Explaining the IT Gender Gap: Australian Stories for the New Millennium'

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The starting point for this study was the findings from a previous study of Australian women working in IT. Four major themes that resulted from a study of IT professionals in Queensland were used as the framework for a deeper exploration of the current position of Australian women in IT. These four findings were explored through open-ended interviews with a broader range of Australian women working in IT. The findings of this study revealed the influence of socio-cultural factors on gender in the Australian IT profession. This paper also discusses more recent research on gender and IT, particularly the attempts to address the under-theorisation of this research area and the significance of mentoring.

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INTRODUCTION

Despite significant worldwide growth in the IT professions in recent years, there remain segments of the population that are under-represented in IT. Among those under-represented are women. In some countries, there is evidence of declining participation by women in IT. For example, female

1 This paper is a version of the paper which appeared in the 11th Australasian Conference on Information Systems (ACIS) held in Brisbane, in 8-10 December 2000 and was nominated for the Best Paper award. This version of the original ACIS paper includes a new section, Ongoing Research, which summarises more recent research into Gender and IT, particularly the attempts to address the under-theorisation of this area and the significance of mentoring. Recent References have also been added.

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enrolments in Australian IT degree courses declined from 24% in 1991 to 19% in 1998. Overall student enrolments in IT courses increased by 30%, from 1994 to 1998, but females accounted for only 10% of that increase (Newmarch *et al, 2000).*

The question in the minds of those who are concerned with IT human resources and the development of qualified IT professionals is, "Why?". It is ironic that at this time of unprecedented opportunity for IT professionals around the world, the field should be experiencing an IT skills crisis stemming from the shortage of qualified IT professionals. Of particular concern for this research is that, despite significant growth in the IT professions, there remains a gender imbalance. A deeper understanding of this question is necessary to ensure the necessary level of qualified IT professionals for the information age, and to ensure more equitable participation by women in the IT industry'. This paper addresses this problem by exploring the socio-cultural influences on women working in the IT industry.

A variety of different theoretical perspectives on gender and IT are reflected in recent literature about women's participation in the IT field. At the highest level, they fall into two categories: those that emphasise fundamental differences between the sexes, and those that de-emphasise them. Two streams of research derive from a view that women and men have basic differences - but they come to radically different conclusions. A stream of research in America has looked at gender differences in technology acceptance in the context of individual adoption and sustained usage of technology in the workplace. These studies assume fundamental, psychological differences between the genders and link this assumed difference to women's lower participation in IT.Venkatesh and Morris (2000) and Venkatesh *et al* (2000) believe that women typically display lower computer aptitude and higher levels of computer anxiety than men, and that they bring fundamentally different approaches to the use of information technology. This stream of research points to inherent differences between men and women in their attitudes toward information technology, claiming that women, being less capable, more insecure and more compliant than men, are less willing to adopt and use information technology.

Since our everyday, common sense experience of successful women IT professionals in every country provides counter examples and, hence, challenges the fundamental assumptions upon which this research is based, explanations must be sought elsewhere. A second stream of research which starts from the same point - differences between the genders - comes to a completely different implication for women in IT. Many feminists have increasingly insisted on the distinctive contribution that women can make. For example, Spender's (1995) view is that if more women held technical positions such as that of programmer, not only would IT's gendered nature disappear over time, but it would be transformed and improved by exposure to 'feminine' values. Many initiatives concerned with 'getting women in to IT,' therefore, assume that it would not only be good for women, but good for technology (Robertson, 1997; Greenbaum, 1998).

Another stream of research by those concerned with the participation of women in IT has taken a different tack. Rather than focusing on inherent differences between men and women, it acknowledges gender socialisation and looks for answers in the social construction of IT as a male domain. For example, the WinIT study" (Pringle *et al,* 2000; von Hellens *et al,* 2000) of female

2 See NOIE (2003) for a discussion of this crisis in Australia. See, for example, Freeman and Aspray (1999) and ITAA (1998) for data about gender and the skills crisis in the US. According to the National Science Foundation (2000), "the under-representation of women and minorities in the IT workforce is a serious national problem. There is agreement among some of the nation's leading researchers and scientists that systematic research efforts are needed to address this problem."

