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Abstract

Computing has been long considered a male domain in the US. With this perception, females may experience negative outcomes in the occupation or activities. Does this perception exist in other countries? This paper reports a study that investigated the gender perception of computing in three different countries: US, China, and India. The study involved 638 undergrad students. The study compared gender perception of computing between males and females within each country and between countries. It is found that American respondents perceived technical and managerial aspects of computing as neither a male nor a female domain, while American female respondents perceived clerical and office uses of computing as a female domain. Chinese males perceived technical and managerial aspects of computing as a male domain. Indian respondents perceived no gender perception toward computing.

Keywords

Gender Perception toward Computing, Gender Stereotype, Cross Culture Comparison, US, China, India

Introduction

The subject of gender perception toward computing has been studied within the MIS discipline for quite sometimes. It has been long perceived that computing is a male domain in work places. If such perception is prevalent worldwide, it can directly and indirectly impact the interaction between male and female computing-related employees within an organization and between organizations. It can also impact the interaction between employees and opposite-gender customers. Gender perception toward computing could affect not only the participation and success of females in computing-related works/careers, but also the interaction among employees. In return, it could affect the productivity and success of computing-related projects and businesses as a whole. For example, US customer might not have confident in female Indian customer support at the end of the line since they think a male customer support personnel should be more knowledgeable on computing technical issues. Undisputedly, female workforce plays significant portion in IT industry worldwide.   In fact, IT customer service such as India tends to use a significant portion of female personal since the female customer service is perceived as a more friendly service provider (Elmoudden, 2004).

Recently, the cross-cultural issue within IT outsourcing context has been gaining attention because increasing number of US companies outsources their IT workforces to foreign countries. Three-quarters of US companies outsourced some or all of their information technology activities in 2004 (The Financial Express, March 26, 2005). According to Global Outsourcing Report 2005, India and China were among top three countries to which US companies outsourced IT workforces (CIO Insight, March 21, 2005). India has built up an international reputation for its dynamic information-technology sector and call centers (Schwarz, 2006). China, following the apparent success of India, began to court outsourcing IT projects on the strength of low labor costs and a large pool of workers skilled in the basics of IT (Won, 2004).

Statistics and research indicated that female workforces in both countries experienced disadvantages in IT industries. Due to differences of culture, computer literacy, and IT infrastructures, offshore outsourcing countries' perception of gender toward computing might be different from the US's. If that is true, the need to understand the gender stereotyping in cross-cultural context is critical to help improve IT outsourcing operation.

This exploratory research is an initial part of a cross cultural gender typing research stream. The primary objective of this particular research is to justify whether or not culture different exists among these three cultures in regard to gender typing in computing. If the finding shows the difference, the future research has to put this difference into consideration when research is designed. The secondary objective is to validate the measurement instruments (Gender Typing Scales) that applicable cross culture. Therefore, the results of exploratory factor analysis and reliability test are included within this study to reflect the second objective. These findings will help researchers build a robust theoretical model regarding gender typing in cross cultural context in the future.

To investigate the gender perceptions toward computing in China and India in comparison with the US, it is logical to pose the question of whether gender perceptions toward computing are different among Americans, Chinese, and Indian?

Research question 1: Is gender perception toward computing different from one subject country to another?

Research question 2: Are there difference in gender perception toward computing between male and female in each subjected country?

Literature review

Women and computing in US, India, and China

In the US, increasing numbers of men and women have been exposed to, and are using, computers, the Internet, and other types of IT in their jobs and in their personal life. The U.S. Census Bureau (2005) reported national trends of an increased overall exposure to computers and the Internet. The report showed that in 2003, more women than men used a computer at home by a small margin, reversing the computer use "gender gap" exhibited during the 1980s and 1990s. Women's Internet use at home also exceeded men's in 2003. At work, 63 percent of women and 51 percent of men used a computer at work. Forty-seven percent of women and 39 percent of men use the Internet on the job in 2003. However, the number of professional women in computing-related workforces was still low. According to Information Technology Association of America (ITAA), the number of women professionals was at 25.3% out of an IT workforce of 3.6 million workers (Messmer, 2003).

