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ABSTRACT

The educational, social, and familial influences that lead women to choose information technology (IT) careers were examined in an online survey. Of the 2,500 women who were employed in IT careers in 38 countries and who belonged to the IT professional organization, Systers, 275 responded to the online survey (11% response rate). The respondents ranged in age from 22 to 64 years (38 years mean age) and they had spent a mean of 10.5 years in the IT field. School experiences were an important influence on the respondents. Many respondents were first introduced to computers in school, and they took seriously the encouragement or discouragement of their teachers in high school and college. A significant number of respondents cited male friends and colleagues as powerful influences in their career decisions. Only half the successful IT women had majored in traditional technical fields as undergraduates. Nearly one-third of the women entered the "IT pipeline" directly by majoring in computer science or information systems as an undergraduate; however, nearly one-third had majored in the arts, social sciences, or humanities and entered the IT field in "little increments" through on-the-job experiences and encouragement from mentors or close male friends. Others switched to computer science at the graduate level. (Contains 26 references.) (MN)

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Why Women Choose Information Technology Careers: Educational, Social, and Familial Influences

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*Why Women Choose Information Technology Careers:
Educational, Social, and Familial Influences*

Statement of the Problem

Despite the growing need for information technology (IT) workers, women are not stepping forward in significant numbers to take advantage of the career opportunities presented in the IT field. As a recent presidential report noted, “Women participate in both computer science and engineering at low rates for all degrees and subsequently in academia and industry” (President’s Information Technology Advisory Committee, February 1999). An important preliminary step in formulating strategies to encourage women to pursue IT careers may be to examine the reasons why some women have chosen such a career path. An analysis of the influences and experiences that informed their decisions may help shape the policies and approaches taken by educators, industry leaders, and policy makers who wish to expand women’s career choices. It is the purpose of this study to take this preliminary step by analyzing the educational, social, and familial influences that have led some women to pursue IT careers.

Background

Though women were the programmers of ENIAC, America’s first electronic computer (Light, 1999), today women are dramatically under-represented in the information technology field. As noted in a recent AAUW-sponsored report, women hold only 20% of IT jobs (AAUW, 2000). This situation may not improve soon, because women have not been preparing themselves for jobs in information technology. According to the Department of Education, in 1995, women earned only 17% of bachelor’s degrees in engineering, 9% of the bachelor’s degrees in engineering-related technologies, and 28% of bachelor’s degrees in computer or information sciences (AAUW, 2000).

There have been many efforts during the past 15 years to identify the reasons for the under-representation of women in the IT field. Many of these studies have focused on girls’ educational experiences, examining their experiences and attitudes before they select a career. Such studies have analyzed how young girls inter-relate with computers (Evard, 1996; Furger, 1998; Huber & Schofield, 1998; Levin & Barry, 1997), how teachers feel about

technology (AAUW, 2000; Holden, 1997), and how young girls regard hackers and other elements of computer culture (Turkle, 1984, 1988). Studies have also documented gender differences in computer attitudes, experiences, and classroom environments (Brosnan, 1998; Edwards, 1997; Joiner, Messer, Light, & Littleton, 1998; Levine & Donitsa-Schmidt, 1995; Libsch & Breslow, 2000; Margolis & Fisher, 2002), and young women's aspirations regarding computer-related careers (Crombie, Abarbanel, & Anderson, 2000; O'Grady, 1993; Stepulevage & Plumeridge, 1998).

While some studies have focused on the experiences of young girls, other studies have examined the experiences of women once they have selected an IT career. For example, women in IT careers have been surveyed about their salaries, career prospects, and job satisfaction levels (Baroudi & Igbaria, 1995; McIlwee & Robinson, 1992; Wright, 1996, 1997). These studies have emphasized women's experiences once in the field; their focus has not been on analyzing the influences that drew women to IT in the first place. This study focuses on the influences that successful women in IT cite as being the dominant forces that led them to their career choice.

