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Profiling cybersecurity competition participants: Self-efficacy, decision-making and interests predict effectiveness of competitions as a recruitment tool

Masooda Bashir ^{a,*}, Colin Wee ^b, Nasir Memon ^c, Boyi Guo ^d

^a School of Information Sciences, University of Illinois at Urbana, Champaign, IL, USA

^b Department of Psychology, University of Illinois at Urbana, Champaign, IL, USA

^c Computer Science and Engineering, New York University Tandon School of Engineering, USA

^d Department of Statistics, University of Illinois at Urbana, Champaign, IL, USA

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ABSTRACT

This paper presents the main results of a large-scale survey on cybersecurity competition participants in the past decade. 588 participants of the Cybersecurity Awareness Week (CSAW) competition were surveyed with measures of personality, interests, culture, decision-making and attachment styles in an exploratory study designed to identify the characteristics of cybersecurity competition participants. Subgroups analyses were performed to examine individual differences between self-proclaimed hackers and non-hackers, males and females, and cybersecurity employees versus students. Regression analyses were used to identify variables that influenced the extent to which cybersecurity competitions were effective at convincing participants to pursue a future career in cybersecurity. Cybersecurity participants who displayed higher self-efficacy, rational decision-making style, and more investigative interests were more likely to declare an interest in a career in cybersecurity after the competition.

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1. Introduction

In the last decade, cybersecurity and information assurance has emerged as a top priority for both governments and industry. Cybersecurity breaches such as Sony Pictures Entertainment's data leak in late 2014 are worst-case scenarios for many organizations. A 2015 global survey indicated that 83% of organizations list cybersecurity attacks as a top three concern (ISACA, 2015). Furthermore, the United States government emphasized the importance of cybersecurity by passing

four sweeping bills in 2014, including the Cybersecurity Workforce Assessment Act (Pub.L. 113–246), aimed at developing a plan for increasing the number of trained cybersecurity professionals in the workforce. Still, there is at present a shortage of skilled cybersecurity professionals available for hire (ISACA, 2015), thus current methods of increasing the influx of workers into cybersecurity careers need to be validated and improved upon to meet global demand.

A key method used by both government and industry to attract individuals into cybersecurity careers has been the sponsorship of cybersecurity competitions. The United States Air

* Corresponding author.

E-mail address: mnb@illinois.edu (M. Bashir).

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Force sponsors the CyberPatriot competition and education program to prepare high school and middle-school students for higher education in STEM fields and potential careers in cybersecurity. The Department of Homeland Security and the National Security Agency continue to sponsor major competitions such as the National Collegiate Cyber Defense Competition (NCCDC) and New York University's Cybersecurity Awareness Week (CSAW). These contests are coordinated by educational institutions around the United States and are typically targeted toward high school- and college-aged students. Competitions such as the University of Santa Barbara's International Capture the Flag competition challenge participants to develop innovative strategies to attack or defend computer systems, while both raising awareness about the various hacker threats and teaching network security practices through live exercises (Vigna et al., 2014). Schools benefit from cybersecurity competitions because they can evaluate their own computer security curricula and foster teamwork and ethical behavior among their students. Conversely, industries benefit from cybersecurity competitions because they are places for professional networking with potential hires (Gavas et al., 2012). Competitions are thus a good method of fostering the next generation of cybersecurity specialists. Cybersecurity competitions are also sometimes held concurrent with hacker conventions. DefCon, the world's largest annual hacker convention, conducts its own capture the flag competition for hackers to test their skills against each other and push the limits of the field of cybersecurity. The U.S. Department of Homeland Security's National Initiative for Cybersecurity Careers and Studies states that, "cyber competitions foster talent in potential cybersecurity professionals that might otherwise be unidentifiable through traditional academic means" (NICCS, 2015). While there has been remarkable work done by the cybersecurity education community to develop the "best" competitions, little empirical research has been done to explore the types of people that are attracted to these competitions and whether these competitions are really effective at funneling like-minded people into cybersecurity careers.

This paper aims to develop a psychological profile of participants from one of the longest-running cybersecurity competitions in the world, Cybersecurity Awareness Week (CSAW). CSAW is an annual on-site competition organized by New York University Tandon School of Engineering. CSAW started 11 years ago as a capture the flag competition. Capture the flag is a team-based activity where contestants race each other through digital mazes to find a unique identifier called a flag. These flags may manifest as a secret password, random string, or unique image (Gavas et al., 2012). These flags may also be hidden within a host network, where one attacking team develops exploits and attempt to retrieve it while the defending teams tried to protect it from being stolen. Since its inception, CSAW has since then grown from a small student-run initiative to a prestigious international competition which annually recruits over 10,000 participants from around the world. Over time, CSAW has diversified the types of competitions it offers; now participants ranging from high school students to graduate researchers compete on tasks including a capture-the-flag challenge, a high school forensics challenge, an embedded systems challenge, an AT&T applied security essay competition, a video competition and a depart-

ment of homeland security quiz tournament. Since many of these competitions target separate audiences, the current paper only develops a psychological profile for capture the flag participants from CSAW as it is the largest and most established population to sample from. The profile we develop can also be compared to workers currently employed in the field of cybersecurity to understand if competitions are attracting people who are similar, or different to the characteristics of the current workforce. Although using only participants from CSAW limits the generalizability of our inferences to other competitions and is subject to range restriction, CSAW is the largest and most established on-site cybersecurity competition and there is a need of pioneering preliminary research into the understudied field of cybersecurity competitions. By focusing on the unique characteristics of cybersecurity competition participants and learning about their interests and motivations, we cannot only design the best competitions but also effectively attract the most talented students into cybersecurity careers.

As a secondary objective, we also compare and contrast the psychological profiles of subgroups within the competitors, addressing questions such as "Are self-proclaimed hackers different from non-hackers in any individual difference characteristic?" Understanding these competitors, especially the differences between those who go on to pursue jobs in the cybersecurity field and those who do not, is key to assessing the utility of cybersecurity competitions in attracting like-minded people into cybersecurity careers.

2. Theory and past research

2.1. Profiling cybersecurity participants

Improving cybersecurity competitions is an important part of solving the workforce deficiency in the field of information assurance. Our research marks an exploratory step into identifying the types of people competitions are attracting and whether or not they are motivated after the competition to enter careers in cybersecurity. We accomplish this by using participants from one of the most established cybersecurity competitions to infer the overall disposition of cybersecurity competition participants in general.

Previous researchers have noted that participants attend competitions for a variety of reasons other than just learning new cybersecurity skills, including because (1) they have the opportunity to apply the skills they have to new challenges, (2) they work in teams to develop socialization skills, and (3) they network with fellow cybersecurity students and with potential employers (Gavas et al., 2012). It is imperative that we study more about who these cybersecurity competitors are and what interests they have – and, ultimately, learn how to best direct interested people into cybersecurity careers.

Several recent studies have focused on the personality traits of IT professionals (Ash et al., 2006a, 2006b; Cruz et al., 2015; Lounsbury et al., 2007, 2009; Rosenbloom et al., 2008; Warren et al., 2012). Ash et al. compared the personality traits and vocational interests of IT professionals to those of working professionals from other fields. In the first of two studies, the researchers used the NEO-FFI (a well-established "big five"

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