3 The WinIT project is funded by the Australian Research Council to investigate the low participation of women in the IT education in Australia. Other relevant papers from this study are von Hellens *et al* (2000) and Nielsen *et al* (1998, 1999, 2000).

practitioners in Queensland revealed the importance of operating within a male domain to the extent of outside-work socialising with male colleagues at sporting events as necessary for career progression. The consequence is that, while women have been socialised away from IT, the IT field has been constructed as a masculine domain. The way in which this stream of research would explain lower female participation in the IT field is that, in order for women to be successful in IT, they must adapt to this masculine domain. A research challenge that emerges from this point of view is to better understand the social construction of IT as a masculine domain.

THE RESEARCH STUDY

The way in which this challenge was pursued in this study was to explore, in greater depth, the findings of the 'WinIT' study of women IT professionals in Queensland (Nielsen *et aI,* 2000). The research for the present study sought greater understanding of the reasons for these findings. In so doing, the data collection was broader and different in focus. Whereas the WinIT project focused on women in IT management in one region, the present study explored the experiences of women who are in more technical positions and who work in a range of industries throughout Australia. The focus was on successful technical women because it is this group that best challenges the assumption that women are inherently unsuited to work in technical fields such as IT. Further, by exploring the life histories of such women, it was hoped that significant influencing factors in the socio-cultural environment could be unearthed. This approach derived from Trauth's work on gender, which has been carried out in several countries (Mitroff *et al,* 1977; Kwan *et aI, 1985;* Trauth, 1995, 2000a, 2000b) with the purpose of examining socio-cultural influences on woman in science and IT. The intended outcome of this research project was a framework of environmental factors which parents, educators, policy makers and IT professionals could address in their efforts to increase the gender balance in the Australian IT field. An interpretive perspective has been taken in this study. Klein and Myers (1999) argue that an important principle in evaluating interpretive research is a reflection of the interaction between the researchers and the. subjects. The positions adopted by the authors (which influence the interpretation of the data) are as outlined above.

Research Questions

Four themes that arose from the WinIT study of IT professionals in Queensland became the research questions for this study:

- Women are -under-represented in technical positions within the IT field.
- Women lacked formal qualifications in IT.
- Women were under-represented in IT management.
- Women who were successful in IT prioritised work over family commitments.

The objective of this study was not so much to answer the question, "Why?" as to explore the question, "How?". These themes, then, comprise the framework that facilitates a deeper exploration of the current position of Australian women in IT.

Methodology

The first author conducted in-depth interviews between March and May 2000 with twenty women who work in the Australian IT field. These women represent a range of ages, employment sectors, educational backgrounds, nationalities and regions of Australia. The interviews were open-ended in fashion. In advance of the interviews, each respondent was contacted by electronic mail and sent a document that contained an overview of the research project, indicating the objective of the research, the researchers' credentials and the types of questions that would be asked. The open-

ended interviews, which lasted approximately 90 minutes in duration, were tape-recorded and covered four main topics. The first topic was the person's demographic information: respondent's age, education, type of work and current position, company and industry. The second topic was information specific to the respondent: work history, educational experiences, career progression and experiences, significant influences in life (e.g. events, people). The next topic included more general questions about gender and IT. Respondents gave their views on the question of IT being a male domain and what that means for their career in IT. They also talked about social influences and barriers to women in IT. Finally, respondents were asked to offer recommendations regarding how society, the IT profession and educational institutions might address the gender imbalance in IT.

RESULTS

Respondent Characteristics

The respondents ranged in age from mid-twenties to mid-fifties. The most common fields of study were computer science, mathematics and engineering; a few studied information systems. Three of the respondents did not have IT degrees. These respondents fell into one of three categories. Half of the women were IT practitioners working in a range of levels and industries in various parts of Australia. These women drew on their own experiences to offer insights about the themes that were explored in this study. Six of the respondents were academics who lectured in information systems, computer science and engineering. These women offered two perspectives on the topic. One was her own experience of getting into and progressing in the IT field. The other perspective was her role in getting other women into IT. Four of the respondents fell into the category of 'observer.' These women contributed meta-level observations and reactions to the emergent interpretations of the interviewer[4]. They were placed in this category by virtue of their position with respect to IT. Two of these respondents had, themselves, conducted research on gender and IT. One respondent worked in IT human resources. The fourth respondent in this category was an IT practitioner who worked with a professional organisation to develop initiatives to promote women in IT. All the participants were working and living in Australia when this study was conducted.

