WOMEN IN STEM: TRUE-SELF KNOWLEDGE AND ACHIEVEMENT MOTIVATION

An Undergraduate Research Scholars Thesis

by

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ABSTRACT

Women in STEM: True Self-Knowledge and Achievement Motivation. (May 2014)

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In this study, I will examine whether there is a relationship between true-self knowledge and motivation to remain in a STEM major among female STEM students. Specifically, I hypothesize that a greater understanding of one's self in an undergraduate female student majoring in a science, technology, engineering, or math-related field positively influences one's motivation to continue studying in these traditionally male- dominated fields. To study this idea, I intend to conduct a study in which I examine how true self-knowledge relates to achievement motivation among STEM students. I predict that in female STEM students, greater true self-knowledge will be related to higher levels of motivation, while this factor in male STEM students will not be related to a higher degree of true self-knowledge.

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NOMENCLATURE

STEM   Science, Technology, Engineering, and Math

CHAPTER I

INTRODUCTION

True Self-Knowledge

The "true self" is commonly thought of as a set of innate, unchanging characteristics that represents the most "real" version of one's self that must be discovered within one's self in order to achieve fulfillment in life (Schlegel, Hicks, Arndt, & King, 2009; Schlegel & Hicks, 2011). Perception of true self-knowledge (that is, feeling like one knows one's authentic self) has been found to positively predict general well being (Kernis & Goldman, 2005; 2006) as well as judgments of meaning in life (Schlegel et al., 2010; Schlegel, Vess, & Arndt, 2012). Of particular importance for the proposed work, true self-knowledge has also been linked to decision satisfaction for both career choice and choice of major (Schlegel, Hicks, Davis, Hirsch, & Smith, 2013). The activation of existing self-knowledge has also been shown to reduce the experience of conflict when making hypothetical career decisions (Nakao et al., 2010; Nakao, Takezawa, Shiraishi, & Miyatani, 2009).

I propose that this "internal" cue will be particularly critical for individuals that face external cues that suggest they may not naturally "fit" into their environment- for example, women in traditionally masculine STEM-related fields. Specifically, such individuals may need a greater awareness of their true self to provide enough confidence in their decision to work (and continue to work) in an otherwise potentially unwelcome environment. In contrast, individuals in groups receiving subtle external cues that suggest they are welcome- in this case, men in traditionally masculine spheres of work- already feel less negativity in their work environments, and therefore their level of true self- awareness is less likely to impact their motivation.

Women in STEM

The term "STEM" refers to the fields including and relating to science, technology, engineering, and math, all historically masculine pursuits. With the advancement of women in the workforce in general, it is therefore somewhat surprising that females in nearly all of the STEM-related jobs are severely under-represented, particularly in the expanding field of computer science (Cheryan, Plaut, Davies, & Steele, 2009). While much research has recently begun to investigate potential contributions to this problem (e.g. Heilbronner, 2013; Hernandez et al., 2013), I propose to examine the hitherto unstudied possibility that levels of true self-knowledge predict women's motivation to to join and continue working in the STEM community.

The implications of this study go far beyond that of merely representation of women in STEM. Rather, if true self-knowledge is found to have an impact on motivation, particularly in unwelcoming environments, this research can be expanded to include groups such as racial and ethnic minorities, as well as into different career sectors and other public settings. Increasing diversity in STEM jobs would contribute to more varied contributions and successes, as well as providing further employment opportunities for historically under-represented populations.

CHAPTER II

METHOD

Participants

One hundred and ninety-seven (197) participants enrolled in an introductory psychology course

at Texas A&M University participated for partial fulfillment of a course requirement.

Participants' gender distribution was relatively even (female=99, male=98), age ranged from 18

to 31 (M=18.85, SD=1.33). Participants were predominantly white (74.2%) and Asian (8.1%).

Participants were enrolled in STEM majors, including biomedical science (33.2%), engineering

(16.5%), biology and biology-related majors (such as biochemistry and molecular biology;

11.6%), animal science/zoology (10.6%), and other (such as chemistry and physics; 28.1%).

Materials and Procedure

Upon arrival, participants were escorted to a private computer and were informed that they

would be participating in a study that explores the way that people describe and think about

different aspects of the self. Participants then completed the measures described below, as well

as several measures outside of the scope of the current report.

True-Self Knowledge

Participants were first asked to answer questions corresponding to measures of true-self

knowledge. Two measures of true self-knowledge were utilized: the true self-awareness subscale

from Kernis & Goldman's (2006) Authenticity Inventory and the self-alienation subscale from

Wood et al.'s (2008) Authenticity Scale.