As for India, the HinduBusinessLine.com reported that in 2000 women comprised only 19 percent of the Indian IT workforce, primarily within the software sector. The male-female ratio in IT jobs was predicted to be 65 men to 35 women by the year 2005 (The Equity for Educational Development, accessed March 4, 2006). Most Indian women still lacked literacy and basic education. More advanced or specialized IT education was out of reach for poorer women and only realistic for those middle class women and elite (The Equity for Educational Development, accessed March 4, 2006). The lack of mobility was one of the major constraints to women's ability to participate in the IT workforce in India. Most IT jobs were located in New Delhi, Hyderabad and Mumbai. If women want to work in the IT sector, they will have to relocate. However living alone away from home is not the norm for young, single women because of security issues and the traditional view that women's role in the home with the family.

Chinese women in IT workforce were also found disadvantages in IT industry. Liu (2004) conducted extensive interviews with women in IT companies. According to Liu (2004), there tend to be fewer female employees than male employees in the technology-intensive departments in both domestic and transnational companies. Women in technical positions within IT companies generally worked on training or technical support, both of which did not require advanced technical knowledge. Women were assigned to such positions because they appear to be better at communicating with customers. According to one female interviewee, women in the core-technology research and development team were there "as decoration or to make male colleagues feel more relaxed" (as cited in Liu, 2004). Liu (2004) explained further that in term of work identity in IT companies, female employees usually have less interest and confidence in technical positions because they could not compete with their male colleagues. Even though female employees believe that they were not less capable than male colleagues in their technical positions, they identified themselves less as a technical person and gave lower self-assessment to their performance. Liu (2004) explained further that family greatly influenced their career development. If they had to choose between a successful career and a happy family, they would choose the latter. In addition, due to the drastic competition and the fast-paced technological changes in the IT industry, women could not afford to have children. Maternal leaves could mean losing promotion opportunities, or even losing jobs. If women want to be good wives and mothers, they believe they would not be able to lead a fruitful career in IT industry.

Gender Stereotyping of Computing

A gender-typed activity/occupation is defined as one where males and females are perceived as possessing different abilities or levels of ability, personality attributes, and/or interpersonal interaction styles (Astone, 1995). Activities that require abilities, attributes, and interaction styles expected of masculine are gender type male, and those expected of feminine are gender type female (Astone, 1995). There are two techniques that have been used to determine if an activity or occupation is gender type male, female or considered neutral. First technique is to use actual rates of participation of men and women in a career field and compare them to some arbitrary cut off (Betz and Hackett, 1981; Stephan and Holahan, 1982). Second technique is to use subjective ratings such as a scale of masculinity/femininity (Panek, Rush and Greenawalt, 1977; Shinar, 1975; Wilder, 1985), the perception of the number of males or females employed in a career (Shinar, 1975), the personality traits associated with jobholders (Glick, 1991; Shinar, 1975), or the perception of undergrad/graduate students to identify gender-typed activities (Astone, 1995; Cash, Gillen and Burns, 1977; Scheresky, 1978; Shepard and Hess, 1975).

Studies attempting to gender type of computing have arrived at different conclusions. Smith (1986, 1987) measured the gender-typing perceptions of teachers and students in grades K-12. Even though respondents showed a positive favoring of the equality of the sexes, more males than females seemed to believe that males were better suited to computer competencies. Clarke (1989) examined 595 Australian adults and gender-typed forty occupations. Five computer-related jobs were included in the list of occupations and all but one, data entry operator was gender typed male. Wilder et al., (1995) in studies with children and youth determined that the computer was perceived to be more suitable for males than females. In a second study using, 334 college freshmen, Wilder et al. (1995) reported that the difference in perceptions between males and females was not significant. Astone (1995) used a gender stereotyping of computing scale to measure perceptions. She reported that overall computing was viewed as slightly feminine. Rainer et al. (2002) investigated how gender perception toward computing of college students has changed between year 1995 and 2002. They found in 1995 both men and women perceived gender type of computing as female. However, women perceived gender type of computing more female than did men. From 1995 to 2002, both men and women had gender type of computing as more male, but no significant differences between male and female perception in 2002.

Methodology and data collection

To investigate difference in gender perceptions of computing in the US, China, and India, the researchers examined six samples of university students with a business major, four from the US (241 students), one from China (233 students), and one from India (164 students). All samples were from four year institutions. All students were offered extra credit as an incentive to complete the questionnaire. The American and Chinese surveys were distributed and collected in an online format, while the Indian survey was done on a paper-based format due to the lack of infrastructure.

