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The Role of Gender in Students' Decisions to Major in Information Systems

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ABSTRACT

In order to understand the reasons for women's underrepresentation in IS, we extended the IS Major Choice Goals Model, which identifies the major factors that influence students' pursuit of IS majors and careers. There were significant differences between female and male students in terms of self-efficacy, interests, and choice goals. Significant gender differences were also found in the relationships among the key determinants of the model meaning that females and males differed with respect to how they developed aspirations to major in IS. The relationship between self-efficacy and interest was stronger in females than in males, as well as the relationship between self-efficacy and outcome expectations. Self-efficacy influenced choice goals more strongly for males than it influenced females. The relationship between outcome expectations and interest was stronger in males than in females. Interest influenced choice goals more strongly for female students than it influenced male students.

Keywords

IS education, enrollments, gender, underrepresentation.

INTRODUCTION

Underrepresentation of women in information systems (IS) and related fields is a major concern. Recent studies indicate that although women make up 47 percent of the United States labor force today, they only account for 20 percent of the information technology (IT) workforce (Ahuja, et al., 2006; Rosenbloom, 2008). Moreover only 32 percent of the undergraduate degrees in IS is earned by women (Beyer, 2008) and the proportion of women pursuing IS/IT degrees and careers continues to decline (Ahuja et al., 2006).

To make matters worse, student enrollment in IS/IT programs in general has fallen by as much as 75 percent since 2000 (Street at al., 2008). At the same time, career opportunities in this field are strong and the demand for IT professionals continues to increase, with a projected growth rate exceeding 50 percent by 2012 (Lomerson and Pollacia, 2006). This paradoxical situation is alarming not only for academic institutions or employers, but also for the entire economy. A highly skilled and diverse IT workforce representing the entire population is crucial to ensure the advancement of our knowledge-based economy (Ahuja et al., 2006). Therefore, attraction and retention of more women in IS/IT fields constitutes an extremely important issue.

To date a number of studies have been conducted in the computer science (CS) domain to address the role of gender and identify the barriers faced by women (e.g. Beyer and Haller, 2006; Cohoon, 2001; Margolis and Fisher, 2002). Given the distinction between CS and IS disciplines, there might be differences between the reasons for the underrepresentation of women in these disciplines. There is very limited academic research that focuses on understanding the factors that facilitate or inhibit women's decisions to pursue IS degrees and careers (Beyer, 2008). Recently, Joshi and Schmidt (2006) conducted a study to understand students' stereotypes of IS professionals and compared the perspectives of male and female students. Ahuja et al. (2006) examined the differences among students majoring in computer science and applied IT disciplines and gender issues. Beyer (2008) investigated if male and female students in IS courses differed as well as the differences between female IS majors and non-majors. Even though certain differences between females and males were identified in these studies, quantitative studies that examine whether these differences explain why female students avoid IS degrees and careers do not exist. Therefore, further studies are needed to understand the role gender plays in facilitating or inhibiting students' pursuit of IS majors and careers.

This study addresses this research gap. In order to understand the role of gender in shaping students' academic choices we extended the IS Major Choice Goals Model, which identifies the major factors that influence students' pursuit of IS majors and careers. More specifically we focused on the following three questions:

(1) Do female and male students differ in terms of the key determinants (i.e. self-efficacy, outcome expectations, interest, and choice goals) of the IS Major Choice Goals Model?

(2) Can we utilize the IS Major Choice Goals Model to explain the factors that facilitate or inhibit female students' decisions to major in IS?

(3) Do female and male students differ with respect how they develop aspirations to major in IS? In order words, does gender influence the relationships between the key determinants of the IS Major Choice Goals Model?

THEORETICAL BACKGROUND

This study extends the IS Major Choice Goals Model, which is derived from the Social Cognitive Career Theory (SCCT) (Lent et al., 1994). SCCT describes the mechanisms through which individuals develop goals to pursue particular educational or occupational paths, make choices among available alternatives, and perform in their selected fields of pursuit. SCCT focuses on several key cognitive-person factors and investigates how these factors function along with the other aspects of the individual's environment to shape the course of career development (Lent et al., 1994). Anchored in SCCT, Akbulut and Looney (2007) developed the IS Major Choice Goals Model to explain the core factors affecting students' decisions to major in IS. The Model consists of four interrelated domain specific factors including self-efficacy, outcome expectations, interests, and goals.