Methodology

The primary research question this study sought to answer was: What are the educational, social, and familial experiences that women in information technology cite as influential in their decision to pursue a career in the IT field? To address this question, a survey was designed with both short-answer and open-ended questions. The survey asked the respondents about their educational experiences, their initial exposure to computers, their parents' occupations, and their own career histories. The survey also asked them to identify and assess the influences that led them to IT. The open-ended questions provided substantial space for extensive responses.

Because IT encompasses a wide scope of job functions (Bureau of Labor Statistics, 2000), a survey of women in IT careers should not be tied to one company or one job title; nor should the survey be tied to one geographic location. An avenue for reaching women in a wide range of companies, IT job titles, and geographic areas is through professional organizations. One such organization is Systers, "an informal organization for technical women in computing that began in 1987 If you are a woman in the technical end of

computing, you are welcome” (Systers website, www.systers.org). The Systers membership is made up of women in the technical aspects of IT, those areas of IT that have been the least likely to be selected by women. Systers is a women-only listserv with over 2,500 members in 38 countries.

Access to the Systers membership is available only through postings to the Systers listserv; no direct solicitations are allowed. A message was posted to the listserv on April 21, 2001. The message contained an explanation of the project and a request for Systers members to complete an online survey. A URL, hotlinked to the survey, was provided in the message. In all, 275 Systers members responded to the survey. Prior to being posted, the survey instrument was reviewed by experts in the field and piloted with six women in IT careers.

It is important to recognize both the limitations and the value of the survey results. Because of the response rate (275 out of 2,500 members), the survey results cannot be seen as representative of the whole Systers membership. Indeed, the voluntary nature of the survey precludes such treatment. However, the survey results do provide an opportunity to examine the experiences of a specific group of women who are not only involved in IT work, but who find the issue of women’s involvement in IT of sufficient significance to evaluate their own experiences in order to add their perspectives to the discussion of this issue. While their responses cannot be regarded as statistically representative of women’s experiences in general, their perceptions and their stories do provide valuable insights about the issues facing women who pursue careers in the IT field. It is possible to garner valuable lessons from their stories.

Results

Characteristics of Respondents

The 275 women who responded to the survey ranged in age from 22-64 with a mean age of 38. Most (59%) were between the ages of 30-50. Their current job titles covered a broad range of IT positions: software engineer, network administrator, programmer, systems analyst, Web developer, IT manager, database administrator, technical writer, application developer, quality assurance engineer, director of student computing, professor, multimedia consultant, and CEO. The number of years the women had been employed in an IT career

ranged from one year to 40 years, with a mean of 10.5 years. Although the women had grown up in 17 different countries, the great majority (87%) had lived most of their childhood in the U.S. More than half grew up in suburban areas. Over 87% reported being college educated; 34% reported having Masters degrees, and 10% reported having doctoral degrees. Of those with Bachelor degrees, 25% majored in computer science, 15% in math, 6% in engineering, 4% in MIS, while nearly half majored in non-technical disciplines in the humanities and social sciences.

First Computer Use

When asked where they first used a computer, half of the women reported that their first computer use was in school, while 23% reported their first use as being at home. The age at which they first used a computer ranged from 2 to 45 years, with a mean age of 17. As would be expected, the younger the women, the earlier their initial use of computers ($r = .78$). Nearly half of the older women who first used a computer at 25 years of age or older experienced that first use at work; however, 57% of the younger women who started using computers between the ages of 6 and 21 reported that their first computer use was in school. This suggests that school is one important influence in introducing today's young women to computers.

Parents' Occupations

The women were asked to provide their fathers' and their mothers' occupations. Seventy-three (27%) of the fathers held jobs that could be considered technical, with technical being interpreted as jobs in engineering, computer science, mathematics, physics, or chemistry. The vast majority of the 73 technical jobs held by the fathers of these women contained the word "engineer" in the title. The proportion of fathers with technical jobs (27%) far exceeds the proportion of people engaged in these jobs nationally. According to the U.S. Bureau of Labor Statistics, in the year 2000, people working in occupations falling into the categories "architecture and engineering," "computer and mathematical," and "life, physical, and social science," comprised 5.1% of the workforce (Bureau of Labor Statistics, November 2001).

