

Recruiting computing professionals — Expanding the recruitment base

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ABSTRACT

A series of four studies examined reasons for the underrepresentation of women in computing. These studies involved 1) 32 male and 32 female university computing students, 2) 19 female computing professionals, 3) 33 schoolgirls, and 4) 22 Australian and 22 Asian university computing students. The studies identified misperceptions about the nature of computing careers as a major factor deterring women from studying computing. It was considered likely that similar misperceptions would deter men from computing. A subsequent study of personality types of 60 computing professionals indicated that certain personality types are underrepresented in computing. A summary of the findings of the five studies is reported below.

BACKGROUND

It has long been a concern that computing classes in most universities in Western World countries are comprised predominantly of male students. The literature reveals that women have been underrepresented in computing courses for at least the past two decades, and that this underrepresentation is worsening [1-10]. This is despite increased awareness of the problem, and many attempts to improve female to male ratios. Most indications are that the attrition rates of female students from computing courses also are higher

than the rates of male students [4, 8, 11, 12].

Less apparent to an observer is that computing attracts particular types of males (and females). Several studies of computing professionals have found that the ratio of personality characteristics of computing professionals are not representative of the general population [13-15]. This suggests that not only are women not attracted to computing as a career, but that many men also do not consider computing an attractive career option.

The underrepresentation of women in computing and the possible underrepresentation of men with certain personality characteristics are discussed below.

WOMEN AND COMPUTING

Many factors deter women from choosing computing as a career [16]. Teenage girls today receive both direct and indirect messages discouraging them from studying mathematics, science and computing and from careers which are stereotyped as male occupations. If more women are to be encouraged to study computing, teachers, parents and friends also must be persuaded that computing is a suitable field for women. Occasional positive interventions and messages generally will be ineffective at counteracting the many and continual negative messages that girls receive [17, 18]. The first study described below was

undertaken with the objective of obtaining fresh insight into the reasons why women don't study computing — by asking young women and men who had recently been involved in making career selections.

Study 1: Male and Female University Students

Interviews with equal numbers of male and female university level computer science students were conducted. Students were asked about their previous computing experience, their reasons for enrolling in a computing course, what they did, and did not, like about computing, and why they thought there were so few female students enrolled in their course. While the responses of the students provided little insight into the reasons for low female representation in courses, it became obvious that computing as the students experienced it differed markedly from the work as experienced by computing professionals [19].

Consistent with other research, the women in the study were found to have inferior prior computing experience to the men [12, 20, 21] although there was little difference in their final unit grades [22, 23]. However, the men in the sample tended to report higher grades and women lower grades than the class averages.

The motivations of the women for enrolling in a computing course were found to differ from those of men in that:

- Slightly more than half of both the women's and the men's responses were related to the opportunities offered by a computing career. Women saw these opportunities mainly in terms of career prospects (job opportunities, salaries, etc.). In addition to career prospects, men mentioned the skills they expected to acquire and how they would use those skills.
- While two thirds of the men in the study cited liking and/or being good at computing as a reason they enrolled, only 20% of women mentioned liking

computing, and none stated that they were good at it.

- For almost a third of women (29%) but only 6% of men the course was second choice to another course, usually commerce.
- Some form of encouragement was more important to women than to men. More than half of the women and a quarter of the men mentioned support, encouragement or motivation offered by a family member, teacher or other person.

The women typically chose computing for reasons other than liking it. As computing is a non-traditional choice for women, it is not surprising that support, encouragement and motivation from another person(s) are important to them.

The students were asked what they liked and disliked about computing, and about their successes and failures. Their responses focussed almost totally on programming. What students liked best about computing was getting a program to work. What they liked least was not being able to solve an error in a program. Their successes and failures similarly focussed on programming. Consistent with other studies, women were found to have lower expectations of their ability, more difficulties with their course (particularly programming) and enjoy the course less than men [12, 20, 21]. For the women, motivation to continue was provided by good grades.

When asked why they thought there were so few women in computing, the responses of the men and women were similar. Stereotyping, computing's 'technical nature', and the male domination of computing were seen as factors which made it unattractive to women. Also mentioned were that girls were less likely to study the perceived prerequisites of mathematics and science, that they were given different career and study option advice, that they were not

given encouragement to study computing, and that there were various opportunity and attitudinal deterrents.

The recommendations of the students for encouraging more girls to study computing were neither new nor innovative. They included: increased use of computers in schools, better information, changing course design/content, changing the image of computing, greater encouragement to girls to enter computing, and changing stereotyped views. Some of these suggestions have been implemented in other places, with apparently little effect. Most of the recommendations require large scale educational programs aimed at teachers, students and the community. If this is what is needed to encourage more women into computing, it is hardly surprising that the small-scale attempts are having little effect.