In the context of the Model, self-efficacy is defined as a student's judgment of his or her capability to perform effectively as an IS major. Outcome expectations refer to a student's judgment regarding the likelihood that valued rewards will occur as a result of majoring in IS. Interest is defined as an emotion that arouses attention to, curiosity about, and concern with the IS major, whereas choice goals refers to a student's aspirations to choose IS as his or her major (Akbulut and Looney, 2007).

RESEARCH MODEL AND HYPOTHESES

Figure 1 shows the original IS Major Choice Goals Model, together with the extensions proposed in this paper.

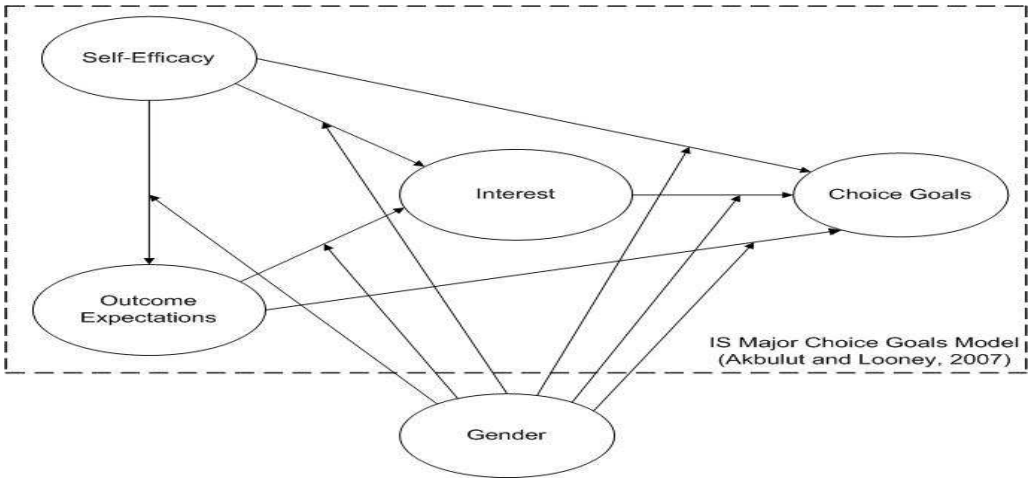

Figure 1. Research Model

The original model posits that self-efficacy, outcome expectations, and interest will independently and cumulatively influence choice goals. We extend the model to include the role of gender and suggest that the strength of these relationships will vary based on gender. Specifically, we investigate how gender will moderate the self-efficacy – outcome expectations, self-efficacy – interest, self-efficacy – choice goals, outcome expectations – interest, outcome expectations - choice goals, and interest – choice goals relationships.

Based on the original model the hypotheses below are put forward. Due to space limitations, development of these hypotheses is not discussed here. Interested readers are encouraged to refer to Akbulut and Looney (2007).

H_1: Self-efficacy will have a significant positive influence on interest.
H_2: Self-efficacy will have a significant positive influence on choice goals.
H_3: Self-efficacy will have a significant positive influence on outcome expectations.
H_4: Outcome expectations will have a significant positive influence on interest.

H_5: Outcome expectations will have a significant positive influence on choice goals.
H_6: Interest will have a significant positive influence on choice goals.

The proposed hypotheses regarding the role of gender are based on the view that women's representation in the IS field is mutually and reciprocally determined by personal, environmental, and behavioral factors (Bussey and Bandura, 1999). These hypotheses discussed below.