While the proportion of fathers working in technical occupations was five times the percentage of technical workers in the general workforce, the number of mothers identified as working in technical occupations was less than half that percentage. Only six (2%) of the women listed their mothers' occupations as involving engineering, computer science, mathematics, physics, or chemistry. The high level of involvement of the fathers in technical careers, when coupled with the frequency with which these women listed fathers as influential forces in their career choices, suggests that fathers' career choices often may be an important factor in these women's occupational decisions.

Significant People

The survey asked the respondents to indicate whether a specific list of significant people in their lives had been encouraging, discouraging, neutral, or not involved regarding their decision to pursue information technology as a career. In general, the women reported more encouragement than discouragement. Those most frequently cited as encouraging were: father (42%), high school teacher (37%), close male friend (39%), mother (36%), close female friend (34%), male in an IT career (33%), and male professor (29%). Interestingly, some of the same categories of people were also noted as being among the most discouraging. Those most frequently reported as discouraging were: high school teacher (17%), guidance counselor (12%), and male professor (9%). These results indicate that these women regarded teachers and professors as a major influence on their career decisions, both positively and negatively. Parents and friends, on the other hand, were regarded as being encouraging but seldom discouraging. One interpretation is that young people expect their parents to be supportive whatever their aspirations.

The survey respondents were strongly influenced by male figures in their lives. When asked to identify the one most significant influence on their choosing IT as a career, 60% cited a male (close male friend, male working in IT, father, husband, or male teacher or professor). Only 20% cited a female as most influential, and another 20% said that the greatest influence had been their own initiative. Since men are more likely to be working in the IT field, it is not surprising that they are more influential than women.

Table 1. Frequency, Mean Age, and Mean Years in IT by College Major

	<i>Undergraduate Major</i>	<i>Graduate Major</i>	<i>Frequency</i>	<i>Mean Age</i>	<i>Mean Years in IT</i>
<i>CS/IT Degree Holders</i>	Computer science, information systems, IT-related field	Varies	84 (31%)	35.0	8.8
	Not computer science, information systems, or IT-related	Computer science, information systems, IT-related field	32 (12%)	40.9	12.1
<i>Non-CS/IT Degree Holders</i>	Arts, social sciences, or humanities	Not computer science, information systems or IT-related, if any	83 (31%)	38.2	9.7
	Technical, but not computer sciences, information systems, or IT-related	Not computer science, information systems or IT-related, if any	37 (14%)	42.5	13.9

Note: n = 275. Of the 275 survey respondents, 12% did not report an undergraduate major.

Multiple Academic Paths

One of the major findings of this study was that the women followed multiple academic paths to their current positions in the information technology field. The successful women in IT represented four categories with respect to their educational background (Table 1). Of these four groups, two groups followed a traditional academic path—an undergraduate or graduate degree in computer science, information systems, or another IT-related field—toward a successful IT career. Nearly one-third (31%) of the women took a traditional career path to IT by majoring in an IT-related field as an undergraduate; some of these women may have gone on to earn graduate degrees in IT-related fields, but the most salient fact for purposes of this study is that they earned IT-related degrees as undergraduates. These women represented the youngest of the four groups, with both the lowest mean age (35.0 years) and the fewest years working in IT (8.8 years). Another 12% of the women responding to the survey did not pursue an undergraduate IT major, instead they majored in various fields ranging from liberal arts to zoology (Table 2); however, these women then switched to IT and earned graduate degrees in an IT-related discipline. These women were

older than the IT undergraduate majors, with a mean age of 40.9 years; and they had worked longer in IT, with an average of 12.1 years in the field.