The survey instrument gathered demographic and computer usage data on respondents, including gender, age, years of computer use, and number of computer courses taken, and hours per week spent on the Internet. The questionnaire contained the gender-typing scale (GTS) developed by Astone (1995). According to Astone (1995) and Rainer et al. (2002), their analysis of the GTS demonstrated two underlying latent constructs, "the technical and managerial aspects of computing" and "the clerical and office uses of computers and affective responses to computing". The GTS measures perception of the gender stereotyping of computing on 5-point Likert scales, ranging from "1" meaning "strongly disagree" to "5" meaning "strongly agree." The study employed two versions of the survey to mitigate survey-wording bias in the GTS section. The first version listed all GTS items as "female first." For example, "I believe that more women than men design computer systems". The second version reversed the GTS items. For example, "I believe that more men than women design computer systems". The researchers tried to distribute each version equally to respondents. The first version's scores were reversed, so that all scores used and reported in the data analysis are in the "female first" direction. To compare male and female perception within each subject country and between subject countries, t-tests were performed.

Data analysis

Demographic

Table 1 shows the demographic data of respondents as well as computer-and-Internet usages. Demographic data included gender and age. Computer-and-Internet usages included number of computer classes taken, years of computer usage, and number of hours per week Internet usage. Forty nine percent of American respondents were male, and 51 percent were female. Sixty percent of Indian respondents were male and 33 percent were female. Thirty nine percent of Chinese respondents were male, and 61 percent were female. The average age of American, Indian, and Chinese respondents were 22, 19, and 22 years old accordingly. There was no significant different of number computer classes taken, years of computer usages, and number of hours per week for Internet usages between American males and females. American males and

females took much more number of computer classes, had more experience in computer usages, and spend more time on the Internet per week than Indian and Chinese respondents.

Table 1: Demographic

Number of Responses and Percentage	American	Indian	Chinese
Male *%*	119 *49%*	110 *67%*	90 *39%*
Female *%*	122 *51%*	54 *33%*	143 *61%*
Age			
Male	22	19	22
Female	22	18	23
Number of Computer Classes			
Male (Standard deviation)	2.0 (1.9)	0.7 (1.1)	2.2 (1.1)
Female (Std)	1.9 (1.8)	0.2 (0.5)**	1.5(0.9)**
Year of Computer Usage			
Male (Std)	11.4 (3.8)	3.0 (2.7)	5.7 (3.1)
Female (Std)	11.5 (3.4)	3.4 (2.2)	5.3 (3.0)
Internet Usage (Hr/Week)			
Male (Std)	21.5 (17.6)	3.2 (3.8)	12.5 (11.4)
Female (Std)	20.4 (20.6)	2.4 (2.4)***	8.0 (12.6)***

 **Significantly difference at 0.001, **Significantly difference at 0.05

Exploratory Factor analysis

The GTS consists of a 13-item factor. The items of the GTS were scored on point Likert scales ranging from "1" meaning "strongly disagree" to "5" meaning "strongly agree." Exploratory factor analyses with oblique rotation were used to examine the interrelationships among 13 items of the GTS for men and women in three countries. In all six analyses (male and female respondents in three countries), a 2-factor solution resulted with identical items in each factor. The first factor, labeled GTS1, consisted of seven items. The items defining this factor represent technical and managerial aspects of computing. The second factor, labeled GTS2, consisted of six items. The items defining this factor represent the clerical and office uses of computers and affective responses to computing. The exploratory factor analysis and alpha reliabilities over 0.7 suggest that the factor structures of the GTS1 and GTS2 are acceptable and provide evidence for the construct validity of the measure.

Research question 1: Comparisons of GTS scores across three subject countries. Table 2 shows the results of mean comparisons of GTS1 and GTS2 scores across three countries.

For America, American respondents' GTS1 score, 2.62, leaned toward '3' (Neutral) ('1' = Strongly disagree, '3' = Neutral, and '5' = Strongly agree), meaning that they did not perceived the technical and managerial aspects of computing as either a male or a female domain. American respondents' GTS2 score, 3.72, leaned toward '4' (Agree), meaning that they somewhat perceived the clerical and office uses of computing as a female domain.

For China, Chinese respondents' GTS1 score, 2.47, leaned toward '2' (Disagree), meaning that they somewhat perceived the technical and managerial aspects of computing were a female domain. Chinese respondents GTS2 score, 3.37, leaned toward '3' (Neutral), meaning that they did not perceived the clerical and office uses of computing as either a male or a female domain.

For India, Indian respondents' GTS1 score, 3.39, leaned toward '3' (Neutral), meaning that they did not perceived the technical and managerial aspects of computing as either a male or a female domain. Indian respondents' GTS2 score, 3.27, also leaned toward '3' (Neutral), meaning that they did not perceived the clerical and office uses of computing as either a male or a female domain.