Self-Efficacy and Gender: Research has found that women typically display high levels of computer anxiety (Igbaria and Chakrabarti, 1990; Venkatesh and Morris, 2000), low levels of computer experience as well as low levels of self-efficacy in general (Bandura, 1982; Venkatesh and Morris, 2000). There is also supporting evidence that compared to men, women tend to be more anxious about computer usage and exhibit lower levels of self-efficacy, increasing their computer avoidance (Ahuja et al., 2006; Beyer, 2008). Self efficacy plays an important role in academic and career choices and attainments (Beyer, 2008; Smith, 2002). Individuals' beliefs in their abilities to master certain subjects influence their motivation and aspirations, level of interest, achievements, and goal persistence (Bandura, 1995). Specific to IT, research has shown that a lack of self-efficacy in this domain may hamper future involvement in the IT field (Smith, 2002). Since people tend to form enduring interests in activities in which they view themselves as capable (Bandura and Schunk, 1981), it is reasonable to assume that female students who exhibit lower levels of self-efficacy would be less intrigued by an IS degree. Moreover, individuals with lower levels of self-efficacy are less likely to set goals to engage in a particular behavior. As such, female students who are less confident in their abilities to perform well as an IS major would be less likely to develop aspirations to major in this field. Therefore, we expect self-efficacy to be more salient for female students compared to its salience for male students.

H_7: Self-efficacy will influence interest more strongly for female students than it will influence male students.

H_8: Self-efficacy will influence choice goals more strongly for female students than it will influence men.

Outcome Expectations and Gender: Research has found differences in vocational preferences between women and men. Men tend place great emphasis on their jobs, accomplishments, salary, and reputation; and are motivated more by achievement needs than women (Ahuja et al. 2006; Venkatesh and Morris, 2000), whereas women tend to value being able to combine a career and family more highly (Herring et al. 2006). Women also value extrinsic job attributes and intrinsic factors associated with interpersonal relationships more than men do. Career research has found that interest and choice behaviors are largely dependent upon the likelihood of achieving certain outcomes, together with the value one places on those outcomes (Lent et al., 1999). In this respect, since male students place more value on expected outcomes, when they expect pursuing a major in IS to result in favorable outcomes, compared to female students, they would be more likely to find the IS field compelling and develop an interest. Similarly the higher the likelihood of obtained valued outcomes, the more likely that people will adopt particular choice goals. As such, it is reasonable to assume that male students would be more likely to develop aspirations to major in IS. Therefore, we expect outcome expectations to be more salient for male students than for female students.

H_9: Outcome expectations will influence interest more strongly for male students than it will influence female students.

H_{10}: Outcome expectations will influence choice goals more strongly for male students than it will influence female students.

Research has shown that self-efficacy perceptions directly influence an individual's outcome expectations (Compeau and Higgins, 1995; Looney et al. 2006). People expect to achieve desirable outcomes in activities at which they believe they can successfully perform. As discussed earlier, men appear to be highly motivated by expected outcomes of their actions. Therefore, male students who possess a strong sense of self-efficacy would be more likely to believe that favorable outcomes would arise from their actions. As such, higher self-efficacy would generate more positive outcomes in male students who are more outcome oriented than it would generate in female students.

H_{11}: Self-efficacy will influence outcome expectations more strongly for male students than it will influence female students.

Interest and Gender: SCCT suggests that although people try out and pursue many different activities during their formative years, they generally end up developing characteristic patterns of academic and career interests (Holland, 1985; Lent et al. 1994). Individuals who are intrigued by certain subjects then tend to seek additional exposure to satisfy their curiosity. Consequently, emergent interests lead to cognized choice goals for further activity exposure (i.e. intention plans, or aspirations to engage in a particular academic or career direction), fostering the development of goals to choose particular actions (e.g., declaring a corresponding major) (Akbulut and Looney, 2007; Lent et al., 1994). Therefore, we expect the

influence of interest on choice goals will not differ based on gender. Both male and female students who are interested in the IS field will be determined to major in IS.

H_{12}: Interest will influence choice goals similarly for both male and female students.

RESEARCH METHOD

Survey methodology was utilized to collect the data. The survey was administered at a large state university in the United States. The sample consisted of students enrolled in different sections of an introduction to management information systems course. Participation in the study was voluntary and participants received extra credit as an incentive for participating. A total of 230 usable responses were obtained. Forty-three percent of the participants were female and fifty-six percent were male.

