

Examining the Gender Gap in Information Assurance: A Study of Psychological Factors

Hsiao-Ying Huang¹(✉) and Masooda Bashir²

¹ Illinois Informatics Institute, University of Illinois at Urbana-Champaign,
Champaign, USA

hhuang65@illinois.edu

² Graduate School of Library and Information Science,
University of Illinois at Urbana-Champaign, Champaign, USA

mnb@illinois.edu

Abstract. The increasing cyber attacks result in an emergent need for Information Assurance professionals in the government and private sector. Young adults' psychological factors related to the career field of Information Assurance (IA) remain largely understudied despite Information Assurance Workforce (IAW) becoming a crucial issue. Gender disparity, in particular, is a concern for Information Assurance. The first of its kind, this study investigates the gender gap in the field of IA by examining psychological factors affecting young adults, including attitudes, interests, self-efficacy, and goals. Our findings on gender difference in IA from psychological perspectives provide insight for understanding gender disparity in the IA field and initiate studies to explore this issue further. The practical purpose of this study is to contribute information related to gender differences, understood with regard to psychological aspects, for IA recruitment strategies to inspire young adults, especially the underrepresented population of women, to join the IAW.

Keywords: Information assurance workforce · Gender disparity · Career choice · Vocational psychology · Cyber security education

1 Introduction

The relative lack of Information Assurance (IA) professionals in the government and private sector leaves the United States vulnerable to cyber attacks [2]. While increasing the Information Assurance Workforce (IAW) is of national priority, we know very little about what psychological factors attract young adults to this field of study. In particular, the gender disparity in IAW is a concern because women constitute only 10–15 % of the IAW [20]. Although the IAW's gender disparity is consistent with the underrepresentation of women in the Science, Technology, Engineering, and Mathematics (STEM) fields, few studies addressed the IAW's gender gap. The purpose of this study is to explore gender disparity in the IA field from a psychological perspective. In our study we focused on students that are majoring in the IA field because we believe that by understanding those who have already chosen IA as their field of study we can evolve our understanding of what psychological factors contribute to young adults'

decision to be in the IA field and if there are gender differences in those factors. In addition, this understanding will enable recruiting programs to develop the appropriate framework and target their efforts on the young adults that are more likely to join this workforce.

To understand young adults' career choice in the IA field, a study of motivational and cognitive processes as it relates to gender difference is necessary [9]. Questions emerge, such as, how do men and women value career goals differently, and do they believe that an IA career will contribute to achieving their career goals? To investigate these questions, we surveyed university students majoring in IA. We adopted the goal congruity theory from social psychology. Our study investigated four psychological factors: (1) students' attitudes towards an IA career, (2) students' interests in an IA career, (3) students' perception of whether an IA career fits their interests, and (4) students' personal career goals and perception of whether an IA career could fulfill those goals. The following section describes the psychological factors that were investigated in our study and how they influence different career perceptions among men and women.

2 Background

The purpose of this study is to examine gender differences among students majoring in IA by assessing four psychological factors: attitudes, interests, self-efficacy, and career goal. Previous studies have pointed out that these factors are influential when it comes to career choice among men and women. Therefore, we think it is important to investigate these four factors as a preliminary step toward understanding gender disparity in the IA field. We provide a brief illustration for each factor below.

Attitudes. Attitudes have been defined as judgments influenced by external information, past judgments of memory, and prior knowledge [1]. After processing the relevant information, new judgments are stored in one's memory and become attitudes, potentially influencing behavior [14]. Attitudes toward the idea of a career influence behaviors affecting career choice. In addition, an earlier study has revealed that genders had different attitudes toward scientific career due to social stereotypes [21]. Therefore, our first research question is:

RQ1: Are attitudes towards IA career gendered?

Interests. Interests are directly related to work performance due to their influence on individuals' educational and occupational choices, as well as efforts for goal achievement in work settings [7]. In addition, prior studies found that interest can be a strong predictor of choice of college majors and occupations [11]. Furthermore, researchers have noted the gender disparity of interest for information technology careers [15]. Thus, our second question is:

RQ2: Is there gender difference among students' interests, and is there gender difference among perceptions about whether interests match the career field of IA?

Self-efficacy. Self-efficacy in one's career refers to an individual's confidence in pursuing a career-related task [16]. Self-efficacy has been broadly used to explain the gender differences that affect career choices and career preferences [12]. Also, researchers found that self-efficacy could predict career options, occupational interests, and personal effectiveness [4]. Self-efficacy is therefore an essential factor to measure when assessing career choice. Earlier studies found gender differences related to career self-efficacy [5]. For instance, women tend to have lower expectations than men for success in their occupations [5, 12]. In terms of STEM fields, prior studies indicated that men have significantly higher degrees of self-efficacy towards computers [3, 6]. However, significant gender differences were exhibited only in the completion of complex computer tasks [3]. This finding suggests that women may have lower confidence toward personal computer skills when encountering a complicated task. Hence, our third question is as follows:

RQ3: Is there a gender difference in self-efficacy relative to IA careers?