Analysis of Findings

This in-depth exploration of the factors that influence women to work in the IT field revealed consistent patterns at both the individual and societal levels. The women in this study saw themselves as different from the feminine stereotype in terms of both academic interests and behaviours. They also consistently revealed the influence of significant persons in their lives. In a myriad of ways, they provided evidence that the bar is higher for women wanting to participate in the IT field. This bar is raised in both the educational preparation and in the workplace itself. Nevertheless, they believed that new messages are being sent which reflect changing economic and societal attitudes about women in Australian society, in general, and the Australian IT sector, in particular.

1. Women in technical positions

The more technical the IT work environment, the more unusual it is for women to work in it. Therefore, this first theme endeavoured to explore the way in which such technical positions in

4 This respondent category was employed by Trauth *et al* (1998) and Trauth (2000b) in socio-cultural studies carried out in other countries.

Australia are male domains. Respondents indicated that this all-male technical work environment is hostile to females in various ways. At Virginia's[5] firm, one out of thirty programmers is female. Her employer looks for university graduates with the highest marks and, she says, males tend to dominate achievement. Technical areas, such as technical support, programming and networks, are male dominated because it is construed that women are not good at this sort of thing. She invoked the term 'blokes' in talking about IT being a male dominated field.

Jill said that "boys will be boys" in a very accepting way when talking about the profanity, and the sexual jokes and language that accompanied her as the sole woman into her first job. Although she is just starting out in her career, Jill accepts what she considers to be impossible to change. She believes she has to fit in to this male domain and prove herself. She commented that if more women were working in such a place, the men might be more tame but would probably be more competitive. Charlene referred to the sexual jokes, language and innuendo as 'locker room' behaviour in the workplace. Her experience of this uncomfortable situation extended into the educational sphere. She spoke about attending training classes in which the university lecturers made comments that degraded women and stereotyped them as silly. All the men would sit there laughing, oblivious to her presence and discomfort. She feels strongly that as long as women keep hiding the issues, then such behaviour in the workplace and at university will continue to flourish.

Lisa offered a different take on the all-male environment when she spoke about a man whose fundamentalist Christian religious beliefs influenced his attitude toward women in the workplace. He spoke openly about a woman's place being in the home and spoke pointedly to women whom he thought should not be in the workplace. She also differentiated the source of the problems with sexual innuendo and jokes, and questioning female competence. She attributed such behaviour to technicians, rather than engineers. Once, a colleague believed she had a romantic interest in him and refused to believe otherwise, even after she rejected his overtures. His harassment, which lasted for a year, had a direct impact on her performance in the workplace. Not only was she was frightened of him, but when she was asked to be his supervisor, she had to decline. She also had to take some time off work because the stress level was so high. She got to the point of considering a job in another city to get away from him. She eventually reported it to her boss and to human resources. His response to the official 'first warning' was to be amused by it. In her view, the problem is that this man did not know how to have a platonic relationship with a woman.

One way in which daily behaviour presents a barrier to women is the requirement to prove themselves in ways men do not have to.

> . . . I think I realised straight away at university that I had stepped into a male dominated industry and it didn't worry me that I had to prove myself. I guess I felt that if I proved myself, it was going to make the woman that followed me just a little bit easier... [W]hen I got to London, I was put on in a contract role with some guys. And they said, "Well, you can be responsible for looking after the help desk software and making sure the calls are up to date." And it was only when we got a month down the track that they realised the guy they said, "Oh, you can look after the network," to, was completely incompetent. And he ended up doing the admin-type work. Like I was supposed to collect the time sheets and make sure that everything was entered in, while he did the serious type job. [Jill]

Respondents spoke about men assuming that women have a lower level of technical competence. Margaret, a human resources manager, relayed a conversation she recently had with a man at her firm. He told her that he approaches a male with the expectation that he is competent

5 All the respondents in this study have been given pseudonyms

until proven otherwise. On the other hand, he approaches a female with the expectation that she is incompetent until proven otherwise.