To measure true self-awareness, participants were told to respond to each of 12 statements of the true self-awareness subscale with the number that they felt most accurately represented their perceptions about themselves on a scale from 1 to 5 (1=Strongly disagree, 5=Strongly agree; Male: M=4.49, SD=.45; Female: M=4.48, SD=.41). Items included statements such as "I am often confused about my feelings", "For better or worse I am aware of who I truly am", and "I have a very good understanding of why I do the things I do."

To measure self-alienation, participants were asked to indicate their agreement with 4 statements using a provided scale from 1 to 5 (1=Strongly disagree, 5=Strongly agree; Male: M=2.31, SD=1.15; Female: M=2.21, SD=1.12). Items included such statements as "I don't know how I really feel inside", "I feel as if I don't know myself very well", and "I feel out of touch with the 'real me'."

Decision Confidence

Next, participants were prompted to think about their decision to pursue their current major. Using a modified version of the decision satisfaction measure created by Schlegel et al. (2013) that includes measures of intentions to remain in a STEM major, participants were asked to indicate their agreement on a scale from 1 to 7 (1=Strongly disagree, 7=Strongly agree) with 10 statements, such as "I am completely satisfied with my major", "I am confident I will not regret choosing this major in the future", and "I sometimes wonder if I am in the right major" (Male: M=5.02, SD=1.35; Female: M=5.12, SD=1.27).

Achievement Motivation

The measure of achievement motivation utilized was derived from work on self-determination

theory (e.g. Deci & Ryan, 2000) and focused on forms of motivation that have been linked to

successful goal achievement (e.g., Sheldon & Houser-Marko, 2001). The measure included was

Vallerand et al.'s (1992) Academic Motivation Scale. Participants were instructed to respond to

12 statements measuring academic motivation on a scale from 1 to 7 (1=Does not correspond at

all, 7=Corresponds exactly) corresponding to amotivation (Male: *M*=2.15, *SD*=1.47; Female:

M=2.01, *SD*=1.18), intrinsic motivation (Male: *M*=4.74, *SD*=1.21; Female: *M*=4.91, *SD*=1.03),

and extrinsic motivation (Male: *M*=5.05, *SD*=.99; Female: *M*=5.23, *SD*=1.14), indicating to what

extent each statement presently corresponded to one of the reasons the participant was pursuing

their current major. Statements included "Because with a different major I would not find a high-

paying job", "Because I experience pleasure and satisfaction while learning new things related to

my major", and "I don't know; I can't understand what I am doing in my current major".

Perception of Major

Participants then indicated their agreement with each of 3 face-valid items intended to measure

how important participants felt it was to succeed in their major, such as "It is important to me to

do well in my major-related classes" and "I intend to work hard on being a good student in my

major-related classes", on a scale from 1 to 7 (1=Strongly disagree, 7=Strongly agree; Male:

M=6.45, *SD*=.82; Female: *M*=6.65, *SD*=.79).

Participants next answered on a scale of 1 to 7 if they felt they belonged/fit in with their major

(1=Strongly disagree, 7=Strongly agree; Male: *M*=5.14, *SD*=1.51; Female: *M*=5.50, *SD*=1.21),

how masculine or feminine they found their major (1=Very feminine, 4=Neither feminine nor

masculine, 7=Very masculine; Male: M=4.83, SD=1.35; Female: M=3.78, SD=1.24), and how they would rate the gender proportion within their major (1=Mostly female, 4=Equal numbers of men and women, 7=Mostly male; Male: M=4.42, SD=1.86; Female: M=3.45, SD=1.53).

Self-Efficacy

Finally, to measure self-efficacy, participants were asked to indicate their agreement with 10 statements derived from the General Self-Efficacy Scale (Schwarzer & Jerusalem, 1995) on a scale from 1 to 7 (1=Strongly Disagree, 7=Strongly Agree; Male: M=5.60, SD=.81; Female: M=5.38, SD=.75). Statements included "I can always manage to solve difficult problems if I try hard enough," "I am confident that I could deal efficiently with unexpected events," and "I can remain calm when facing difficulties because I can rely on my coping abilities."

CHAPTER III

RESULTS

Preliminary Analyses

The bivariate correlations between significant and marginally significant variables are presented in Table 1.

Table 1.