Career Goal. Prior research has revealed that understanding one's goal is an important factor for predicting individuals' motivation and task performance [22]. According to a goal congruity perspective, goals are often stable and malleable to social roles [9]. As scholar [9] illustrate, particular social roles lead to social structures that individuals navigate in the pursuit of their goals. To understand gender differences related to career goals, we examined two types of goals—agentic goals and communal goals. An agentic goal indicates interest in pursuing status, power, achievement, and popularity. A communal goal, in contrast, refers to helping others, working with others, relational needs, and intimacy [9, 14].

Prior study found that women prefer communal goals, such as helping others and working with people, which also influences their occupational interests [18]. Furthermore, if a woman valued people-oriented or society-oriented occupations, she also favored health-related careers [13]. Also, women who considered science to be relevant to altruism tended to exhibit more interest in scientific careers [8], which corresponded to the finding that communal goal endorsement was negatively correlated to STEM interests [9]. Therefore, our fourth question is as follows:

RQ4: Relative to one's personal goal, is there a gender difference in perceptions of career goal and career fit?

Utilizing the above literature on gender differences and career choice, we proposed four research questions to examine gender differences in the IA field. As shown above, attitudes play an important role in career choice. We further examined the relationship between each factor and attitudes toward an IA career.

3 Results

Are attitudes towards IA career gendered? Our first question is whether genders exhibited different attitudes toward IA career. Results did not show significant gender differences in attitudes toward an IA career. Also, the results found that for both women

and men, those with a higher interest in an IA career also had more positive attitudes toward an IA career (women: $r = .42$, $p = .002$; men: $r = .66$, $p = .000$).

Is there gender difference among students' interests and perceptions about whether there is a fit between their interests and the career field of IA? With regard to personal interest toward an IA career, women and men did not show significant difference. However, women showed a lower interest fit between personal interest and the IA field than men ($t = -2.13$, $p = .036$). We also explored the relationship between interests fit and attitudes toward an IA career. The results showed that for both women and men, those who perceived an IA career to be more fitting for their personal interests also had more positive attitudes toward an IA career (women: $r = .44$, $p = .002$; men: $r = .61$, $p = .000$).

Is there a gender difference in self-efficacy relative to IA careers? We found that women had lower self-efficacy than men ($t = -4.44$, $p < .00$) to work in the IA field, even though there was no significant gender difference in their GPA performance, which is similar to prior studies. However, self-efficacy did not show a significant correlation with attitudes toward IA for both women and men.

Relative to one's personal goal, is there a gender difference in perceptions of career goal and career fit? Finally, we examined the gender differences in personal career goal and the fit between personal goal and an IA career. Our analysis indicated that women had a higher tendency than men to consider communal goals as a personal career goal ($t = 2.49$, $p = .015$). The results did not exhibit a significant gender difference as to the fit between personal goals and an IA career. However, we found that men had higher ratings on the fit between communal goals and an IA career, and that women had higher ratings on the fit between agentic goals and an IA career. This finding indicates that men may regard an IA career as a way to fulfill communal goals; conversely, women may consider an IA career as a way to fulfill agentic goals. To clarify the influence of career goals for an IA career, we further analyzed the relationship between career goals and attitudes toward an IA career. The results indicated that women who perceived an IA career as fitting their agentic goals had more positive attitudes towards an IA career ($r = .39$, $p = .006$). Similarly, men who thought that an IA career could fit their agentic goals also had more positive attitudes toward IA career ($r = .48$, $p = .002$). Notably, men who perceived a career in IA as fulfilling their communal goals also had more positive attitudes toward the IA field ($r = .41$, $p < .008$).

4 Discussion

Our findings suggest gender difference in three of the factors that we assessed: perception of fit between personal interests and IA career, self-efficacy, and communal goals for students majoring in the IA field. Our findings were similar to previous studies [3, 6]: although there was no gender difference relative to GPA performance, women had lower self-efficacy than men to work in the IA field. One possible explanation is that women's lower self-efficacy emerges from gender stereotypes and self-conception of technological ability rather than actual performance discrepancy [19]. However, while gender

differences existed in self-efficacy, it is worth noting that self-efficacy was not correlated with attitudes toward the IA field.

Furthermore, our study provides empirical evidence that the IA field might be viewed as having a lower association with fulfilling communal goals. This may account for women having less interest in pursuing a career in IA [8, 9]. However, for men, an IA career might fulfill both their communal and agentic goals, which might further enhance their positive attitudes toward an IA career. These findings indicate two things: first, women and men may need to receive different recruiting strategies due to their preferences for career goals; second, if the IA field can be increasingly presented to young adults in terms of fulfilling communal goals, this may result in more women to the field [10].

5 Conclusion

To the best of our knowledge, this is the first study to examine the gender difference from psychological perspectives in the IA field. By examining gender differences with regard for psychological aspects, we contribute to IA recruitment strategies so that more young adults, especially women, might join the IAW. For instance, the educational programs in the IA field may consider adding more communal elements to courses and enhancing the self-efficacy of young adults, particularly women, in their mentoring and assessment strategies. Our findings enhance our understanding of gender disparity in the IA field and, hopefully, initiate future studies to further explore this issue in the IA workforce.