When Jill talked about her first job, she noted that her male co-workers were surprised whenever she knew the answer to something that they didn't. What was noteworthy in the interview with this young woman was the calmness with which Jill acknowledged and accepted the uneven playing field as a fact of life in Australian IT. It was much the same thing on the academic side. While Laura was generally positive about her academic career in IT, she also commented that she needed to meet higher standards than her male contemporaries in order to be promoted. She was also spread very thin at the university. They want female representation on these committees, she complained, but not enough women have been hired or retained. Consequently, there are not enough to go around!

The women who participated in this study had lived in nine other countries besides Australia. They also worked with men from many countries. Some of the firms are multinational, while others are indigenous. Thus, the influence of national culture is felt in the policies of the firm and the individual people in it. Charlene, who is from Poland, feels lucky to work for a Scandinavian firm because she believes there is a culture of equality emanating from the home office. Hence, she believes she has a greater chance for advancement as a woman than would be the case were she working in an Australian company. She finds too many stereotypes in Australian society that women are polite and softer, regardless of their capabilities. Too many stereotypes in the raising of children - how to dress, for example. In her view, this gender typing is extended to directing people into certain fields. She does not agree with the view that there are women's fields and men's fields.

*2. Acquiring **IT** qualifications*

The women interviewed in the WinIT study tended not to have formal IT qualifications. Rather, they tended to move into IT from other fields. That was not the case for the respondents in the present study, however. The women in this study, for the most part, did have formal IT credentials and revealed the significant influences and barriers they encountered in acquiring them. Key among the influencing factors was attendance at all-girls' schools. The number of respondents who attended a gender-segregated school was noteworthy. But the perceptions about the effect of attending such a school varied. One camp regarded the influence of a single sex school on interest in IT careers in a positive light. They noted, for example, that leadership skills were more developed than they would have been in a co-educational environment.

A second perception was that mathematics and science, as a rule, were not emphasised as much in girls' schools as they were in boys' schools. Nevertheless, many of the women in this study attended the few 'exceptional' all-girls' schools that did emphasise mathematics and science. These schools provided encouragement for the respondents to consider 'non-traditional' fields in mathematics and science.

The third view about gender-segregated schools was that all-girls' schools didn't provide as much exposure to the IT field. Hence, girls came to university less knowledgeable about the field and less informed about the basics of programming. In this way, gender-segregated educational approaches served to disadvantage women when it came to IT careers.

In telling their own stories about getting into the IT field, these respondents consistently identified a significant person who provided the exposure, support and encouragement they needed to enter and remain in courses of IT study. These significant people were parents, partners, other relatives, teachers and role models. Charlene's husband, who also works in IT, encouraged her to go into computer science when they came to Australia. Her father is a civil engineer; her mother is an accountant. Her mother is also strong-willed and technical. She admires her parents for coping

with her and accepting how she raised issues in school. She believes it is acceptable to be very strong and still be a woman. Her parents' view was that if you believed in something, it was alright; be true to yourself.

Where these women experienced female role models, they saw IT as a 'gender-friendly field.' Where they encountered stereotypical male behaviour, they saw IT as a 'man's world' in which they would have to prove themselves. Laura also talked about having strong female role models in her life that were outside the IT field. In her case, she benefited from exposure to her strong, independent aunts. Because young women need role models, Margaret makes visits to schools as part of her work routine. As evidence of the value of such behaviour, Lisa, who works at the same firm, decided to study engineering because of a 'Women and Science' night held at her high school.

Lisa's parents grew up in Germany. They never had formal education themselves because of the War. Therefore, formal education was very important to them. While her parents were very supportive of her, she noticed that other people's parents weren't. She thinks immigrant families in Australia place higher emphasis on education, even for girls, than Australian families. She received no marriage pressure from her parents.

