Information Technology Career Interest: Cross-cultural Study of College Women in Australia, New Zealand, & the United States

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Abstract - Underrepresentation of women in information technology (IT) fields in the United States, Australia, and New Zealand, among other countries, has been well established. However, there is a desire to increase the participation of women in IT college majors and careers because of a need for more IT workers, the aspiration of women to enter high income occupations, and the equity argument that women should have opportunities equal to their male peers. There has been a decline in women (and men) pursuing computer science degrees in these three countries and, because of this, Australia and New Zealand have seen their CS departments shrink or be eliminated. In this study of three English-speaking cultures, the goal was to examine how women view the IT field and its culture in terms of a viable career and how their background in computer use has led them to a college IT major.

Keywords: women and information technology, cross-cultural information technology studies, IT recruitment and retention.

INTRODUCTION

Underrepresentation of women in information technology (IT) fields in the United States (U.S.), Australia, and New Zealand, among other countries, has been well established. Desire to increase the involvement of women in IT fields has stemmed from disparate factors: the economic need for more professionals in the IT industry; an aspiration to see more women in higher income occupations; the equity argument that women should have the same opportunities as their male counterparts; and the diversity factor that has been embraced by most industry professionals which says that having people imagining, developing, and producing IT products and applications will lead to a more vibrant and economically valuable product. Regardless of the motivation, attempts to bring more women into IT careers have had some success. However, women continue to be underrepresented in IT fields.

While 3.3% of male undergraduates major in IT disciplines in the United States, only 1.1% of female undergraduates do so [8]. From 1980 to 1994 the percentage of women in the United States receiving computer science degrees decreased [2]. In that time period the percentage of Ph.D. degrees awarded to women in computer-based disciplines increased significantly, but the large gender imbalance remains in the classroom and in employment [2]. In Australia more women are enrolling in IT courses, but not at the same rate as men. Therefore, the proportion of women in IT courses decreased from 22% in 1994 to 19% in 1998 [10].

Earlier work in New Zealand raised concerns about the low percentage of women majoring in IT at New Zealand universities [12]. As in reports from other countries, researchers found that high school girls were ill informed about the range of career opportunities in computer-based fields. They saw IT as a male, "nerdy" domain; they lacked confidence in their computer abilities; there were few female role models or mentors; and they had little computer

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experiences. More current research shows that females in U.S. high schools and colleges have caught up with their male peers in their computer skills and abilities [9], but they still lack information about the variety of IT jobs available and still have few female mentors and role models.

Previous studies examined both the way women enter IT employment [5] and the attitudes of women working in this male-centered IT culture [15]. Leventman [5] found that, in the U.S., women entered IT in one of three ways. Those entering by a traditional pathway decided on a computer-based career in high school or as undergraduates, earned a bachelor's degree in IT, and had a job in IT or another highly technical field. Others transitioned from a non-IT filed to IT by pursuing a graduate degree in IT. The last group did not have a technical degree but worked in an IT organization. They received training or took IT classes on their own and moved into IT work.

The way women navigate the male-centric IT culture in Australia was broken down into three general types. First, some women were neither discouraged nor disturbed by being in a predominantly male environment. These women never expected special treatment for childbirth or family issues. The second group of mostly younger women accepted that this was the way things were in the IT workplace. The third group was those who chose to recognize and speak out about inequitable policies and practices [15]. Earlier work examined the effects of cultural background on how IT skills were valued [12]. There was some confusion among first year students majoring in IT at three Australian universities about what having a career in IT actually entailed. Confounding these perceptions were gender, national origin, and cultural values. These researchers concluded that female students from Western cultures in Australia saw computer-based professions as masculine.

When the IT industry began to blossom, there were great hopes that this new field would be welcoming to women, but this was not the case. After an initial influx, women's participation in IT in the U.S. settled at about 20% or less: fewer in upper management, more in lover level, data entry position. In Australia, "(t)he Association of Professional Engineers, Scientists and Managers, Australia found that in 2007, 8.3% of female IT professionals were employed at level 1 (on a scale of 5 with 1 the lowest) compared with 6.1% of males, and 12.2% at level 5 and 'above level 5' compared with 15.8% of males. Encouragingly, the number of female IT professionals at level 4 increased from 22.0% in 2004 to 28.8% in 2007" [17]. (Comparable data from New Zealand could not be found. However, in interviews with university faculty in New Zealand, the author was told that fewer than 20% of IT professionals in New Zealand were female.) Given this underrepresentation of women in IT fields, it is important to understand what decision factors influence whether women choose IT careers. These factors include social and cultural variables and are not restricted to the simple explanations of aptitude and interest. The existing literature on why women do not pursue IT careers includes cultural factors such as sex-role stereotyping [10], discrimination [13], and parental and peer pressure [13]. Also, women often have inaccurate perceptions of what computing careers involve. This misconception causes them to avoid courses and majors that could lead to these careers, which could have potentially been appealing to them [10,14,16]. Some factors contributing to women deciding to pursue study in IT fields include attendance at all girls schools [16], supportive parents [16], and mentoring [13]. This is clearly not a simple problem with a simple solution. Instead, a variety of complex factors combine to determine whether women choose to study in IT fields.

