An Investigation Into the Relationship Between Gender Perception of Computing, Computer Self-Efficacy and Anxiety: Comparison Between the US and India

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ABSTRACT
Computing has always been perceived as a male domain. This perception can discourage women to participate in computing-related careers/educations/activities. The researchers’ previous studies on gender perception toward computing compared the difference of gender perception toward computing, computer self-efficacy, and computer anxiety across cultures. The goal of this study is to continue what left out and overcome problems we found from the previous research. In the nutsheills, this study aims to (1) define more parsimonious gender perception toward computing construct, computer self-efficacy construct and computer anxiety construct, (2) empirically tests the relationship that forms a model among these constructs, and (3) conducts the cross cultural study by comparing the model results from two populations, namely the US and the Indian. A model developed to explain behaviors/phenomena in one country may not hold in other countries due to culture difference. Thus, a model should be subjected to test before applying it in other cultures. One of the main findings shows that in the US computer anxiety has negative impact to gender perception toward computing in the US. This relationship, however, is not found in India.

Keywords (Required)
Gender, Computer Self-efficacy, Computer Anxiety, Culture Difference, US, and India

INTRODUCTION
Computing has been perceived as a male territory in the US and India. This perception is possibly rooted in the national culture. According to Bem (1981), the gender difference in roles is mediated by cognitions as children encode and organize incoming information according to the definition of “male” and “female” behavior current and active in the society at that time. This implies that culture and social factors influence how men and women view themselves in relation to their work (Ahuja and Thatcher, 2005). For example, Gefen and Straub (1997) have argued that gender-related social expectations have roots in national culture. On Hofstede’s (1980) scale of masculinity versus femininity, certain countries consistently show a masculine tendency. The US and India shows masculine tendency 62 and 56 respectively, compared with the World average of 50. When computing is perceived as a specific gender domain, it can discourage another gender to participate in IT-related activities/careers/educations or impact diversity and work productivity between male and female employees in IT-related activities/projects. The impact of male-dominated-IT perception can be seen through the decline of female participation in most computing-related education fields/careers. MSNBC (Feb 10, 2008) reported that the low women participation in computing in the US was caused by the perception that computing is male activities and ‘geeky’ professions.

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 was among top three countries to which US companies outsourced IT workforces (CIO Insight, March 21, 2005). While computing is perceived as a male domain in India, the number of Indian female IT workforces has been rising

1 Computing are activities/occupations that relate to mathematics, engineering, and other technology/information technology related fields.

2 Masculinity (versus its opposite – femininity) refers to the distribution of roles between the genders. Men's values contain a dimension from very assertive and competitive and maximally different from women's values on the one side, to modest and caring and similar to women's values on the other (Hofstede, 1998).

3 On a 1-100 scale where 1 is the lowest and 100 is highest.
in the past few years. It means that increasing number of female Indian IT workforces would become an integral part of IT-related works/projects. More and more female Indian IT employees would work side-by-side with male Indian IT co-workers or remotely work with American employees/employers.

What factors influence gender perception toward computing? Studies showed that computer self-efficacy and computer anxiety have close relationship with gender and/or gender perception toward computing. The first objective of this study is to develop a model that could explain the relationship among these constructs. By understanding how these constructs influence each others, a guideline/suggestion to lessen gender perception toward computing in organizations/education institutions.

The researchers’ previous studies conducted in 2006 and 2007 revealed a significant difference of gender perception toward computing between the US and India. The researchers’ previous studies also revealed that computer self-efficacy and computer anxiety were significantly different between the US and India. These findings indicate that the investigating model may not hold across cultures. According to McCoy et al (2006), a model demonstrating relationships in one culture might not hold across other cultures. For example, the technology acceptance model (TAM), which is one of the most widely used behavioral models in the IS field and was developed in the US, has been widely used to predict IS adoption behaviors. Even though TAM has also been used in other countries because TAM has been considered universal, a recent study shows that the model does not hold across cultures. McCoy et al (2006) conducted a study using Hofstede’s cultural dimensions to categorize TAM samples from 25 countries. Their findings show that TAM does not appear to fully hold for countries scoring low on uncertainty avoidance, high on power distance, and high on masculinity. McCoy et al (2006) emphasize that transferring a model to another culture context should be subjected to rigorous testing. Thus, the second objective of this study is to see whether the relationships in the investigating model holds across the US and India.

THEORETICAL DEVELOPMENT AND RESEARCH HYPOTHESES

Gender and IT between the US and India

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/occupations 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). Two main techniques have been used to determine whether an activity/occupation is a gender stereotype. The first technique uses actual rates of participation of men and women in a career field and compares them to some arbitrary cut off (Betz and Hackett, 1981; Stephan and Holahan, 1982). Second technique uses 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. Computing Smith (1986, 1987) measured the gender-typing perceptions of teachers and students in grades K-12. More males than females seemed to believe that males were better suited to computer competencies. Rosen and Maguire (1990) found that women seemed to suffer greater computer phobia than men did. 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. Rainier et al. (2002) investigated how gender perception toward computing of college students had changed between year 1995 and 2002. They found that computing was perceived as a female domain in 1995, but the perception had changed to a male domain in 2002.