References

1. Albarracín, D., Johnson, B.T., Zanna, M.P. (eds.): *The Handbook of Attitudes*. Psychology Press, New York (2014)
2. Libicki, M., Senty, D., Pollak, J.: An examination of the cybersecurity labor market. National Security Research Division. http://www.rand.org/content/dam/rand/pubs/research_reports/RR400/RR430/RAND_RR430.pdf (2014). Accessed 07 Nov 2014
3. Busch, T.: Gender differences in self-efficacy and attitudes toward computers. *J. Educ. Comput. Res.* **12**(2), 147–158 (1995)
4. Markman, G.D., Balkin, D.B., Baron, R.A.: Inventors and new venture formation: the effects of general self-efficacy and regretful thinking. *Entrepreneurship Theor. Pract.* **27**(2), 149–165 (2002)
5. Wilson, F., Kickul, J., Marlino, D.: Gender, entrepreneurial self-efficacy, and entrepreneurial career intentions: Implications for entrepreneurship Education I. *Entrepreneurship Theor. Pract.* **31**(3), 387–406 (2007)
6. Cooper, J.: The digital divide: the special case of gender. *J. Comput. Assist. Learn.* **22**(5), 320–334 (2006)
7. Nye, C.D., Su, R., Rounds, J., Drasgow, F.: Vocational interests and performance a quantitative summary of over 60 years of research. *Perspect. Psychol. Sci.* **7**(4), 384–403 (2012)

8. Weisgram, E.S., Bigler, R.S.: Effects of learning about gender discrimination on adolescent girls' attitudes toward and interest in science. *Psychol. Women Q.* **31**(3), 262–269 (2007)
9. Diekmann, A.B., Clark, E.K., Johnston, A.M., Brown, E.R., Steinberg, M.: Malleability in communal goals and beliefs influences attraction to stem careers: evidence for a goal congruity perspective. *J. Pers. Soc. Psychol.* **101**(5), 902 (2011)
10. Diekmann, A.B., Steinberg, M.: Navigating social roles in pursuit of important goals: a communal goal congruity account of STEM pursuits. *Soc. Pers. Psychol. Compass* **7**(7), 487–501 (2013)
11. Eccles-Parsons, J.: Expectancies, values, and academic behaviors. In: Spence, J.T. (ed.) *Achievement and Achievement Motivations*, pp. 75–121. Freeman, San Francisco (1983)
12. Eccles, J.S.: Understanding women's educational and occupational choices. *Psychol. Women Q.* **18**(4), 585–609 (1994)
13. Eccles, J.S.: *Where Are All the Women? Gender Differences in Participation in Physical Science and Engineering*. American Psychological Association, Washington, D.C. (2007)
14. Ajzen, I., Fishbein, M.: The influence of attitudes on behavior. In: Albarracín, D., Johnson, B.T., Zanna, M.P. (eds.) *The Handbook of Attitudes*, pp. 173–221. Erlbaum, Mahwah (2005)
15. Zarrett, N., Malanchuk, O., Davis-Kean, P.E., Eccles, J.: Examining the gender gap in IT by race: young adults' decisions to pursue an IT career. In: Cohoon, J.M., Aspray, W. (eds.) *Women and Information Technology: Research on Underrepresentation*, pp. 55–88. MIT Press, Cambridge (2006)
16. Hackett, G., Betz, N.E.: Self-efficacy and career choice and development. In: Maddux, J.E. (ed.) *Self-efficacy, Adaptation, and Adjustment*, pp. 249–280. Springer, Berlin (1995)
17. Hagemeyer, B., Neyer, F.J.: Assessing implicit motivational orientations in couple relationships: the partner-related agency and communion test (PACT). *Psychol. Assess.* **24**(1), 114 (2012)
18. Konrad, A.M., Ritchie Jr., J.E., Lieb, P., Corrigan, E.: Sex differences and similarities in job attribute preferences: a meta-analysis. *Psychol. Bull.* **126**(4), 593 (2000)
19. Kurtz-Costes, B., Rowley, S.J., Harris-Britt, A., Woods, T.A.: Gender stereotypes about mathematics and science and self-perceptions of ability in late childhood and early adolescence. *Merrill-Palmer Q.* **54**(3), 386–409 (2008)
20. LeClair, J., Shih, L., Abraham, S.: Women in STEM and cyber security fields. In: *Proceedings of the 2014 Conference for Industry and Education Collaboration*, Savannah, Georgia, 5–7 Feb 2014
21. Lips, H.M.: Gender and science-related attitudes as predictors of college students' academic choices. *J. Vocat. Behav.* **40**(1), 62–81 (1992)
22. Locke, E.A., Latham, G.P.: *A Theory of Goal Setting and Task Performance*. Prentice-Hall Inc, Englewood Cliffs (1990)