Bivariate correlations among variables

	1	2	3	4	5	6	7	8	9	10	11
1. True-self awareness	-	-.63**	.15*	-.13	.21**	.16*	.34**	.08	.13	.12	.02
2. Self-alienation		-	-.06	.17**	.01	-.08	-.31**	-.01	-.15*	-.05	-.04
3. Decision confidence			-	-.76**	.57**	.22**	.14*	.40**	.71**	-.03	-.18**
4. Amotivation				-	-.52**	-.31**	-.11	-.46**	-.63**	.04	.10
5. Intrinsic motivation					-	.56**	.19**	.42**	.56**	.04	-.11
6. Extrinsic motivation						-	.12	.40**	.30**	.07	.03
7. Self-efficacy							-	.24**	.28**	.07	.02
8. Major-importance								-	.44**	-.21**	-.19**
9. Belonging/fit									-	-.11	-.17*
10. Masculinity vs. Femininity										-	.73**
11. Gender proportion											-

Note. $^*p < .05.$; $**p<.01$

Primary Analyses

A *t*-test for independent samples was performed to test whether there were any gender differences on any of the measures. Results revealed a significant difference between female and male participants' perceptions of how feminine/masculine they found their major ($t(196) = 5.68$, $p < .01$). Female participants reported perceiving their major as significantly less masculine ($M=3.78$, $SD=1.24$) than male participants ($M=4.83$, $SD=1.35$). Another *t*-test revealed a significant difference between female and male participants' perceptions of the gender proportion within their major ($t(196) = 3.98$, $p < .01$). Female participants reported perceiving the gender proportion within their major as significantly less male-dominated ($M=3.45$, $SD=1.53$) than their male counterparts ($M=4.42$, $SD=1.86$). These significant findings are displayed in Figure 1.

Marginal differences were also found between female and male participants in ratings of self-efficacy ($t(196) = 1.93$, $p < .10$), perception of importance in doing well in their major ($t(196) = -1.76$, $p < .10$), and sense of belonging/fit in their major ($t(196) = -1.86$, $p < .10$). Female participants reported lower ratings in self-efficacy ($M=5.38$, $SD=.75$) than male participants ($M=5.60$, $SD=.81$), but women also reported higher ratings in their perception of importance of success in their major ($M=6.65$, $SD=.79$) and in their sense of belonging to or "fitting in" with their major ($M=5.50$, $SD=1.21$) than men ($M=6.45$, $SD=.84$; $M=5.14$, $SD=1.51$).

The hypothesized interactions between measures of true self-knowledge and gender predicting decision confidence and achievement motivation were not found to be significant ($p > .10$). However, the significant correlations between the measures listed in Table 1 combined with the

above significant results do indicate that further modified investigations could present different
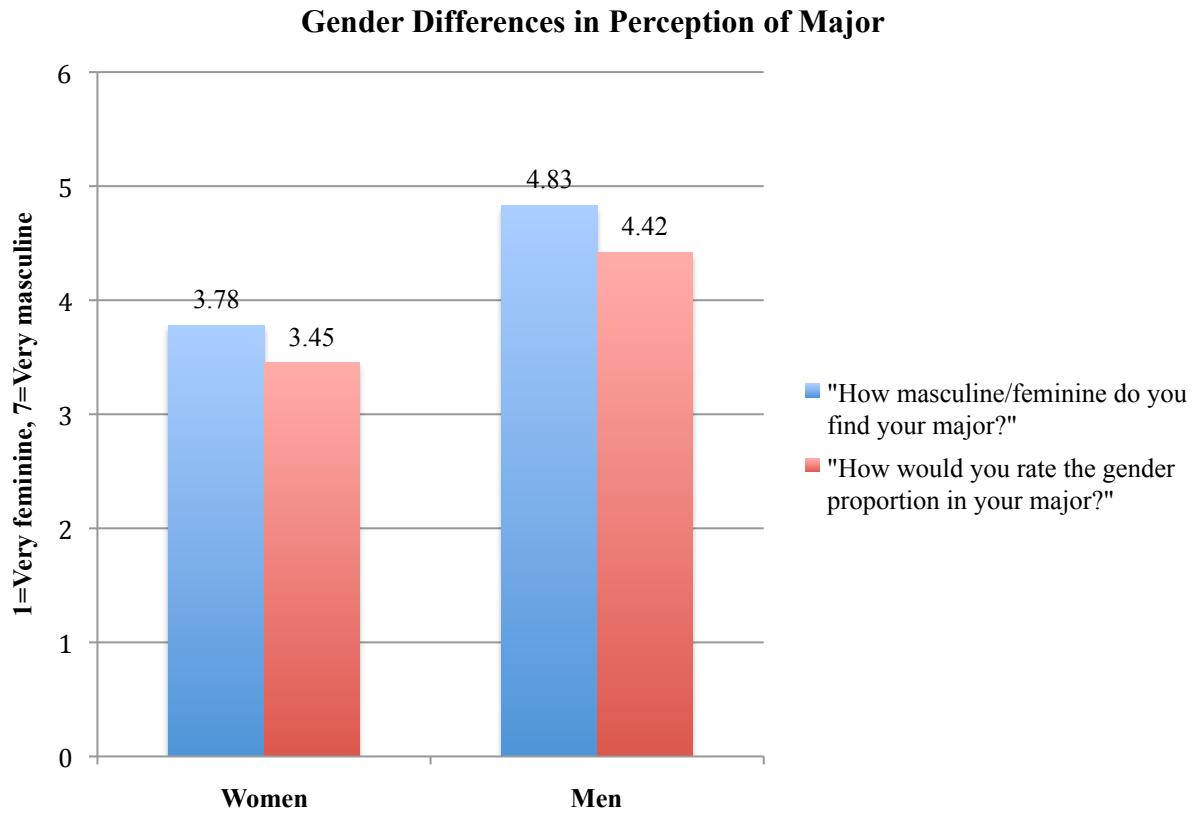
significant results.