Table 2. Undergraduate and Graduate Degrees of Women Who Switched to IT Fields Through Advanced Degree Programs

<i>Undergraduate Major</i>	<i>Graduate Major</i>
Liberal Arts and Humanities	Information Systems (n=4) Computer Science (n=6) Telecommunications
Business or Management	Information Systems (n=2)
Chemistry	Computer Science
Engineering	Computer Science (n=4)
Math	Computer/Information Science (n=9)
Nursing	Computer Science
Zoology	Computer Science

On the other hand, two groups of women had no degrees in computer science, information systems, or other IT-related fields at either the undergraduate or graduate levels. A surprising number (31%) of these women in IT majored in the arts, social sciences, or humanities as undergraduates and entered the IT field through non-traditional means, primarily as a result of on-the-job experiences. These women represented the second youngest group, both in age and in IT experience (mean age of 38.2 and mean years in IT of 9.7). A smaller number (14%) majored as undergraduates in technical fields other than computer science, primarily mathematics and engineering, and did not go on to earn a graduate degree in an IT-related field (Table 3). Most of these women were able to use their technical degrees to enter the IT field, despite the lack of a degree in computer science, information systems, or another IT-related field. This group was the oldest of the four, ranging in age from 27 to 65, with a mean age of 42.9 years; and they had the most experience in IT, with an average of 13.9 years in the field. The fact that these women were older and had more years' experience in IT indicates that they were more likely to enter the IT field early, when degrees in computer science, information technology, and MIS were not readily available.

Table 3. Areas of Study for Women Who Entered the IT Field with Technical Degrees Other than IT Degrees

Accounting (n=2)
Aerospace Engineering
Biometry
Botany
Chemistry (n=3)
Electrical Engineering (n=3)
Genetics
Marine Science
Mathematics (n=17)
Medical Technology
Molecular Biology
Physics (n=4)

In addition to questions about degrees earned and parents' occupations, the survey included two open-ended questions:

1. Which people had the most influence on your decision to enter the IT field and why?
2. Was there some other experience that encouraged you to go into the IT field?

Nearly all the women responded by telling their personal experiences, with responses ranging from a few words to over 500 words. The primary factors discussed in these responses by all the women, regardless of whether they held IT-related degrees or not, fell into three major categories: influential people, influential experiences, and internal motivating factors.

While there are differences in emphasis among the four groups of women described above, their responses in general showed markedly similar themes regarding the influences that led them to pursue an IT career.

External Influences—People

The vast majority of the women who answered the survey identified a specific person, or persons, as having the most influence in steering them toward a career in IT. A small number wrote of a distinct lack of encouragement. One woman spoke of “non-existent [sic]

support,” while another said she “got no encouragement in school. NONE in college.” Parents, teachers, friends, husbands or boyfriends, and co-workers were mentioned as influential by women in all four of the groups described above; however, the frequency with which parents or teachers or co-workers were mentioned varied across the groups.

For the women with undergraduate IT majors, the most important influences were family members and teachers. Fathers were cited most frequently. Fathers emerged as important not only because of the frequency with which they were mentioned, but also because of the active role they were portrayed as playing in their daughters’ lives and decisions. Fathers were described as creating the opportunity for their daughters to learn about computing. Fathers’ attitudes toward computing had an influence, as exemplified by one woman’s explanation that, “my father had the most influence on my decision to enter the IT field. His love of engineering and software development was infectious.” These women not only responded to their fathers’ attitudes toward computing, but also were influenced by the desire to make their fathers proud of their achievements. This desire was exhibited in one woman’s explanation that whenever she and her father talked about IT, “he sounded proud of me that I was interested in it.” Unlike the active role assigned to fathers, the few women who mentioned their mothers as being most influential described their mothers’ involvement in much more passive terms, as being generally encouraging or as setting an example.

As would perhaps be expected of women who pursued IT-related undergraduate majors, teachers were important influences. Several women named teachers as being a primary influence in their decisions. Teachers at all levels—elementary school, high school, and college—were mentioned; most of those cited taught math or science, with some mention of computer science teachers. Just as with parents, female teachers were usually presented in a more passive context than were male teachers. Female teachers were cited as role models or as people to be admired. One woman wrote of a female computer science professor who was “very encouraging and a wonderful role model.” Male teachers, on the other hand, were described in a more dynamic context. One woman explained her involvement in computer science by talking about a specific male teacher who was “an excellent teacher and a dynamic speaker.” Teachers were also valued because of providing unique opportunities. For example, a woman applauded a male teacher for allowing her to work on special

projects, and by so doing giving her “the encouragement and confidence [she] needed to pursue a career in IT.”