This study was undertaken as a continuation of a previous comparison done between college women in the U.S. and Korea [3]. The opportunity to survey and interview students majoring in information technology at two universities in Australia and two in New Zealand allowed us to compare student opinions about IT careers in countries with a common language and similar cultures.

For this study we used the theoretical framework of self-authorship to examine the decision factors influencing women's IT career choices. Self-authorship is a developmental construct first articulated by Kegan [4] and further developed by Magolda [6, 7]. Self-authorship is significant for decision making because it is "the ability to collect, interpret, and analyze information and reflect on one's own beliefs in order to form judgments" [7, p. 14]. Using self-authorship shows how women take input from parents, teachers, and other influential individuals and incorporate that into their IT career decision-making process. The purpose of this research is to examine differences between American and Australian and New Zealand college students on factors associated with interest in IT careers. In comparing the interest, ability, and career plans of college women in these three countries, it is important to understand the differences, though slight, in the three educational systems (Table 1).

Table 1. Grades in USA, Australia, and New Zealand public education systems

	Primary or Elementary School	Intermediate or Middle School	Secondary or High School
U.S.	K - 5	6, 7, 8	9 - 12
Australia	K – 7 (in some states primary ends at grade 6)		7 – 12 (in some states secondary school starts at grade 8)
New Zealand	1 - 6	7, 8	9 – 13

The public schools have a few differences that show up mainly in the lack of middle schools in Australia and the "grade 13" in New Zealand secondary schools. The latter means that college students study for only three years before receiving a bachelor's degree while students in U.S. and Australian universities attend for four (or more) years to obtain a bachelor's degree.

METHODS

Participants in this cross-cultural study included 393 female college students majoring in IT at a land grant university in the mid-Atlantic region of the U.S. There were 35 female college students from two universities in Brisbane, Australia, and 63 female college students from two universities on the North Island, New Zealand. A total of 496 female college students completed usable questionnaires. Of those who were interviewed, 35 were from the U.S., 13 from Australia, and 16 from New Zealand. Table 2 shows the racial/ethnic identity of the students who completed the questionnaires.

Table 2. Race/ethnicity

Race/Ethnicity	**U.S.**	**Australia**	**New Zealand**
White/European	155 (39.4%)	12 (35.3%0	16 (25.8%)
Asian		17 (50.0%	24 (38.7%)
Maori			6 (9.6%)
Other		4 (12%)	16 (25.8%)
Minority	219 (55.7%)		
Total	393	34	62

A 118-item questionnaire, developed in the U.S. as part of a project funded by the National Science Foundation[2], was used as the basis for the research. In order to compare the differences in interest in IT majors and careers between and among U.S., Australian, and New Zealand female college students, we analyzed : 1) the amount of computer use including the types of computers use – social, technical, cultural, or entertainment; 2) positive and negative attitudes about IT workers; 3) communication with others, like family members, friends, and significant others, about majors and careers; and 4) parental support for careers.

RESULTS AND DISCUSSION

Table 3 shows the differences in the amount of overall computer use between and among U.S., Australian, and New Zealand students. The results indicate that female students in Australia and New Zealand overall use of the computer is significantly higher than U.S. female use.

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Table 3. Overall computer use by female college IT students in Australia, New Zealand, and the U.S.

Country	Compared to	Mean Difference	Std. Error	Significance
Australia	New Zealand	.25622	.55396	.889
	U.S.	8.96531*	.45808	.000
New Zealand	Australia	.25662	.55398	.889
	U.S.	9.22153*	.41546	.000
U.S.	Australia	-8.96531	.45808	.000
	U.S.	-9.22153	.41546	.000

* The mean difference is significant at the 0.05 level.

In order to explore the differences in the types of computer use, we divided the list of computer utilization into four categories: communication (Table 4), technical (Table 5), entertainment (including games and news sources) (Table 6), and education (including school work and web design) (Table 7).