Gender Differences in Perception of Major

Figure 1. Means of perception of femininity/gender proportion of major reported by women and men.

CHAPTER IV

CONCLUSION

Summary of Findings

The results of the current study did not suggest an interaction between gender and measures of true-self knowledge in the prediction of decision satisfaction and achievement motivation in regards to STEM-related majors. The results suggests that true self-knowledge was equally predictive (or not-predictive, depending on the measure) of these two outcomes across the two genders. The lack of the hypothesized interaction may be explained by the fact that the genders differed in their perceptions of how feminine/masculine their majors were, as well as the gender proportion within those majors. The crux of our hypothesis rested on the idea that women were receiving an external cue that they may not belong in these male-dominated fields. However, the women in our sample did not perceive their majors to be all that masculine or male-dominated. In fact, their ratings on both of these items were below the midpoint of the scale (suggesting a slight bias toward perceiving their majors as more *feminine* than masculine*)*. They also rated their belonging/fit in their major as *higher* than their male counterparts. This is the exact of opposite of what we expected, and may be due to the nature of our sample. Almost all of our participants were freshman and were likely to still be taking courses to fulfill general education requirements and prerequisites for their majors. These classes are likely more gender balanced than upper division classes within STEM majors. Thus, a different pattern may emerge in a more advanced undergraduate sample or graduate sample.

Nonetheless, marginal differences were found between female and male participants in ratings of self-efficacy, suggesting that women have less confidence in their ability to perform well even at

this early stage in their careers. This is important to note as these differences may become exacerbated as they move through their careers

Implications

From the significant and marginal results that *were* gathered, it is possible that gender is involved with various factors associated with motivation to remain in a STEM major. Even though the female participants in this sample were high in belonging, these women were also lower in self-efficacy, which recent studies have indicated tends to decrease throughout a woman's undergraduate career (Dennerlein, 2013). Self-efficacy is also related to many aspects related to this study, including decision confidence and achievement motivation, and is an important predictor of success in many areas of life (including career success and general well-being; Sheldon, K. M., & Elliot, A. J., 1999).

Limitations

Despite the lack of significant results within the hypothesized interactions, several extraneous factors could be at play that skewed the results. The sample of participants, as earlier stated, was selected from a pool of students enrolled in an Introduction to Psychology course at Texas A&M University for course credit. Although there is typically a large range of diversity in the students enrolled in these courses, it is important to note that the majority of the subjects were still very early in their undergraduate career, and as such may not have been enrolled in many of their major-specific courses. There was also a very high percentage of students enrolled in biology majors, including biomedical sciences (33.2%). Biology-related fields have been found in recent years to be far less male-dominated than in the past, an exception to the general rule of STEM

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fields (Heilbronner 2013. A future direction could be to take a more active recruiting approach of more heavily male-dominated majors such as engineering, mathematics and computer science.

Conclusions

Though our results did not reveal the interactions we hypothesized between gender and true self-knowledge predicting decision satisfaction and achievement motivation, the results did suggest that gender is involved in women's decisions and motivations to remain in a STEM major. Steps could be taken to further investigate these possible interactions, and to bolster existing empirical data that suggests self-efficacy is involved in these decisions and motivations.

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