All items were derived from previously validated scales developed by Akbulut and Looney (2007). Self-efficacy was measured using six items with a response format consisting of an 11-place Likert-type scale ranging from 0% (cannot do) to 100% (certain can do). Outcome expectations consisted of self-evaluative (e.g. pride, sense of accomplishment), social (e.g. status enhancement, recognition, monetary compensation), and physical (e.g. worry, sense or security) dimensions. This construct was measured using ten items, with a response format consisting of an 11-place Likert-type scale ranging from 0% (will never occur) to 100% (will always occur). Interest and choice goals were measured using five and four items respectively, with a response format consisting of a 7-place Likert-type scale ranging from 1 (strongly disagree) to 7 (strongly agree).

Partial least squares (PLS) was used to analyze the data. The software package used to perform the analysis was PLS Graph, Version 03.00 (Chin, 2003).

Measurement Model Analysis

We first assessed and confirmed the psychometric properties of the measurement model before we analyzed the data and the structural model. The measurement model was evaluated separately for the full sample (i.e. female and male students pooled together) and each of the subsamples (i.e. females taken separately and males taken separately). First reliability of the constructs was examined for each sample. Both Cronbach α's and composite reliability scores were well above the recommended level (0.70) for acceptable reliability (Barclay et al., 1995; Fornell and Larker, 1981). Discriminant validity of the constructs was examined by comparing the AVE associated with each construct to the correlations among constructs (Barclay et al., 1995). For each construct, the AVE exceeded the correlations between constructs, confirming discriminant validity. Convergent validity was examined both at the item and construct levels. All individual items exhibited adequate loadings (greater than 0.707) and no unacceptable cross loadings emerged. Moreover AVE values were greater than 0.50, confirming the convergent validity of the items and constructs (Fornell and Larker, 1981; Gefen et al., 2000). Due to space limitations, these test results are not reported here.

RESULTS

Question 1: We conducted a series of t-tests to investigate whether there were gender differences in terms of the key constructs of the IS Major Choice Goals Model. In terms of self-efficacy, the t-test revealed a significant value ($t= - 3.51$, $p< .01$), meaning the average self-efficacy score for female students (M=5.46, SD=2.08) was significantly lower than the average self-efficacy score for male students (M=6.45, SD=2.17). Regarding outcome expectations, no significant statistical differences were found between female and male students ($t= - 0.43$, ns). In terms of interest, the t-test again revealed a significant value ($t= -2.97$, $p< .01$), meaning the average interest score for female students (M=3.62, SD=1.45) was significantly lower than the average interest score for male students (M=3.62, SD=1.45). Finally, for choice goals, the t-test revealed a significant value as well ($t= - 4.33$, $p< .001$), indicating that the average choice goals score for female students (M=1.72, SD=0.97) was significantly lower than the average score for male students (M=2.52, SD=1.63). Table 1 represents the descriptive statistics by gender and the t-test results.

	Female Students		**Male Students**		**Females vs. Males**
Constructs	**Mean**	**Std Dev.**	**Mean**	**Std Dev.**	**t-value**
SE	5.46	2.08	6.45	2.17	-3.51**
OE	6.66	2.07	6.77	2.06	-0.43
INT	3.62	1.45	4.19	1.45	-2.97**

CG	1.72	0.97	2.52	1.63	-4.33***

Note. ** $p < .01$; *** $p < .001$

Table 1. Descriptive Statistics by Gender

Question 2: In order to answer the second question we estimated three different structural models in PLS, including the full sample, the male subsample, and the female subsample. The predictive powers of the structural models were evaluated by looking at the R^2 values in the final dependent construct (choice goals). As shown in Table 2, the Model explained a sizeable proportion of the variance in choice goals (38.7 percent for the entire sample, 35.7 percent for females, and 39.8 percent for males), interest (23.2 percent for the entire sample, 22.4 percent for females and 21.8 percent for males), and outcome expectations (15.4 percent for the entire sample, 17.5 percent for the females, and 14.7 percent for the males).