Mitul's story reveals the range of people who can influence the career of an IT professional. In her case, both her parents and her in-laws are responsible for the fact that she is a wife and mother who is also an engineer working in IT. Because she was bright in school, she received early encouragement at home. Her father was happy for her to pursue engineering, though he did caution her that it was a 'man's field'.

A second key influence on these women entering IT was the treatment of mathematics, science and computing as 'male subjects' in school. When these women told their stories about getting into the IT field, they inevitably talked about their experience and attitudes about mathematics. Being good at or attending schools that emphasised maths and science was consistently present in the respondents' backgrounds. Respondents who were born or educated in another country provided evidence that in certain cultures, it is acceptable for women to study science, mathematics and engineering. A similar phenomenon can be applied to gender typing of the computing field. For example, in Yugoslavia where Anita grew up and was educated, women were expected to have careers and engineering was not viewed as a male domain. Lisa's high school in Australia had been a boys' technical high school. She believes she benefited from the fact that it still retained some of the male flavour, especially in science subjects.

3. Women in IT management

Anyone's advancement in a career is aided by good career planning and mentoring; the IT field is no exception. Therefore, if fewer women are in IT management, an explanation might be found in career development activities. At Charlene's multinational IT firm, the executive positions are all held by white men. She notes that in the Australian office, there is neither gender nor cultural diversity. She is very concerned about her career development. She believes she will reach the glass ceiling soon. Although she received agreement on the career plan that she wrote up, she has not been supported in her efforts to implement it. She does not get opportunities to enable her to progress further in management. When she raised the issue, she was given excuses. She eventually left that group. In her new group, she also experiences a lack of support in her development plan. She may leave the company because of it.

A compounding issue, in her view, is that men do not seem to know how to mentor women. Some confuse it with sexual behaviour. Further, some women are reluctant to report sexual harassment. When Charlene encountered sexual harassment from her immediate manager, she

didn't complain because she believed she would be the loser and would be uncomfortable in the company. She would be seen as the black sheep, the troublemaker.

Virginia, on the other hand, can see how she benefited from the female mentors she had earlier in her career. She is one of the three women in this study without formal IT credentials. She moved into the IT industry through IT in health care, where she did have formal educational credentials. Nevertheless, she is currently a female 'non-techie' successfully managing a group of technical males. She attributes her success to several factors. She is very task oriented, not 'touchy-feely.' She is a perfectionist who places extreme emphasis on being logical.

Charlene manages twenty-five people. Her experience of managing men varies by cultural background. The Australian men she manages tend to be middle-aged, hence, she is young enough to be their daughter. They react out of a stereotype that women are not expected to have a strong view. She finds she has to work harder than a man does in her position. Being a manager, she's not an expert in every area, so she has to work hard at maintaining credibility. She believes a man wouldn't be challenged in the same way she is. She commented that "tall, Caucasian, middle aged men" will command more authority, as opposed to a "short, young woman who is not a native English speaker."

The women who are in management positions revealed that they possessed personality characteristics typically thought of as 'masculine'. In this respect, they see themselves as different from other women. At Virginia's workplace, all middle and senior management are males. There were two other females, but they resigned just as she was joining the fmn because the environment was too male dominated, they said, citing evidence that males didn't listen to women and got opportunities that women didn't get. She believes she is different from other women in that she exhibits certain 'male traits', such as being logical, task-oriented and assertive. Her consultant friends, like her, 'don't take crap', she said. She also doesn't let herself be a victim. For these reasons, it is also difficult to set her up. She can delegate, keep people on track, and has broad enough vision to see the issues. This enables her to anticipate problems and, when necessary, escalate them. She makes issues visible in ways such as copying the CEO an email exchange about changing requirements on a project she managed.