American respondents demonstrated significant higher GTS1 and GTS2 scores than did Chinese respondents. American respondents' GTS1 score, 2.62, was closer to the neutral than was Chinese respondents' GTS1 score, 2.47. It means that American

respondents perceived that the technical and managerial aspects of computing were more 'neither male nor female' domain than did Chinese respondents. However, Chinese respondents' GTS2 score, 3.37, was closer to the neutral than was American respondents' GTS2 score, 3.72. It means that American respondents had stronger perception of the clerical and office uses of computing as a female domain than did Chinese respondents.

American respondents demonstrated significant lower GTS1 score than did Indian respondents. While both country respondents' GTS1 scores were closed to the neutral, Indian respondents' GTS1 score, 3.39, showed stronger perception of the technical and managerial aspects of computing as a female domain than did American respondents' GTS1 score, 2.62. Indian respondents' GTS2 score, 3.27, was closer to the neutral than was American respondents' GTS2 score, 3.72. It means that American respondents had much stronger perception of the clerical and office uses of computing as a female domain than did Indian respondents.

Indian respondents demonstrated significant higher GTS1 score than did Chinese respondents. Indian respondents perceived that the technical and managerial aspects of computing were neither a male nor a female domain, while Chinese respondents perceived that the same aspects of computing were somewhat a male domain. While Chinese respondents' GTS2 score was significantly higher than was Indian respondents', both scores demonstrated that both Chinese and Indian respondents did not perceived the clerical and office uses of computing as neither a male nor a female domain.

Table 2: Comparisons of GTS1 and GTS2 scores across three subject countries

Psychological Constructs	(GTS1) (technical and managerial aspects)				(GTS2) (clerical and office uses)			
American VS Chinese	2.62	VS	2.47	***	3.72	VS	3.37	***
American VS Indian	2.62	VS	3.39	***	3.72	VS	3.27	***
Chinese VS Indian	2.47	VS	3.39	***	3.37	VS	3.27	***

***Significantly difference at 0.01, Hotelling's T test with 5000 Monte Carlo Randomization

Research question 2: Comparison of GTS scores between males and females in each subject country. Table 3 shows the results of mean comparisons of GTS1 and GTS2 scores between males and females in each country.

For America, the overall GTS1 demonstrated that American respondents did not perceive the technical and managerial aspects of computing as neither a male nor a female domain. American males also reported no significant difference of GTS1 score than did American females. Both American males' score, 2.51, and females' GTS1 score, 2.74, showed that their gender perceptions of technical and managerial aspects of computing closed to a neutral, meaning that both genders somewhat perceived technical and managerial aspects of computing as neither a male nor a female domain. The overall GTS2 demonstrated that American respondents somewhat perceived the clerical and office uses of computing as a female domain. American females reported significant higher GTS2 score, 4.08, than did American males, 3.38. It means that while American females perceived that the clerical and office uses of computing as a female domain, American males perceived same aspects of computing as neither a male nor a female domain.

For China, the overall GTS1 demonstrated that Chinese respondents somewhat perceived the technical and managerial aspects of computing were a male domain. However, Chinese females reported significant higher GTS1 score, 2.69, than did Chinese males, 2.10. It means that while Chinese females perceived the technical and managerial aspects of computing as neither a male nor a female domain, Chinese males perceived the same aspects of computing as a male domain. The overall GTS2 demonstrated that Chinese respondents perceived the clerical and office uses of computing as neither a male nor a female domain. However, Chinese females reported significant higher GTS2 score, 3.74, than did Chinese males, 2.74. It means that while Chinese females somewhat perceived the clerical and office uses of computing as a female domain, Chinese males perceived the same aspects of computing as neither a male nor a female domain. These findings support Liu's (2004) research findings.

For India, the overall GTS1 demonstrated that Indian respondents perceived the technical and managerial aspects of computing were neither a male nor a female domain. Indian males also reported no significant difference of GTS1 score than did Indian females. Indian males' score, 3.26, indicated that Indian males perceived this aspect of computing as neither a male nor a female domain. Indian females' GTS1 score, 3.66, indicated that Indian females somewhat perceived these aspects of computing as a female domain. The overall GTS2 demonstrated that Indian respondents perceived the clerical and office uses of computing as neither a male nor a female domain. Indian males also reported no significant difference of GTS2 score than did Indian females. Indian males' score, 3.14, indicated that Indian males perceived this aspect of computing as neither a

male nor a female domain. Indian females' GTS2 score, 3.54, indicated that Indian females somewhat perceived these aspects of computing as a female domain.