While studies showed mixed conclusions, a report by InfoWorld (Jan 29, 2007) indicated that men still dominate computing-related careers/educations in the US. To make it worse, the number of women in computing-related careers/educations in the US has been declining in the past years. According to the US Bureau of Labor Statistics, women accounted for only 26.7 percent of computer and mathematical positions in 2006. This percentage has been declining for some time, and the decline has been nearly across all IT job categories. For example, women filled 16.6 percent of all network and computer systems administrator positions in 2006, down from 23.4 percent in 2006. At the management level, the disproportion persists. Among computer and IS managers, for example, 27.2 percent were women in 2006 (InfoWorld, Jan 29, 2007). Based on the same report by MSNBC (Feb 10, 2008) and InfoWorld (Jan 29, 2007), women seemed to have difficulty to be accepted or accommodated in a male-dominated IT field. For example, due to the nature of long work hours of IT, women had difficulty to find a balance between family and IT-related careers.
The situation of female in computing in India is quite different. Due to the outsourcing phenomenal, there has been recent growth in IT-enabled service businesses in India. According to Agarwal (2005), these IT-related businesses included call centers, medical transcription, technical support and back office processing, engineering and design, geographic information services, payroll and other human resource services, insurance claim processing, and legal databases. Women comprised 20-25 percent of total number of science and engineering graduates in the country. The number of software professionals increased from 6,800 in 1985 to 650,000 in 2004. Women were joining that IT sector and their numbers rapidly increased from 18 percent in 1998 to 35-37 percent in 2005. Quite a few call centers had a sizeable number of female employees ranging from 35-65 percent (Agarwal, 2005). Women employed in IT belong to the younger age group (median age of software professionals was about 26 years). Forty four percent of software professionals possessed over 3-years work experience. The lack of mobility is one of the major constraints to women’s ability to participate in the IT workforce in India. Most IT jobs are 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 (The Equity for Educational Development, accessed March 4, 2006). However, IT companies try to accommodate Indian women in term of time flexibility and work at home concept. For example, several companies give female employees a choice of four-day weeks instead of the normal five. There are also flexible work-hours incentives for married women, especially with small children.

**Computer Self-Efficacy**

Self-efficacy refers to an individual's belief that he/she has ability to perform a certain behavior (Bandura, 1997). Correspondingly, computer self-efficacy refers to an individual’s judgment of computing capability (Compeau and Higgins, 1995). Several studies indicated that computer self-efficacy is related to the belief that computers are part of the male domain. Collis (1985) reported that secondary school male students were more positive about using computers than females. Miura (1987) found that undergraduate males reported higher computer self-efficacy ratings than did females. Ogletree and William (1990) stated that males had significantly more confidence in their ability to program computers than did females. These findings imply that the lower the computer self-efficacy, the higher the gender perception toward computing. The following hypothesis is proposed:

**H1:** Computer self-efficacy will be negatively related to gender perception toward computing.

**Computer Anxiety**

Computer anxiety is defined as “The tendency of an individual to be uneasy, apprehensive, or fearful about the current or future use of computers” (Ibaria and Parasuraman, 1989). According to Rainer et al. (2003), several studies from the 1970s to the 1990s indicated that computer anxiety is related to the belief that computers are part of the male domain. Temple and Lips (1989) reported that males were more comfortable and confident with computers than females. Wilder (1985) asserted that females felt significantly less comfortable than males in using computers. These findings imply that the higher the computer anxiety, the higher the gender perception toward computing. The following hypothesis is proposed:

**H2:** Computer anxiety will be positively related to gender perception toward computing

Number of studies also reported that computer anxiety and computer self-efficacy are inversely related (e.g. Igbaria et al., 1996; Johnson and Marakas, 2000; Thatcher and Perrewe, 2002; Webster et al., 1990; Fagan and Neill, 2003/2004). The following hypothesis is proposed:

**H3:** Computer self-efficacy will be inversely related to computer anxiety.

Based on these hypotheses, the study’s conceptual model is depicted in Figure 1.

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**Figure 1: Proposed Conceptual Model**

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**Proceedings of the Fourteenth Americas Conference on Information Systems, Toronto, ON, Canada August 14th-17th 2008**

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METHODOLOGY

The researchers examined five samples of university students with a business major, four from the US (241 students) and one from India (206 students). All samples were from four year institutions. All students were offered extra credit as an incentive to complete the questionnaire. The US surveys were distributed and collected through an online format, while the India survey was done on a paper-based format.