The assertiveness seen as necessary for success in the workplace is also seen as necessary in university, in order to 'get what you need' from the educational establishment while studying IT. High self esteem has helped Virginia. Throughout her childhood, she received the message from her father that she could achieve anything she wanted. Consequently, "There's nothing in the world I can't achieve," is her attitude. Those who attended all-girls' schools said that experience taught them leadership and assertiveness. In making her career decisions, Lisa believed she had to be capable of looking after herself. She never thought of having a husband to look after her. Both she and her sister were very sports minded in school. Thus, they were good both physically and mentally. She attributes her position in IT to sports: it gave her the experience of finding and testing her true capabilities. In this way, it contributed to her self-confidence.

Some women, however, believe co-workers are threatened by a woman's assertiveness. Consequently, they have gotten into trouble with older men who do not like being told what to do by a woman. Charlene gets negative feedback for being a strong woman. She was told she's very (too) aggressive and very (too) ambitious. Even the man who has been charged with looking after her career progression isn't supportive of her. She says, "I don't take 'no' for an answer", "I don't just accept without questioning" and "If there's an issue to be raised, I'll raise it." In contrast, Charlene said that male domination of fields is about power: power is in men's hands and if a profession-is powerful, it is male dominated. That is why there are not many women in executive positions. "There is a societal expectation that men make strategic decisions," she said.

4. Work and family

Several respondents talked about the nature of the work in the IT field and how that fits with societal expectations about women in Australia. Some talked about the perception that people who work in the IT field have to work long hours and that the field has little flexibility in the IT field. The younger respondents also spoke about a disconnect between the 'new' messages being sent to young women today, and the 'old' messages being sent to the men. Girls were being sent messages different to those their mothers received about having a career and were recognising the range of career options before them. However, boys were still receiving the old messages about being the bread-winner and being in charge. Consequently, there was tension in relationships. Jill had a relationship in Brisbane that ended because she got a job offer in Sydney. While she chose the job and the move and accepted the consequent breakup, she felt some angst about it. Soon after her move, she found herself walking around the streets of Sydney thinking, "I'm twenty-eight, I want to be married and have children. Am I ever going to have that?"

The women in this study who were married pointed to the support they received from their partners, many of whom also worked in IT. They also commented that their partners are unusual in that respect. Lisa has experienced the range of support levels. A former boyfriend was very competitive and upset when she did better than him at something. An older relative of his cautioned her not to exceed him. On the other hand, her current boyfriend, with whom she is contemplating marriage, has considered the possibility of him staying home with their children. Virginia has a supportive husband who is involved in their children's upbringing; all her professional women friends have supportive husbands. She also had a full-time nanny. She has an equal marriage and, therefore, equal involvement with the kids.

Charlene believes that the twenty-first century will be the century of women in all countries. Women will have to be treated as equals intellectually, socially and economically, she said. For economic reasons it must happen. In Australia, it must happen because families can no longer live on one income alone. She said husbands will have to adjust to working wives. Children will begin to see working mothers as normal. Girls will, therefore, be encouraged to get more education. Consequently, social structures will have to change. The stereotype of men as breadwinners is changing and will drive other changes in society. Women will continue to gain more access to education and professional jobs.

CONCLUSION

Three types of women emerged from these interviews. The first type of woman is one who appeared more or less unfazed by being a woman in a male dominated career and didn't admit to operating on an uneven playing field. They were generally at the top of their classes in high school and university. Given their age and orientation, they would have been in an extreme minority in school and in their careers. These women tended not to focus on the fact that they are women. These women generally said their gender was not an issue. Nonetheless, instances of an uneven playing field often crept into the interviews. For example, Laura views herself first and foremost as a person, not a woman. When she had her two children, she didn't miss a beat at work. She never expected any special treatment, kept her motherhood to herself. As long as she kept up her workload, no-one ever complained that she was a woman or a mother. In late twentieth century language, she was the prototype 'supermum.' However, while she viewed her career largely in a positive light, she talked about how her research suffered while her children were young and that she was put up for promotion in a cohort of men less qualified than her.