Study 2: Women in the workplace

The interviews with computing students undertaken for Study 1 conveyed an overwhelming sense that computing as they experienced it had almost nothing in common with computing as experienced by computing professionals. In particular, computing to the students meant long hours programming and debugging, and little else. To confirm that computing careers were not solely programming careers, interviews were conducted with 19 women working in a range of computing and computing-related careers. These women were asked what their work involved and what they enjoyed and did not enjoy about computing. Their responses portrayed a completely different view of computing careers to the perceptions of the students [19, 24].

The women's responses were so different to those of the students that it was clear that computing, as experienced at university, were markedly different from the realities of life in the workplace. These women loved their jobs and spent

relatively little time working at the computer alone. Most of their time was spent writing reports rather than programming. The job features which they enjoyed were the challenge, the variety and working with people. Essentially, they talked about a person-oriented job rather than a technical, mathematical or scientific one. Further, very few of them encountered failures or dissatisfactions, except to note that there was too much to do and too little time to do it to their personal satisfaction. These interviews confirmed that computing can be an enjoyable and rewarding career for women.

Study 3: Schoolgirls

The differences in perceptions encountered in the first two studies suggested a third study to determine the perceptions of schoolgirls about computing careers. Thirty-three schoolgirls, aged 13–17, were asked about their career aspirations, the attributes that would attract them to careers, their experiences with computers, and what they thought of computing as a career.

This study found that:

- Schoolgirls decide on a preferred career at a relatively young age. Thus, interventions targeting senior high school girls must aim to change preferred career choice, not suggest possibilities for careers. High profile (law, medicine) and traditionally female (working with children or animals, paramedical) careers were the most popular. It seems probable that some of these choices will change as the reality of obtaining places in preferred courses becomes apparent.
- Girls find computing classes boring, although less so where a variety of software is used [25]. Girls enjoy using computers in informal settings for work which is relevant to them.
- The attributes that girls would seek in a career were: job satisfaction, meeting

and communicating with others, good money, challenge, variety, being able to move around and get outside, and work with children or animals.

- When asked if they had considered a computing career they typically gave replies such as 'boring', 'menial', 'not sufficiently challenging', and 'wouldn't want to be stuck in an office with just a computer'. When pressed to describe their image of computing careers they either responded in terms of programming and technical computing, or office work, particularly word processing. 'Sitting in front of a computer all day' was seen as essential whatever the application. It was apparent that computing careers were not well understood by these schoolgirls.

Public perceptions of computing, stereotyping of careers, the emphasis of many traditional computing courses on programming and individual work, and the apparent lack of relevance of computing studies to the real world all contribute to deter girls and women from studying computing. Schoolgirls have a very narrow and limited knowledge of the range of computing careers available, and do not see computing as an attractive career choice. In contrast, women in the workplace, when describing their own careers, described most of the attributes which the girls said they wanted in a career [24].

Study 4: Australian and Asian tertiary students

Although female students are in a minority in computer science classes in Australia, the United States and many European countries, the proportion of Asian female students enrolling in computing classes indicates that the problem is cultural rather than gender related. This is true of both Chinese students and Muslim students [26-28]. The fourth study sought reasons for these cultural differences. Twenty-two

Australian and 22 Asian students were asked: why they thought the proportions of female students in computing were different in the two groups, to describe their successes and failures, and to suggest ways of encouraging more Australian women into computing.

Both groups identified similar reasons for the underrepresentation of Australian women in computing [29]. The primary reasons given were: the lack of encouragement in Australia for girls to study computing, and the greater emphasis in Asia to achieve and to acquire the qualifications to obtain a good job, were identified. Both groups were attracted to computing mainly because of the good job prospects. Successes and failures were related to formal situations, and generally to programming. It appeared that neither group of women used computers extensively informally.

Recommendations from the two groups for increasing Australian female involvement were to provide greater encouragement at school, to increase exposure to computers and to change the image of computing. These recommendations are similar to the students' recommendations from Study 1 (the male/female study). Again, implementation would require a large scale (government) approach.

PERSONALITY ATTRIBUTES OF COMPUTING PERSONNEL

The four studies described above identified misperceptions of the nature of computing careers as a factor deterring girls from computing courses. University students were preoccupied with programming (technical work) while school girls perceived computing careers to be boring, sitting at a screen all day. However, the attributes of computing careers as described by female computing professionals indicated that there are many jobs in computing: 1) that are not technical: and 2) that have attributes that

closely resembled the attributes school girls sought in a career.

This misperception suggested that both school boys and school girls may have similar perceptions about computing — that some students of both sexes may be attracted to what they perceive to be a technical, programming, career, while others are deterred from computing for exactly the same reason.