Table 4. Comparison of computer use for communication among Australia, New Zealand, and U.S. female college IT majors

Country	Compared to	Mean Difference	Std. Error	Sig.
Australia	New Zealand	.065	.031	.109
	U.S.	1.453*	.045	.000
New Zealand	Australia	-.065	.031	.109
	U.S.	1.389*	.055	.000
U.S.	Australia	-1.453*	.045	.000
	New Zealand	-1.389*	.055	.000

* The mean difference is significant at the 0.05 level,

Table 5. Comparison of computer use for technical tasks among Australia, New Zealand, and U.S. female college IT majors

Country	Compared to	Mean Difference	Std. Error	Significance
Australia	New Zealand	-.14194	.28655	.874
	U.S.	3.16456*	.24706	.000
New Zealand	Australia	.14194	.28656	.874
	U.S.	3.30649*	.18685	.000
U.S.	Australia	-3.16456*	.24706	.000
	U.S.	-3.30649*	.18685	.000

* The mean difference is significant at the 0.05 level.

Table 6. Comparison of computer use for entertainment among Australia, New Zealand, and U.S. female college IT majors

Country	Compared to	Mean Difference	Std. Error	Significance
Australia	New Zealand	-.28664	.41994	.774
	U.S.	3.00705*	.36653	.000
New Zealand	Australia	.28664	.41994	.774
	U.S.	3.29369*	.25236	.000
U.S.	Australia	-3.00705*	.36653	.000
	U.S.	-3.29969*	.25236	.000

* The mean difference is significant at the 0.05 level.

Table 7. Comparison of computer use for educational tasks among Australia, New Zealand, and U.S. female college IT majors

Country	Compared to	Mean Difference	Std. Error	Significance
Australia	New Zealand	.108	.080	.375
	U.S.	1.364*	.060	.000
New Zealand	Australia	-.108	.080	.375
	U.S.	-1.256*	.073	.000
U.S.	Australia	-1.364*	.060	.000
	U.S.	-1.256*	.073	.000

* The mean difference is significant at the 0.05 level.

Previous work showed that female students at all educational levels held negative attitudes about those who worked in computer-related professions [1]. As computers became ubiquitous in households and in the workplace, these attitudes softened. More current research [8] shows that female students' opinions have modified since the late 1900's with most young women having a positive attitude toward IT workers. In our survey, positive attributes, including interesting, good at math, hardworking, and smart, were combined as were the negative attributes, including being geeks, males, and loners. In looking at the attitudes toward IT workers, we found that U.S. students had the most positive attitudes about IT workers and Australian women were the least positive (Table 8). Interestingly, U.S. students were also most negative about IT workers (Table 9). This polarization we not borne out conversations with female students who did not express the negative attitudes seen in the survey results.

Table 8. Positive attitudes about workers in computer-related fields

Country	Compared to	Mean Difference	Std. Error	Significance
Australia	New Zealand	-.94378	.45342	.103
	U.S.	-1.26186*	.40711	.010
New Zealand	Australia	.94378	.45342	.103
	U.S.	-.31808	.24391	.397
U.S.	Australia	1.26186*	.40711	.010
	U.S.	.31808	.24391	.397

The mean difference is significant at the 0.05 level.

Table 9. Negative attributes of workers in computer-related fields

Country	Compared to	Mean Difference	Std. Error	Significance
Australia	New Zealand	-.08245	.48551	.984
	U.S.	-2.13718*	.40788	.000
New Zealand	Australia	.08245	.48551	.984
	U.S.	-2.05473*	.30824	.000
U.S.	Australia	2.13718*	.40788	.000
	U.S.	2.05473*	.30824	.000

* The mean difference is significant at the 0.05 level.

In order to examine the messages the young women were receiving about the suitability of having a career, we explored the differences in the amount of communication with family members, friends, and other adults that occurred. We found that parents in all three countries were perceived as being supportive of their daughters' pursuit of careers (Table 10).

Table 10. Parental support for careers

Country	Compared to	Mean Difference	Std. Error	Significance
Australia	New Zealand	.76820	.99634	.722
	U.S.	1.10271	.81383	.376
New Zealand	Australia	-.76820	.99634	.722
	U.S.	.33452	.64539	.863
U.S.	Australia	-1.10271	.81383	.376
	U.S.	-.33452	.64539	.863

* The mean difference is significant at the 0.05 level.