	Full Sample	**Female Students**	**Male Students**
R^2 Choice Goals	38.7%	35.7%	39.8%
R^2 Interest	23.2%	22.4%	21.8%
R^2 Outcome Expectations	15.4 %	17.5 %	14.7%

Table 2: Predictive Power of the IS Choice Goals Model by Gender

Next, we tested hypothesis H_1 through H_6. For all samples, self-efficacy had a significant direct effect on interest providing support for H_1. Within the full dataset and male subgroup, self efficacy did have a significant effect on choice goals; however, within the female subgroup self-efficacy was not a significant predictor of choice goals. Therefore, H_2 was supported for the entire dataset, and the male subgroup; but not for the female subgroup. Self-efficacy was found to be a significant predictor of outcome expectations, providing support for H_3. Outcome expectations was found to be a significant predictor of interest, offering support for H_4. Outcome expectations did not have a significant influence on choice goals. Therefore, H_5 was not supported. Finally, interest was found to be a significant predictor of choice goals, supporting hypothesis H_6. The results are summarized in Table 3.

	Full Sample		**Female Students**		**Male Students**		**Females vs. Males**
Paths	**β**	**t-value**	**β**	**t-value**	**β**	**t-value**	**t-value**
SE-INT	0.284	4.47***	0.282	3.19**	0.228	2.41*	4.42*
SE-CG	0.162	3.02**	0.026	0.29	0.188	2.78**	-15.56***
SE-OE	0.393	5.43***	0.418	4.32***	0.384	3.79***	2.57***
OE-INT	0.293	4.05***	0.280	2.83**	0.329	3.63***	-3.91***
OE-CG	0.015	0.29	0.036	0.47	0.020	0.29	5.77***
INT-CG	0.547	11.67***	0.570	8.60***	0.549	8.59***	2.43*

Table 3: Model Results and Gender Differences

Question 3: In order to answer the third research question, we tested for differences between the male and female students by using the test for differences. The hypotheses relating to gender (H_7 to H_{12}) were tested by statistically comparing the path coefficients in the structural model for female students to the path coefficients in the structural model for the male students. This statistical comparison was carried out by utilizing the procedure suggested by Chin (2000). This procedure is appropriate as it allows a comparison between multiple population groups. In this approach, the researcher examines the differences between groups by treating standard error estimates for the structural paths provided by PLS in a parametric sense via t-tests. This procedure is consistent with the previous studies that have examined moderating effects of gender (Venkatesh and Morris, 2000; Ahuja and Thatcher, 2005) and culture (Keil et al., 2000) and provides more robust results compared to the approach used in earlier studies that have only looked at the numerical values of path coefficients without conducting statistical tests when comparing corresponding paths across structural models (Keil et al., 2000).

Our results (see Table 3) indicated that gender moderated the relationships between the model variables. Self-efficacy influenced interest more strongly for female students than it influenced male students ($t= 4.42$, $p < .05$), hypothesis H_7 was supported. Self-efficacy influenced choice goals more strongly for male students than it influenced female students ($t=-15.56$, $p < .001$). No support for hypothesis H_8 was offered. Outcome expectations influenced interest more strongly for male students than it influenced female students ($t= -3.91$, $p < .001$), providing support for hypothesis H_9. Outcome expectations influenced choice goals more strongly for female students than it influenced male students ($t= 5.77$, $p < .001$). No support for hypothesis H_{10} was provided. Self-efficacy influenced outcome expectations more strongly for female students than it influenced male students ($t = 2.57$, $p < .001$) and hence hypothesis H_{11} was not supported. Finally, interest influenced choice goals more strongly for female students than it influenced male students ($t=2.43$, $p < .05$). Hypotheses H_{12} was not supported.

DISCUSSION

Our first research question investigated whether there were any differences between male and female students in terms of self-efficacy, outcome expectations, interests, and choice goals. We observed that compared to male students female students exhibited lower levels of self confidence in their ability to perform as an IS major (i.e. self-efficacy). Similarly female students' expectations about the valued rewards that could be attained by majoring in IS (i.e. outcome expectations) were lower than that of males. Female students were also found to be less interested in an IS major in general and exhibited lower levels of aspirations to choose IS as their major than male students. When we analyzed whether these differences between male and female students were statistically significant, we found significant statistical differences between female and male students in terms of self-efficacy, interest, and choice goals. Both groups had similar expectancies about the results that can be achieved by pursing an IS major.