While the women with undergraduate IT degrees were highly influenced by teachers, the women with non-IT technical undergraduate degrees were more likely to be influenced by family and friends than by teachers, with several of them mentioning male family members, mothers or peers as influences on their career choice. As an example, one woman cited her fiancé, who had “the vision to see that PCs would become a requirements for small businesses,” while another woman spoke of her father, who “talked about robots and artificial intelligence and all kinds of neat stuff.”

Unlike the women who held technical undergraduate degrees—both in IT-related and non-IT disciplines—the women with non-technical undergraduate degrees and no graduate degrees in IT were less likely to cite family members or teachers as most influencing their career decisions. These women were most often influenced by a boss or colleague at work, or by a friend already in the IT field who recognized their aptitude for computing and encouraged them to consider a job in information technology. A particularly salient example is the woman who rose through the ranks to president of a multimedia development company and who credited the network administrator where she had worked as an administrative assistant 13 years ago:

My mentor always said that he knew I could do it, that he had complete faith in me. I didn't have any business career goals at the time; I had majored in drama and expected to emphasize my unpaid "work" in theatre rather than my "day job." But my mentor's belief in me helped changed my mind.

Some mentors encouraged the women to explore on their own and try to figure things out, while other mentors devoted considerable time to teaching their protégés what they knew.

Those women who were first educated in non-IT fields and then went on to receive a graduate IT degree overwhelmingly claimed to be influenced by a male teacher or college professor, female college faculty member, or boss, rather than a family member or friend. Sometimes the influence was somewhat subtle, as one woman, who received her undergraduate degree in math and music and later a Ph.D. in computer science, wrote when talking of her encouragement from an eleventh-grade teacher: “He always wondered why I did well in his CS class (I mean, he wondered out loud). However, he was a very good, very challenging teacher and furthermore, let us study AI in depth.” While these women were

often encouraged by family and friends, it appears they were far more likely to move into the IT fields based on mentoring relationships at work or support from college professors once they returned to school.

External Influences—Experiences

The survey respondents cited a range of experiences that were influential in leading them to a career in IT. Again, all four groups mentioned similar experiences—both in the classroom or on the job—but the emphasis and frequency with which these influences were mentioned varied across the four groups.

The most frequently mentioned influential experience for the women with undergraduate degrees in IT disciplines involved taking a programming course and deciding that computer science was the right career direction. Several women reported taking computer courses in high school or college and having a positive reaction that involved enjoying, liking, or even loving the experience. As one woman noted, “I ran into computers in school and discovered I enjoyed them.” In addition to course work, exposure to computer games and science fiction were mentioned as influential; and several women described in detail very specific experiences with computers that influenced their later career choice. For example, one woman ascribed her decision to take computer classes in high school to a desire to replicate the computer-generated picture her older brother—a computer science major—had made for her to color; [she] “thought it was really neat.”

The women with non-IT technical undergraduate degrees were more likely to be influenced by job opportunities in IT and the possibilities of a high income. Rather representative of the remarks made by the women when talking about job opportunities was that made by one woman:

When I considered finding a job after I finished my PhD in 1964, there were 300 applicants for a typical Asst. Prof. Position in Chemistry. There were no applicants for computer jobs and the job paid twice as much.

These women did not speak of education as a route to their decision making process; rather they entered IT because of some experience in the field or their recognition of the value of a job in IT.

Like the women with non-IT technical undergraduate degrees, the women with non-technical undergraduate degrees and no advanced degree in IT were influenced by job experiences. Typically they entered the IT field indirectly as a result of on-the-job experiences. As one woman who has been in the field 16 years explained, "I slid into IT in little increments, from being a person who understood the library circulation system through using the Humanities Computing Lab ... to teaching myself dBASE." Their initial job experiences covered a wide range of non-technical positions: secretary, librarian, accountant, marketing, writer, but these experiences exposed them to computing. An English major, now a Web manager, explained that while she was in an administrative job, "I sat in a cubicle next to the guy who maintained the website at my new job, and we were also friends, so I used to come over and watch over his shoulder, and had an aha! moment."