Table 3: Comparison of GTS1 scores between males and females within each country

Psychological Constructs	US (Cronbach's alpha)	China (Cronbach's alpha)	India (Cronbach's alpha)
GTS1 (technical and managerial aspects)			
Male	2.51 (0.94)	2.10 (0.85)	3.26 (0.79)
Female	2.74 (0.93)	2.69 (0.88) ***	3.66 (0.82)
GTS2 (clerical and office uses)			
Male	3.38 (0.91)	2.74 (0.79)	3.14 (0.78)
Female	4.08 (0.91) ***	3.74 (0.84) ***	3.54 (0.90)

***Significant difference at 0.01, Hotelling's T test with 5000 Monte Carlo Randomization

Discussion

With regard to technical and managerial aspects of computing, the results suggest that American respondents perceived equal capabilities and opportunities in technical and managerial aspects of computing. One possible explanation is that both American males and females had equal experience in computer usages and Internet usages. This finding is welcome because it promotes equal opportunities in technical-and-managerial types/areas of computing-related works or careers regardless of gender, and thus, encourages the participation of women in these types/areas of computing-related works or careers. In addition, it means that American employees would feel comfortable to work on technical-and-managerial types of computing-related projects with foreign, opposite-gender employees located in offshore outsourcing countries such as China and India. American customers would also feel comfortable to receive technical-and-managerial types of computing-related services from foreign, opposite-gender technical supports.

Based on the result from India, Indian employees also feel comfortable working with American employees on technical-and-managerial types of computing-related projects, or providing technical supports to American customers regardless of gender. This is because Indian respondents perceived no gender attitude toward these aspects of computing. However, this might not be the case for China. Chinese males perceived technical and managerial aspects of computing-related projects or careers as a male domain. With a male dominated perception, Chinese males may dominate and control technical and managerial types of computing-related activities/projects for their own advantages. They may not feel comfortable to work with Chinese females or American females on those activities/projects because they perceived that females did not have the same level of capabilities in these aspects of computing.

With regard to the clerical and office uses of computing, the results indicate that male respondents from three countries perceived these aspects of computing as neither a male nor a female domain. American females perceived the clerical and office uses of computing as a female domain, while Chinese and Indian females somewhat perceived the same aspects of computing as a female domain. While the findings showed gender stereotyping in the clerical and office uses of computing, they do not discourage either men or women to participate in these aspects of computing. However, American female employees or customers might feel less comfortable to work or receive the computing services that relates to clerical and office uses from male employees within their organizations or foreign male customer supports from India or China.

Limitations

This study assumed that the means of data collection had no impact on the results. In the pilot study, the researchers found that the majority of Indian students could not conveniently access the Internet. Therefore, we decided to distribute a paper-based survey to Indian respondents. An online survey was conducted in America and China to provide convenience to respondents. In reality, there may be a difference resulting from the various data collecting methods. For future research, American and Chinese respondents could be polled using the paper-based survey, and then compare the result with the existing online-survey data of the American and Chinese.

Conclusions and Managerial Implication

The findings show that American perceived equality of capabilities and opportunities in technical and managerial types/areas of computing-related works/projects regardless of gender. American males perceived no gender perception toward clerical and office uses of computing, but American females the same aspects as a female domain. Both findings encourage women to participate in computing related-careers and projects within organizations. The findings also show that there was no gender perception toward computing between Indian males and females. US companies that use IT services from India or work with employees from India on IT projects would not have to concern the issue of gender perception toward computing that might

impact the productivity and success of IT projects. This is the good news for US companies since India is among the top three to which US companies outsourced IT workforces.

The findings also show that Chinese males perceived technical and managerial types/areas of computing-related work/projects as a male domain, but clerical and office uses of computing as neither a male nor a female domain. Chinese females perceived technical and managerial aspects of computing as neither a male nor a female domain, but they perceived clerical and office uses of computing as a female domain. These finding provide some vital guidance to IT-related managerial implication for US companies that use IT service from China or work with Chinese employees in China on IT projects. Chinese male employees in China might not feel comfortable to work with or under American female employees. To avoid the conflict that could decrease the productivity of IT-related projects, a short term solution for US companies is to designate American male employees to work with Chinese male employees on those projects. For a long term solution, US employers should also encourage Chinese female and male employees to work together in different IT projects, and promote the equality in workplaces.

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