The second category of woman is one who accepted the uneven playing field. These women appeared in two forms. In some cases, these women acknowledged they were 'second class citizens'

in the IT workplace. In their view, this was simply the way things were. Surprisingly, these women were often younger. Jill, for example, seems untroubled by the hostile environment in which she worked in her first job. Another type of woman in this category was the woman who easily accepted that a mother working in IT had two full time jobs. Cultural background was often a factor. Cynthia, who is from China, spoke of how difficult it is to keep up with technical changes in the field. Even though her company (and the law) would have allowed her to take more time off when her son was born, her profession required that she return after three months. If she had had a daughter, she said she wouldn't encourage her to become an engineer. Cynthia said it was simply too difficult managing domestic responsibility while trying to keep up with a rapidly changing field. When pointedly asked, she confirmed my interpretation that she had two full time jobs.

The third type of woman is one who has experienced the uneven playing field and who is willing to speak about it. These women expressed their experiences in terms of a 'raised bar' for proving themselves, a hostile educational and work environment, and sexual harassment. Margaret's story about the man with the gender-based perceptions of competence and the various respondents' stories about unwanted sexual advances are some of the strongest evidence of this hostile environment. Denise told about the counterpart in academia. She suffered through sexual innuendo and lies about her sexual conduct with co-workers until she finally left that university.

Those women who had lived in other countries provided evidence of the influence of socio-cultural characteristics on the position of women in IT. One influence was the attitude toward what are considered '.masculine' subjects (mathematics, science, engineering and computing) in some countries, including Australia. On the other hand, Charlene said that in Poland, gender wasn't an issue. There is more acceptance of women working in IT and she observed a more developed societal support infra-structure for childcare. Anita echoed this view when reflecting on her career in IT. In the Yugoslavia of her university days and early career, it was totally acceptable for a woman to become an engineer.

Another influence of socio-cultural context was the attitude toward women working and the behaviour toward women in the workplace. Mitul spoke at length about her experience studying IT and then working as an IT professional in India. In her second year at university, the other two women who were studying engineering with her dropped out. She was left alone to cope with the comments that were carved into the desks or that greeted her when she looked at the blackboard at the beginning of a class. She had no-one to complain to. Nevertheless, she persisted. After she married and had a child, management at the network company in which she worked expected her to quit her job and stay home with the baby. When she didn't, her manager made life difficult for her. She wanted new challenges and opportunities to manage staff; she wasn't given them. After five years of fighting in this 'man's world' she and her husband moved to Australia. In contrast, she has experienced much better IT working environments after moving to her current employer, an American multinational firm in Australia.

The objective of this research study was to probe the findings of an earlier study into the participation of Australian women in IT. The purpose for doing so was to offer deeper insights into the dimensions of this issue to create more awareness about a topic that will remain at the heart of the global information technology sector. This objective has been achieved by offering a framework for organising issues so that educators, policy makers and IT professionals can better understand the meaning behind the observed fact that IT is a male domain in Australia.

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ONGOING RESEARCH

The declining participation of women in the IT education and industry continues to be a complex issue and there is now a considerable body of research literature; for example, see the review by Ahuja (2002). The declining participation prevails despite the idea that "women may prove to be a key resource of skilled technology workers for International IT markets" (Maitland, 2001).

In USA, a NSF funded project (Gurer and Camp, 2002) attempted to bring all research into the declining participation of women in computer science education together and help provide a coherent direction for future work. In their work, a large number of articles was gathered and processed on the topic of women in computing and the shrinking pipeline. A publicly available on-line database was created to organize the references of this body of work by topic, author, and reference information (e.g., date, journal, volume, pages etc.) and their report summarises much of the information that was contained in the database (as of August 2001). The work of Margolis and Fisher (2002) complements this effort by documenting the efforts of a particular institution to address the under-representation of women in computer science.

In Australia, a study among year 9 and first year TAFE and University students by Women in Technology (Tasmania) presents recommendations to increase the number of women entering an IT career (Young, 2002). The Department of Women in New South Wales undertook a pilot research project in 2002 to identify factors influencing students' choice of IT subjects in secondary education. Their report "Girls and IT choices" is expected to be available later this year.