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 three psychological constructs. These constructs include: 1) Gender Typing Scale (Astone, 1995), 2) Computer Self-efficacy (Murphy et al., 1989), and 3) Computer Anxiety Rating (Heinssen, Glass, and Knight, 1987).

The gender-typing scale (GTS) was developed by Astone (1995). This 13-item scale measures gender perception toward computing on 5-point Likert scales, ranging from "1" meaning "strongly disagree" to "5" meaning "strongly agree" and 3 meaning "neutral". Previous analyses of the GTS demonstrated two underlying latent constructs. The first construct, labeled GTS1, represents technical and managerial aspects of computing. The second construct, labeled GTS2, represents the clerical and office uses of computers and affective responses to computing (Astone, 1995). The questionnaires 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 "women first" direction.

Computer Self-Efficacy Scale (CSE) was developed by Murphy et al. (1989). This 32-item scale measures perceptions of computer self-efficacy on 5-point Likert scales. Previous analysis of the CSE demonstrated three underlying latent constructs. The first construct, labeled CSE1, represents beginning computer skills. The second construct, labeled CSE2, represents more conceptual computer skills. The third construct, labeled CSE3, represents mainframe computer skills (Harrison and Rainer, 1992). The mainframe computer skills construct was not included in these two studies because the pilot tests indicated that students did not use mainframe computers.

Computer Anxiety Rating Scale (CAR) was developed by Heinssen et al. (1987). This 19-item scale measures perceptions of computer anxiety on 5-point Likert scales. Previous analysis of the CAR demonstrated two underlying latent constructs. The first construct, labeled CAR1, represents high anxiety toward computer use. The second construct, labeled CSE2, represents confidence, enthusiasm and/or anticipation regarding computer use (Harrison and Rainer 1992).

Due to culture difference, if each country separately uses its own dataset to develop a proposed model, each country’s model may have items within its constructs that are different from other countries’ models. Consequently they may not be suitable to compare with each others. Therefore, for this cross cultural study, the researchers employed the model comparison technique in SEM to develop the proposed model (Figure 1) that can be used to compare between the US and India.

RESULTS

Demographic

Table 1 shows the demographic data of respondents as well as computer-and-Internet usages. Forty nine percent of American respondents were male, and 51 percent were female. Fifty three percent of Indian respondents were male and 47 percent were female. The average age of American and Indian were 22 and 19 years old respectively. American respondents (11 years) have been using computer much longer than do Indian counterparts (3 years). American respondents (21 hours/week) also spent a lot of time on the Internet than do Indian counterparts (3 hours/week).

Measurement Model Results

The measurement aspect of the model was estimated prior to testing the structural aspect to prevent any interaction between two constructs due to measurement error.

To assess internal consistency, items demonstrating high within/across factor correlated errors were examined as candidates for removal. Before deletion from the study, each indicator was first examined for its conceptual contribution and if deemed negligible was removed from the study. In all, 52 items were removed from the study due to high standardized residuals. The remaining items from GTS are ones under the clerical and office uses of computers and affective responses to computing (GTS2). The remaining items from CSE are ones under beginning computer skills (CSE1). The remaining items from CAR are ones under high anxiety toward computer use (CAR1) (Figure 2 and 3).
Number of Responses and Percentage

<table>
<thead>
<tr>
<th></th>
<th>American</th>
<th>Indian</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male (%)</td>
<td>119 (49%)</td>
<td>110 (53%)</td>
</tr>
<tr>
<td>Female (%)</td>
<td>122 (51%)</td>
<td>96 (47%)</td>
</tr>
<tr>
<td>Age</td>
<td>22.3(0.31)</td>
<td>18.8(0.12)</td>
</tr>
<tr>
<td>Number of Computer Classes taken (Std)</td>
<td>1.9 (0.12)</td>
<td>0.57 (0.086)</td>
</tr>
<tr>
<td>Year of Computer Usage (Std)</td>
<td>11.4 (0.23)</td>
<td>3.17 (0.20)</td>
</tr>
<tr>
<td>Internet Usage (Hr/Week) (Std)</td>
<td>20.98(1.23)</td>
<td>2.94 (0.27)</td>
</tr>
</tbody>
</table>

Table 1: Demographic

For the path analysis, two-group comparison feature from AMOS 7.0 is used to the proposed model. All fit indices indicate that the proposed model performs a good fit. The Cmin/DF of the three factor model is below 2 (1.566), indicating that the model is a good fit. The comparative fit index (CFI) is near 0.90 range (0.985), which is deemed acceptable. The internal consistency (RMSEA) is in the acceptable range at 0.031.