For this category of women, school experiences played a lesser, though not insignificant role. Although they had majored in non-technical areas, a surprising number had taken programming courses in college as an elective. A woman who majored in political science and sociology, for example, described two programming courses she took that got her "hooked on computers." Some women, however, experienced outright discouragement from teachers despite their aptitude for math and science. A few of the women responded to discouragement with defiance. One wrote, "I insist on doing anything I'm told I can't do."

Frequently, for these women without technical or IT degrees, an early school or home experience planted a seed that germinated when an opportunity arose on the job. Attending a gifted kids camp, or participating in a Junior Achievement program sponsored by IBM, or playing with their family's PC, may not have been a strong enough influence to encourage these women to choose an IT major in college, but they were strong enough influences to encourage them to consider the IT field later in life.

Like the women with undergraduate IT degrees, many of the women who did not major in IT as undergraduates but who later pursued IT graduate degrees reported that the classroom experience was important in directing their interest in the IT field. One typical comment was "I took a course in C++ while I was a chemical engineer, and realized I liked it more than what I was doing." Not surprising, a career change was also reported as important in encouraging these women to return to school for degrees in the IT field. Some of the reasons stated by the women included on the job training that led to a need for higher

education, the lack of a job in their current field, and the desire for new challenges. Popular culture was also cited as a factor in the interest of several women. One woman reported that time spent MUDing gave her exposure to UNIX, while others claimed that science fiction sparked their interest in IT or AI.

Internal Influences—Motivation

The women who answered the open-ended questions in the survey described being influenced by external factors—people, events, and experiences—but they also spoke of internal motivations that led them to enter the IT field. As was true for the external influences, the internal motivations listed by these women were similar across the four groups; however, the emphasis placed on the specific motivating factors often varied by group.

The comments provided by the 84 women with undergraduate IT majors suggest an interesting blend of practical and emotional motivations. For several of the women, the financial aspects of IT careers were important motivating factors, with many of them mentioning earning potential, job security, and the desire for a marketable skill as their reason for pursuing an IT career. However, others were less practical in their motivations, and spoke of finding computers to be “exciting and glamorous.” As one woman explained, her change of major to CS as an undergraduate was “because the coolest kids were in the engineering school.” Being involved in IT made these women feel special and admired. Perhaps one woman summarized the situation best when she noted, “I rather enjoyed the response of other people when I told them I was majoring in Computer Science—people think you’re weird, but they’re usually impressed.”

For quite a few of these women, computers represented a way do what they were good at, and more than that, a way to find a form of emotional fulfillment. Several women talked of their aptitude for mathematics. One woman noted, “I was always exceptional at math, logic and science.” But for some of these women, their involvement with computers stemmed from more than a simple aptitude, it came from a deep love for mathematics, logic, artificial intelligence, analytic problem solving, and technology. One woman said quite simply, “I love the logic.” For these women, computers were more than just a job; they were

also a way to attain a certain kind of fulfillment or mastery. Perhaps one woman explained this most graphically when she said:

The first time I “played” on a computer, I was fascinated and KNEW I had to figure out how these things worked! And when I wrote my first computer program, the feeling I had when it worked is beyond description! It just made ALL my bells ring! I knew I had found my “calling.”

The women with undergraduate degrees in non-IT technical areas often reported having an ability or skill, but were less likely to report being in IT because of enjoyment. While they would often comment on the pleasure of working in IT, they were more likely to speak of selecting the field because it was “the best fit for my skills,” or because “I was very good at programming, algorithms, math.” Even among these apparently more pragmatic women, there were a few who saw the future in IT. As one woman said: “The people I met as a result of that [work] formed my view of computing as a medium for changing the world.”