According to the current understanding one of the main reasons for young women's lack of interest in IT careers is the commonly held perception of the IT work being predominantly technical with little social contact. The authors have suggested that providing role models and mentoring could rectify the under-representation of women in the IT education and industry (von Hellens *et aI, 2001;* von Hellens and Nielsen, 2001)

Gender and IT is also under-theorised as most of the published work focuses on data analysis rather than theoretical implications that relate to the existing body of gender, and gender and IT literature (Adam *et aI,* 2001). Addressing the noted under-theorisation, Trauth (2002) employs the empirical data of women IT professionals to theorise about women's participation in the IT sector. An emerging theory of individual differences is being proposed which is positioned as a rejection of the essentialist argument, which reduces the complexity of social phenomena to a single dimension - an essence. The theory of individual differences deepens our understanding of social construction theory by exploring the ways that individual women experience the social shaping of both gender and IT, and thus helps us understand better the many faces of the gender gap in the IT sector. Another promising area of theorisation about gender and IT is to consider the commonalities across under-represented groups as the work of Kvasny and Trauth (2002) on race and gender does.

Recent attempts at developing theories in the context of gender and IT also include studies originating from UMIST in the UK developing a new paradigm for understanding the role of gender in information systems development. (Wilson, 2001, 2002; Wilson and Howcroft, 2000) These studies have employed concepts that have derived from social studies of technology (SST). This theory has primarily been applied within the health care industry.

Nielsen *et al* (2003) presents a re-examination of professional women's interviews using concepts from Giddens' structuration theory which in the last two decades has been applied to information systems research in a number of ways (Walsham, 2002). It has also been suggested that Giddens offers "considerable promise for the development of fuller understandings between gender, power and organisation" (Halford and Leonard, 2001). Concepts such as dualisms and structures of signification were initially established as relevant through a re-reading of the interviews.

Recent research by the WinIT group also discusses an IT mentoring program which was set up for high school students to provide interactions with professional IT organisations. (Beekhuyzen *et al*, 2003; von Hellens *et al*, 2003). The experience gained indicated that students maintaining contact with a mentor generally had a positive experience and gained some insight into the true nature of IT education and work. It is suggested that professional IT women talking to females in their IT education years can give new ideas to the perceptions of IT and thus challenge the dualisms and transform the structures of signification.

The authors continue to study the construction of female identities (Anthias, 1999) and the question of gender differences in IT work and to apply the concepts of structuration theory to the data collected from interviews and surveys of IT students and high school students.

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BIOGRAPHICAL NOTES

Eileen Trauth

Eileen M. Trauth is Professor of Information Sciences and Technology at The Pennsylvania State University. Her research interests are at the intersection of socio-cultural and organizational influences on IS and the IS profession. In 2000 she was Visiting Scholar at the School of Computing and Information Technology at Griffith University in Brisbane, Australia where she conducted research on socio-cultural influences on gender in the IS profession. Dr. Trauth has also published papers on qualitative research methods, global

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Liisa von Hellens

Liisa von Hellens is Associate Professor and the current Head of School of Computing and Information Technology in Griffith University. She has over thirty years experience in the IT industry (including working as a programmer and systems developer) as well as university level education experience in Australia and Europe (Finland and UK). Her doctorate at Templeton College, Oxford University, was about packaged software provision and use, and her subsequent research, publications and consulting activities have covered information systems development and use in organisations, strategic quality management of software development, the management of IT human resources and the associated skills supply. Several refereed articles have been published on these topics. Since 1995 she has also carried out research with Sue Nielsen (Griffith University) into the influence of culture and gender on perceptions of IT education and work, and the factors affecting female participation in IT education and work funded by the Australian Research Council (WinIT project). She has also been involved in establishing an IT Mentoring Program for selected high schools in Brisbane, funded by Griffith University's Strategic Improvement Grant.

Sue Nielsen

Sue Nielsen has taught and worked in Information Management and Information Systems for almost twenty-five years and is currently a senior lecturer in the School of Computing and IT at Griffith University. As well as her involvement with Liisa von Hellens in the WinIT and mentoring projects, she has carried out research on organisational culture and employee commitment in information systems development and software quality management. Her PhD from Griffith University used ethnographic methods and discourse analysis to study change management in an information technology centre. Her current research is investigating cultural differences in perceptions of time and change in information systems development and use.