Personality considerations have become increasingly important in recent years. Firstly, computing professionals today are expected to have a broader range of skills than in the past [30-32]. Secondly, many users are dissatisfied with the personal, rather than the technical, service they receive from their information technology (IT) departments [5, 33, 34]. One skill essential for members of an IT department is the ability to communicate [30-32, 35].

In a study of 18 systems developers, Sullivan [36] found that most spent more than half their time in verbal communication. Unfortunately, computing professionals are not renowned for their communication skills and helpful attitudes [5, 33, 34]. Kennedy [34] accuses IT professionals of being rude, not caring about user problems, making users look stupid, and being poor communicators.

The Myers-Briggs Type Indicator

One widely used measure of personality type is the Myers-Briggs Type Indicator

Table 1: Characteristics [37] and population distribution [15] of MBTI attributes

MBTI type & distribution	Characteristic	MBTI type & distribution	Characteristic
Extraversion (75%)	Focus on the outer world of people and things	Introversion (25%)	Focus on the inner world of ideas and impressions
Sensing (75%)	Focus on the present and on concrete information gained from their senses	Intuition (25%)	Focus on the future, with a view towards patterns and possibilities
Thinking (men 60%, women)	Tend to base decisions on logic and on	Feeling (men 40%, women)	Tend to base decisions primarily on

(MBTI). Based on the work of C. G. Jung, this instrument is used extensively in industry. It measures an individual's preference on each of four pairs of attributes: Extraversion/Introversion (E/I), Sensing/iNtuition (S/N), Thinking/Feeling (T/F) and Judging/Perceiving (J/P). Each person has a preferred alternative on each of four personality preferences. The MBTI preferences relate to how people view the external world, and how they gather data and make decisions. With these four pairs of preferences, individuals can be characterised as one of sixteen possible types: each type is identified by a four character combination of the letters mentioned. For example, extraverted/sensing/thinking/perceiving is written 'ESTP'. The characteristics and general population distribution of the pairs are given in Table 1.

MBTI characteristics of computing professionals

Several studies have found that the MBTI ratios among computing professionals differ markedly from the general population [13-15]. Two types, ISTJ and INTJ, appear in the list of the three most commonly occurring personality types in all six studies. ISTJ was the most common personality type in four of the studies, with INTJ second in each case. In the largest study [14], 22.6% of participants were ISTJ, compared with 6% of the general

35%)	objective analysis of cause and effect	65%)	values and on subjective evaluation of person-centred concerns
Judging (55% – 60%)	Like a planned and organised approach to life and prefer to have things settled	Perceiving (40% – 45%)	Like a flexible and spontaneous approach to life and prefer to keep their options open

population; 15.5% were INTJ, compared with 1% of the general population. Introverts (67%), iNtuitives (54%), Thinkers (81%) and Judgers (66%) were overrepresented when compared with the general population.

The MBTI personality types are often shown using the matrix depicted in Figure 1. This enables all combinations of the four pairs of attributes to be included in the matrix. For the six studies mentioned above, the matrix in Figure 1 has been shaded to show all of the personality types which appear in the list of the five most commonly occurring types for each of the studies (only three types are mentioned in one study [13]). N.B. The cell headings in the matrix have no meaning other than as headings. The matrix layout follows the convention adopted for the MBTI.

	ST	SF	NF	NT
IJ	ISTJ	ISFJ	INFJ	INTJ
IP	ISTP	ISFP	INFP	INTP
EP	ESTP	ESFP	ENFP	ENTP
EJ	ESTJ	ESFJ	ENFJ	ENTJ

Figure 1: Most commonly occurring personality types of computing professionals (heavier shading indicates the two personality types which occur most frequently)

It now becomes apparent that the pairs of attributes N and T or S and J occur in all seven of the frequently occurring personality types of the computing professionals in the six studies mentioned above. The MBTI letter pairs NF, NT, SJ, SP are known as temperaments. Otto

Kroeger Associates [38] describe these temperaments as:

NF people motivators, empathic, aware of others feelings, persuaders

NT conceptualizers, systems planners, architects of change

SJ administrators, precise, structure, orderly

SP problem solvers, practical, resourceful, quick starters

Clearly, all of these temperaments would have a place in any software development team. The predominance of particular types amongst computing professionals suggests that many organisations may lack NFs and SPs. In addition, although ISTJ and INTJ, the two most frequently occurring personality types in the studies, are very well suited to program and system development, these types may not have the characteristics that would help them to relate well to users. ISTJs ‘make up their own minds as to what should be accomplished and work toward it steadily, regardless of protests or distractions’, while INTJs are ‘sceptical, critical, independent, determined, have high standards of competence and performance’ [37]. Thus, the research indicates that computing attracts a preponderance of certain personality types. There may be a greater need for the skills of underrepresented personality types.