Our second research question investigated whether the IS Major Choice Goals Model could be utilized to understand the factors that facilitate or inhibit female students' decisions to major in IS. The results suggest that the Model can be readily adapted to investigate the mechanisms through which female students develop aspirations to major in IS as it explained a sizable proportion of the variance in choice goals in the female subgroup. In female students, self-efficacy and outcome expectations had significant direct effects on interest. Moreover self-efficacy was a significant predictor of outcome expectations. Self-efficacy and outcome expectations did not have significant direct effects on choice goals. Interest was found to be a significant predictor of choice goals. The results suggest that for female students the effects of self-efficacy and outcome expectations on choice goals are channeled through interest. Unlike male students who may be aspired to pursue an IS major simply because they believe they are qualified; female students who do not find the IS major intriguing would not develop aspirations to pursue the major regardless of their beliefs in their abilities to be successful as an IS major. Moreover, expectations about the rewards for majoring in IS by itself does not motivate females students to select the IS major directly. These results validate the model and highlight the importance of self-efficacy, outcome expectations, and interest on female student's decisions to major in IS.

Our third research question investigated the moderating effects of gender. The results provided strong support for gender effects on the relationships between the key variables in the model, meaning that female and male students are different with respect to developing aspirations to major in IS. The relationship between self-efficacy and interest was stronger in female students than in male students, meaning that self-efficacy was more salient to female students than male students in explaining interest in the IS major. On the other hand, self-efficacy influenced choice goals more strongly for males than for females. In fact, self-efficacy was not a salient factor for female students in terms of its direct effects on choice goals at all. The relationship between self-efficacy and outcome expectations was stronger in female students than in male students. This suggests that compared to male students, female students are more likely to develop more robust outcome expectations when they believe in their abilities to successfully pursue the IS major. The relationship between outcome expectations and interest were stronger for males than for females, suggesting that compared to female students, males are more intrigued by the potential favorable outcomes of majoring in IS. Finally we found out that gender moderated the relationship between interest and choice goals. Interest influenced choice goals more strongly for females than for males. This suggests that when females are interested in IS, compared to males; they would be more likely to seek additional exposure to satisfy their interest. As such, they would be more likely to set goals to pursue IS as their major of choice than male students would be.

The findings have important implications for theory and practice. To the best of our knowledge this is the first study that has theoretically and empirically investigated the role of gender in facilitating or inhibiting students' aspirations to pursue a degree in IS. Understanding the factors that are important to female students and how these factors shape their academic and career choices would prove extremely helpful in devising intervention strategies to increase the representation of women in IS. For example, we found out that females had significantly lower self-efficacy levels than males. Low self-efficacy might be an important barrier for females in pursuing IS majors and careers. Therefore, IS educators should focus on fostering a robust sense of self-efficacy among female students through enactive mastery experiences, behavioral modeling, social

persuasion, and by creating positive psychological states. Based on our findings, increasing self-efficacy would help raise female students' outcome expectations as well as their level of interest in the IS field, which would in turn positively influence their aspirations to pursue a career in IS. IS educators should also focus on the activities that would promote the rewards that could be achieved by pursuing an IS degree. Marketing efforts that target specifically female students might prove helpful in this respect. Internships, presentations by peers and IT professionals that include female role models, female IS instructors and mentors, might play an important role in getting the message across to female students. Educators also need to pay attention to the IS related topics that are off interest to the female students and incorporate such topics and technologies into their courses to a greater extend. It is also important to note that the efforts that focus on inspiring female students should start as early as possible as studies show that female students' interest in IT begins to decline in the middle school years.

Clearly this study only focused on a limited number of factors that could potentially influence female students' major choices. The findings of this study can be leveraged to study additional factors that might impede or encourage female students to major in IS.

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