The factor analysis and alpha reliabilities for GTS2, CSES1, and CARS1 were examined. For the US, the alpha reliabilities for GTS2, CSE1, and CAR1 are 0.89, 0.98, and 0.97 respectively. For India, the estimates for the same constructs are 0.75, 0.71, and 0.73 respectively. All estimates ranged from 0.70 to 0.98, indicating acceptable reliability for the constructs.

Structural Model Results

Figure 2 shows the three-factor model (CSE-CAR-GTS) for the US. The SEM results indicate that there is no empirical relationship between gender typing scale and computer self-efficacy. The relationship between computer self-efficacy and computer anxiety and the relationship between computer anxiety and gender typing of computing are significant at 0.01 level. Figure 3 shows the three-factor model for India. The only significant relationship within this model is computer self-efficacy and computer anxiety.

** Significant at 0.01 level

DISCUSSION

Based on the SEM results, only items represent the clerical and office uses of computers and affective responses to computing (GTS2), the beginning computer skills (CSE1), and high anxiety toward computer use (CAR1) remain in the model.
The first hypothesis (H1) is not supported in both the US and India (Table 2). One possible explanation is that the remaining items from CSE only represent the aspect of the beginning computer skill, which in turn does not create a strong influence toward the aspect of affective response to computing.

The second hypothesis (H2) is supported only in the US (Table 2). It means that individuals with higher levels of computer anxiety will have stronger gender perception toward computing. However, this hypothesis is not supported in India. Parts of possible explanation may lie in Indian culture. Indian people may not have high anxiety or tend to hide their anxiety, which in turn did not influence the gender perception toward computing. This assumption is supported by the study in 2006, which showed that Indian people had significantly lower computer anxiety than American (Leingpibul et al., 2006). In addition, the fact that the majority of computing-related call center jobs have been outsourced to India than any other countries might show that not only that Indian people possess qualified computing-related skills, but also that they have high tolerant and lower anxiety when they provide computing-related service to frustrated customers in the US.

The third hypothesis (H3) is supported in both countries (Table 3). As expected from the computer self-efficacy and computer anxiety literature, both have a negative impact to each other (H3). It means that increasing levels of self-efficacy in the beginning computer skills results in decreasing levels of computer anxiety. It also means that increasing levels of computer anxiety results in decreasing levels of self-efficacy in beginning computer skills.

<table>
<thead>
<tr>
<th>Hypothesis</th>
<th>Paths</th>
<th>US Path Estimates</th>
<th>Results</th>
<th>India Path Estimates</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>H1</td>
<td>CSE → GTS</td>
<td>-0.1</td>
<td>Not Supported</td>
<td>0.07</td>
<td>Not Supported</td>
</tr>
<tr>
<td>H2</td>
<td>CAR → GTS</td>
<td>-0.43**</td>
<td>Supported</td>
<td>0.31</td>
<td>Not Supported</td>
</tr>
<tr>
<td>H3</td>
<td>CSE ↔ CAR</td>
<td>-0.88*</td>
<td>Supported</td>
<td>-0.42*</td>
<td>Supported</td>
</tr>
</tbody>
</table>

**significant at p < 0.01

Table 2: Results of Hypothesis Tests

LIMITATION

This study assumed that the means of data collection had no impact on the results. 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 the US. In reality, there may be a difference resulting from the various data collecting methods.

CONCLUSIONS AND MANAGERIAL IMPLICATION

The findings show that in American culture there is no direct relationship between self-efficacy of the beginning computer skills (CSE1) and gender perception toward the clerical and office uses of computers (GTS2). However, CSE1 may indirectly influence gender perception toward computing (GTS2) through computer anxiety (CAR1). Future research should investigate which one between these two antecedents (CSE1 and CAR1) would be a real antecedent of the phenomenon. The mediation or moderation effect could yield an insight about how to study this phenomenon more effectively. Assuming that CSE1 is an antecedent of CAR1, one way to lessen or promote no gender perception toward computing in the US is to improve computer self-efficacy and/or decrease computer anxiety of individuals. For educational institutions, by providing the beginning computer skills to students, students will develop less computer anxiety and, in turn, their perception that computing is gender stereotype will be lessened. Unlike the US culture, the relationships between CSE1 and GTS2, and CAR1 and GTS2 do not exist in Indian culture. By providing the beginning computer skills to Indian people, they will develop less computer anxiety. However, decreasing computer anxiety levels would not translate into lower levels of gender perception toward computing in India.

The proposed model (figure 1) cannot be used to explain the relationship between gender perception toward technical and managerial aspects of computing, computer self-efficacy, and computer anxiety. Thus, the model does not provide a complete picture of gender perception toward computing. One possible explanation for the missing of technical and managerial aspects of computing from the model is that items represented this aspect of computing might not relevant to computing activities at the current time. The gender perception toward computing construct was developed by Astone in 1995. It has been more than 10 years, and thus, it is possible that items represented technical and managerial aspects of computing should be revisited and updated.
REFERENCES