Study 5: Personalities of programmers, designers and analysts

For this study, only three main functions of systems developers — programming, analysis and design — were included. The

various subtasks of programmers, systems designers and systems analysts were identified [30] and for each of these, the MBTI characteristics considered to be 'most appropriate' for the subtasks (referred to below as 'most preferred') were identified [39].

Previous studies have investigated personality types of computing professionals in a particular work category, e.g. programmers. In this study, current position was not considered relevant. Participants experienced in analysis, design and programming were asked to rank their preference for these three tasks. It was assumed that they would rank as their first choice the area for which they are best suited, where 'suited' includes 'happiest' as well as most capable. At the time of writing, 57 participants have been 'typed'.

Participants with a preference for systems analysis

The characteristics proposed in this study as most preferred for systems analysts were Extroversion (to encourage communication) and iNtuition (for extracting what is important from large quantities of data). A team of analysts ideally would have both Thinkers and Feelers, and Judgers and Perceivers. Figure 2 shows the distribution of participants who preferred systems analysis. The data confirm the choices of Extraversion and iNtuition as preferred characteristics for systems analysts. A previous study [14] found less than 20% of computing professionals were Extraverted iNtuitives. Given the increasing demand for systems analysts [40], this suggests that there is a need to attract more Extraverted iNtuitives to computing.

	ST	SF	NF	NT
IJ				INTJ (1)
IP				INTP (2)
EP	ESTP (1)		ENFP (2)	ENTP (3)
EJ	ESTJ (1)		ENFJ (5)	

Figure 2: Personality types of computing professionals preferring systems analysis (heavier shading indicates more preferred characteristics).

Participants with a preference for systems design

The characteristics proposed in this study as most preferred for systems designers were Sensing paired with Judging (for detailed work) or Thinking paired with iNtuition (for the early stages of design). These attributes are covered by the SJ or NT temperaments, or possibly ISTPs, who are logical and excel at solving practical problems. However, a design team would benefit from having some NF and SP temperaments included. Figure 3 shows the distribution of participants who preferred systems design. The participant data confirm the choices of the SJ and NT temperaments, and ISTP types as preferred characteristics for systems designers.

	ST	SF	NF	NT
IJ	ISTJ (3)		INFJ (1)	INTJ (4)
IP	ISTP (2)		INFP (2)	INTP (2)
EP	ESTP (1)		ENFP (1)	ENTP (5)
EJ	ESTJ (1)			ENTJ (1)

Figure 3: Personality types of computing professionals preferring systems design (heavier shading indicates the most preferred characteristics)

Participants with a preference for programming

The most preferred type proposed in this study for programmers involved in the maintenance and development of programs from specifications prepared by systems designers was ISTJ. These programmers need to be able to work alone (I), have attention to detail (S), be logical (T) and be organised (J). The preciseness of SJs should make them good programmers, while SPs, who enjoy problem solving, are likely to enjoy the challenge of producing programs that work. Where less emphasis is placed on traditional programming and programmers are expected also to perform analysis and design tasks, there is a place also for the conceptualising and planning skills at which NTs excel. Figure 4 shows the distribution of participants who preferred programming. The data confirm the choices of the SJ, SP and NT temperaments as preferred characteristics for programmers.

	ST	SF	NF	NT
IJ	ISTJ (2)	ISFJ (2)	INFJ (3)	INTJ (3)
IP	ISTP (2)		INFP (2)	
EP	ESTP (1)	ESFP (1)		
EJ	ESTJ (2)	ESFJ (1)		

Figure 4: Preferred personality types for computer programmers (heavier shading indicates the most preferred characteristics).

CONCLUSIONS

A series of five studies has been described. The first four studies identified as one reason for the underrepresentation of women in computing the misperceptions which students have of computing careers. Computing was viewed as either a technical career, or possibly as office work. However, women working in the field identified as the attributes of their

jobs almost the same attributes as schoolgirls would seek in a career.

The findings of these four studies suggest that computing attracts students who want a career where they can spend all day sitting at a screen doing technical work. As computing includes a high proportion of work opportunities that do not involve sitting at a screen or working in isolation at a computer, it was suggested that not only are women underrepresented in computing careers, but that men who might excel in non-technical computing might be underrepresented also. The fifth study identified MBTI personality characteristics that were considered most appropriate for each of the subtasks of programming, design and analysis. The characteristics and work preferences of 57 computing professionals tended to confirm the identified characteristics as appropriate for the three subtasks.

The studies indicate that not only are women underrepresented in computing, but that many of the personality types that would be suited to various computing subtasks also are underrepresented. As methods of traditional systems development change, and new career opportunities in computing continue to expand, there is an urgent need to attract into computing both women and men who would enjoy and are suited to the many career opportunities that are less attractive to the technically oriented.

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