).

Our post hoc finding of higher computer usage among higher income participants should be noted. While this finding may be spurious due to the multiple post hoc analyses or confounding variables such as aptitudes or skills, it is reasonable that higher income participants had greater means and opportunities to use computers. This finding supports Dholakia (2006) who suggested economic resources are a major constraint in computer and Internet usage. Another factor could be employment status. Controlling for time at work, Ono and Zavodny (2005) found in the United States that people in part-time employment have fewer opportunities to use computers at work than those employed full-time.

Women who knew women in computer and IT positions did not differ from those who did not in our summative attitudinal measures. This may be due to the small number of women who did not know women in computers and IT positions. Post hoc, we did find knowledge of women in computers/IT associated positively with perceptions of computer and IT careers as creative. If confirmed by further research, this would support more active efforts to expose young women to female computer/IT role models.

As Turner et al. (2002) reminded us, women come to computer and IT careers from different paths. In their survey of members of Systers, a listserv of women involved in the more technical side of IT, Turner et al. found less than 50% had computer science or IT undergraduate or graduate degrees. Only a third had majored in CS/IT as undergraduates. One of every three women surveyed came to CS/IT nontraditionally. These women earned undergraduate degrees in the humanities, the social sciences, and the arts. Eventually, after other job experiences, they pursued computer/IT careers.

Kuhn and Rayman (2006) reported similar findings. In an Internet survey of nearly 1,700 men and women in software and Internet companies, they found less than 50% had computer science or information science degrees. In response to the item, "When graduating from high school, I considered a career in the technology field," only 16% of the women replied "very seriously" compared to 41% of the men. Over half of the women replied "not seriously at all." Kuhn and Rayman stated this was the largest gender difference in their study. They commented:

> We can only speculate about the effect of this early lack of interest on the later careers of these women, but we also find it very hopeful to see that, contrary to today's conventional wisdom, women who do not catch the "technology bug" before high school graduation can still enter technical careers (p. 49).

Perhaps part of the solution to the underrepresentation of women in computer science and IT is to market computer/IT careers to women who are already in the workplace. The women in our study were women in transition and had positive attitudes toward computer/IT careers, especially those who reported more computer usage. Future research needs to explore how women come to computer science and/or IT careers from nontraditional paths and what we as educators and professionals can do to assist them.

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