Table 11. Comparison of Parental Support among U.S., Australian, and New Zealand Female College Students (% who agree or strongly agree)

Survey statement	Australia	New Zealand	U.S.
It is important to my mother/female guardian that I have a career	97.0	93.3	98.0
It is important to my father/male guardian that I have a career	97.0	93.2	95.9
My mother/female guardian has a clear idea about careers that would suit me	64.7	54.2	76.3
My father/male guardian has a clear idea about careers that would suit me	54.5	54.2	70.0
My parents/guardians encourage me to make my own decisions about my future career	97.1	90.3	94.9
I would like my parents to approve my choice of career	93.9	85.0	17.3
My parents encourage me to talk with others about my career options	68.8	80.0	76.9
My parents encourage me to explore a variety of career options	62.5	72.5	82.6

Students in all three countries perceive that their parents or guardians think that it is important for a female to have a career at least at some point in their lives. During interviews, very few female college students thought that they would leave the workforce permanently if and when they married and had children. Fewer students believed that their parents had any idea about what career would suit them. Those in the U.S. had more faith that their parents "knew them." Students in all countries felt encouraged by their parents to make their own decisions, but only the U.S. students felt strongly about not needing parental approval for their career choice. Finally, the percentages of students in the three countries who felt encouraged by their parents to seek out information about a variety of career options were quite a different with those in Australia feeling the least encouragement.

We further examined how much time the young women spent discussing their career plans with others. Overall, Australian and New Zealand students communicated with others more about careers (Table 12). Their communication sources included family (Table 13), friends (Table 14), and other adults (Table 15).

Table 12. Communication with others about career plans

Country	Compared to	Mean Difference	Std. Error	Significance
Australia	New Zealand	-.62998	1.02383	.812
	U.S.	6.28993*	.80504	.000
New Zealand	Australia	.62998	1.02383	.812
	U.S.	6.91991*	.75608	.000
U.S.	Australia	-6.28993*	.80504	.000
	U.S.	-6.91991*	.75608	.000

* The mean difference is significant at the 0.05 level.

Table 13. Communication with family members about careers

Country	Compared to	Mean Difference	Std. Error	Significance
Australia	New Zealand	-.09108	.45434	.978
	U.S.	1.72929*	.36693	.000
New Zealand	Australia	.09108	.45434	.978
	U.S.	1.82037*	.30868	.000
U.S.	Australia	-1.72929*	.36693	.000
	U.S.	-1.82037*	.30868	.000

* The mean difference is significant at the 0.05 level.

Table 14. Communication with friends about careers

Country	Compared to	Mean Difference	Std. Error	Significance
Australia	New Zealand	.14009	.48615	.955
	U.S.	2.51840*	.40152	.000
New Zealand	Australia	-.14009	.48615	.956
	U.S.	2.37831*	.32746	.000
U.S.	Australia	-2.51840*	.40152	.000
	U.S.	-2.37831*	.32746	.000

* The mean difference is significant at the 0.05 level.

Table 15. Communication with other adults about career plans

Country	Compared to	Mean Difference	Std. Error	Significance
Australia	New Zealand	-.65714	.45938	.330
	U.S.	2.05425*	.32350	.000
New Zealand	Australia	.65714	.45939	.330
	U.S.	2.71139*	.37597	.000
U.S.	Australia	-2.05425*	.32390	.000
	U.S.	-2.71139*	.37597	.000

* The mean difference is significant at the 0.05 level.

CONCLUSION

In summary, this study was undertaken to examine the cultural differences and similarities between and among three countries with the same national language (English) and similar population origins – immigrants mostly from Western European countries. The differences in educational systems were slight enough so that comparison of college IT majors was felt to be valid. In all areas surveyed save two, female IT students in Australia and New Zealand were very similar and significantly different from their American counterparts. Australian and New Zealand females used the computer more than Americans, and communicated more with others about possible

career plans. In all three countries, parents were supportive of their daughters' plans to have careers. The economic realities of modern life do not allow parents to encourage girls to get a little education and then marry and stay at home. In interviews, all females reported planning to combine work with family life, although not many were clear about how that could be accomplished.

American women had the strongest reaction toward IT workers; they were had the most negative and the most positive responses. New Zealanders were moderate in their opinions while Australians were the least positive. The survey results did not correspond with the interview opinions, however. Some women pointed out particular events that mirrored negative stereotypes of IT workers but did not, overall, think of IT workers in a negative way. This may be because they saw themselves as future IT workers.

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BIOGRAPHICAL INFORMATION

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