Only a handful of the women who had non-technical undergraduate degrees and no graduate IT degrees wrote that financial security and “golden opportunities” in a fast-growing field influenced them to switch from their original career goals. Much more frequent were comments about liking a challenge and wanting a field “in which I could make a difference.” Clearly, the primary internal motivation for these women was that they discovered, usually as a result of work experiences, that they liked programming and problem solving and were “good at it.” The real-world experiences developed their self-confidence. As one said, “I got a lot of approval and satisfaction making solutions for people.” Another reported, “Being seen as the ‘hero’ who could ‘fix the computer’ was always a thrill, as was the continual challenge of figuring things out.”

For the women who had no undergraduate IT degree but who went on to earn graduate IT degrees, internal motivation involved the challenge and an enjoyment of the work, often coupled with getting paid for what is fun. Perhaps these came together best when one woman stated:

“I drifted into my first programming job with no particular long-term plan. When I discovered that this was something I was good at, enjoyed, and could get paid for, it seemed to me that I had found my niche.”

Like many of the women with IT undergraduate degrees, a number of these women also saw their careers in the IT field as a higher calling. They commented that they wanted to be a part of the future or were “interested in the power that computers and good software give people to do tedious or extremely complex tasks.”

Discussion

The findings of this research can be influential in shaping educational policy and intervention strategies to expand women's career choices and encourage more women to pursue information technology. For the women employed in IT careers who responded to the survey, school experiences were an important influence, suggesting that school and teachers can be a target for effective intervention programs. Many of the successful women were first introduced to computers in school, and they took seriously the encouragement or discouragement of their teachers in high school and college. The significant number of respondents who cited male friends and colleagues as being powerful influences in their career decisions suggests that intervention efforts should be directed to men—as students, faculty, and co-workers—as well as to women.

In addition, this study points out the wide variety of paths that women take toward a career in information technology. Only half of the successful IT women majored in traditional technical fields as undergraduates, suggesting that intervention programs should not be limited to computer science or engineering curricula and teachers.

The influences and motivations that led the women in this study to pursue these various paths are summarized in Table 4. Nearly one-third entered the “IT pipeline” directly by majoring in computer science or information systems as an undergraduate. Consistent with the Margolis and Fisher (2002) study of computer science majors at Carnegie Mellon, these women entered the field because they were good in math and science, enjoyed problem solving and doing puzzles, and took a programming class and enjoyed it. A similar group of women chose a career in IT after majoring in engineering, mathematics, or science because they realized it was a good fit for their skills. On the other hand, nearly one-third majored in the arts, social sciences, or humanities in college and entered the IT field “in little increments” through on-the-job experiences and encouragement from a mentor in the field or

a close male friend. Others switched to a computer science major at the graduate level, often as a result of enjoying an elective computer course or on-the-job training.

Table 4. Summary of Influences and Motivations by Academic Path

	<i>CS/IT Undergraduate Degree Holders</i>	<i>CS/IT Graduate Degree Holders, but not CS/IT Undergraduate Degree</i>	<i>Non-Technical Undergraduate Degree Holders</i>	<i>Technical Undergraduates, but not CS/IT</i>
<i>Influential People</i>	Parents (especially fathers), teachers	Teacher or boss	Boss, co-worker, friend in IT	Family and friends
<i>Influential Experiences</i>	Programming class	Elective computer class, on-the-job training, desire for career change	Job experiences and memory of early computer classes	Job opportunities
<i>Internal Motivations</i>	Wanting to be seen as special, love of math, finding a calling, marketable skill	Wanting a challenge, enjoyment of the work, finding a calling	Wanting a challenge, desire to make a difference, good at problem solving	Good fit for skills, good at math and programming

Contrary to the oft-cited pipeline analogy, a degree in computer science is clearly not a prerequisite to a career in information technology. For many successful women, interest and talent in IT emerged gradually and developed over time, challenging the myth of the adolescent computer geek who masters the computer early in life. Rather than an “incredible shrinking pipeline” (Camp, 1997), the field of information technology is a roadway with many on-ramps. In order to satisfy the growing need for information technology workers and expand women’s participation in the field, it is important that we understand the experiences of those who enter the roadway at later points as well as those who enter through traditional academic paths.

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