

Self-efficacy in Cybersecurity Tasks: Relationships with Cybersecurity Competition and Work-Related Outcomes



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Funding & Support

- **Project made possible by NSF funding
(Early-Concept Grants for Exploratory Research)**
- **Grant supported 3-years of research**
- **Phase I: Exploratory study of cybersecurity
competition participants**
- **Phase II: More focused study based on findings
from Phase I**

Research Rationale

- **Employee shortages in the cybersecurity field**
- **Congress passed the Cybersecurity Workforce Assessment Act to address these shortages**
- **What role might cybersecurity competitions play in these recruitment efforts?**
- **Academics: evaluate cybersecurity competitions and study the participants**

Introduction

What are Cybersecurity Competitions?



Introduction

- Challenge participants to attack/defend networks/systems
- Educational tool to raise awareness about online threats and practice computer security skills through live exercises
- Recruitment platform to share cybersecurity career information
- Often sponsored by the US Gov't. and hosted by schools



Phase I Research

- **Exploratory study (2013) to obtain a psychological profile of cybersecurity competition participants**
- **Participants of NYU's Cybersecurity Awareness Week - Capture the Flag (CSAW)**
- **Found: openness to exp., interest in investigative tasks, rational decision-making styles, & self-efficacy**
- **Self-efficacy was strongest predictor of whether or not participants entered cybersecurity career**

Phase II Research

- **Phase II: focused follow-up on Phase I**
- **RQ1: Why participants join cybersecurity competitions**
- **RQ2: The role of self-efficacy in competition and career related outcomes**

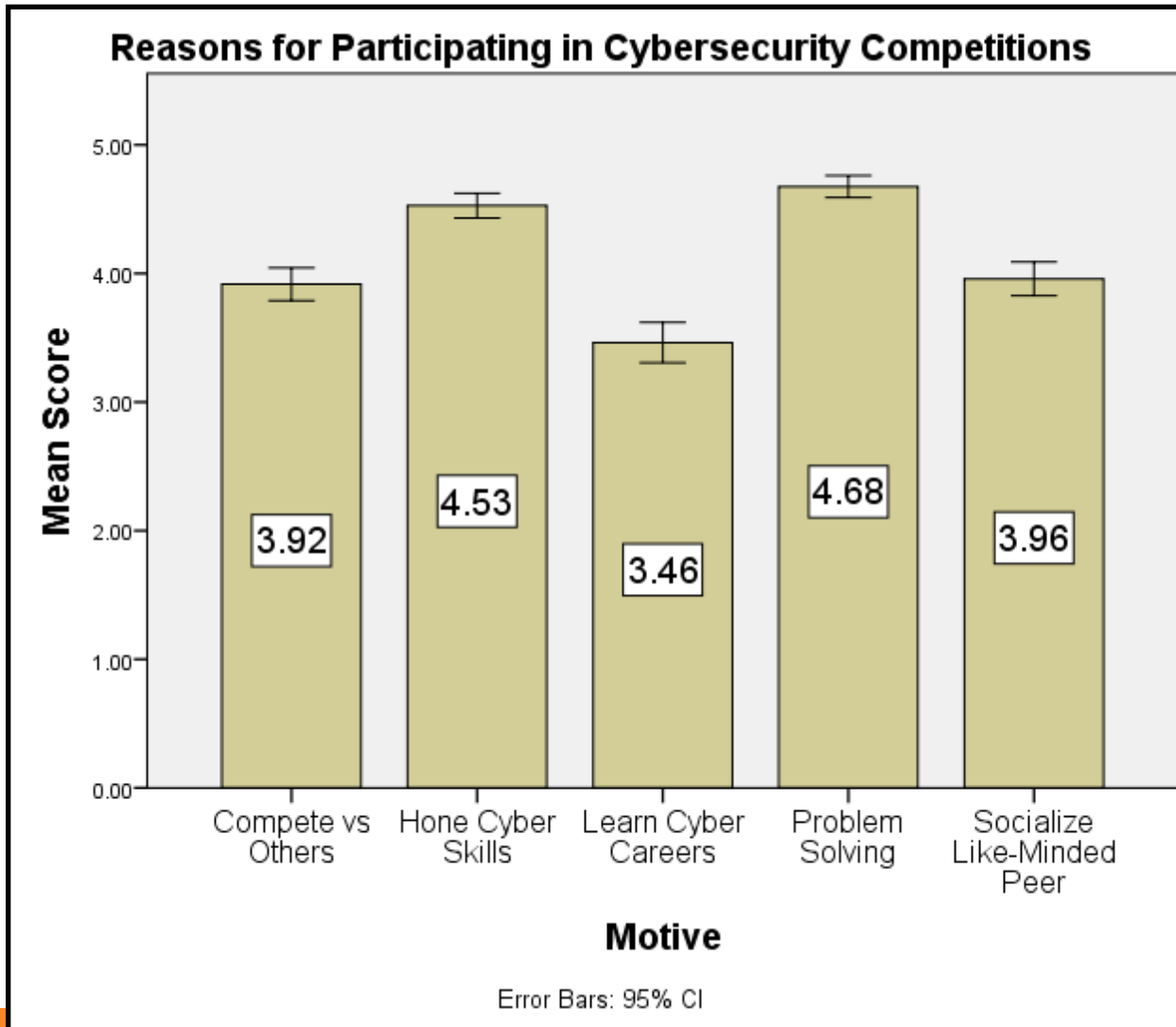
Phase II Research

- **Contacted same population of participants – survey**
- **588 past participants of Cybersecurity Awareness Week - Capture the Flag (CSAW)**
 - **One of the longest running, most established capture-the-flag competitions**
 - **Hosted annually by NYU**
 - **Access to 10 years worth of participants**
 - **Willing to release mailing lists to researchers**

Sample

- **195 respondents (184M / 11F) passed the quality control questions**
- **Average age 24.28**
- **58.9% White, 30.2% Asian**
- **88 were employed in cybersecurity jobs**

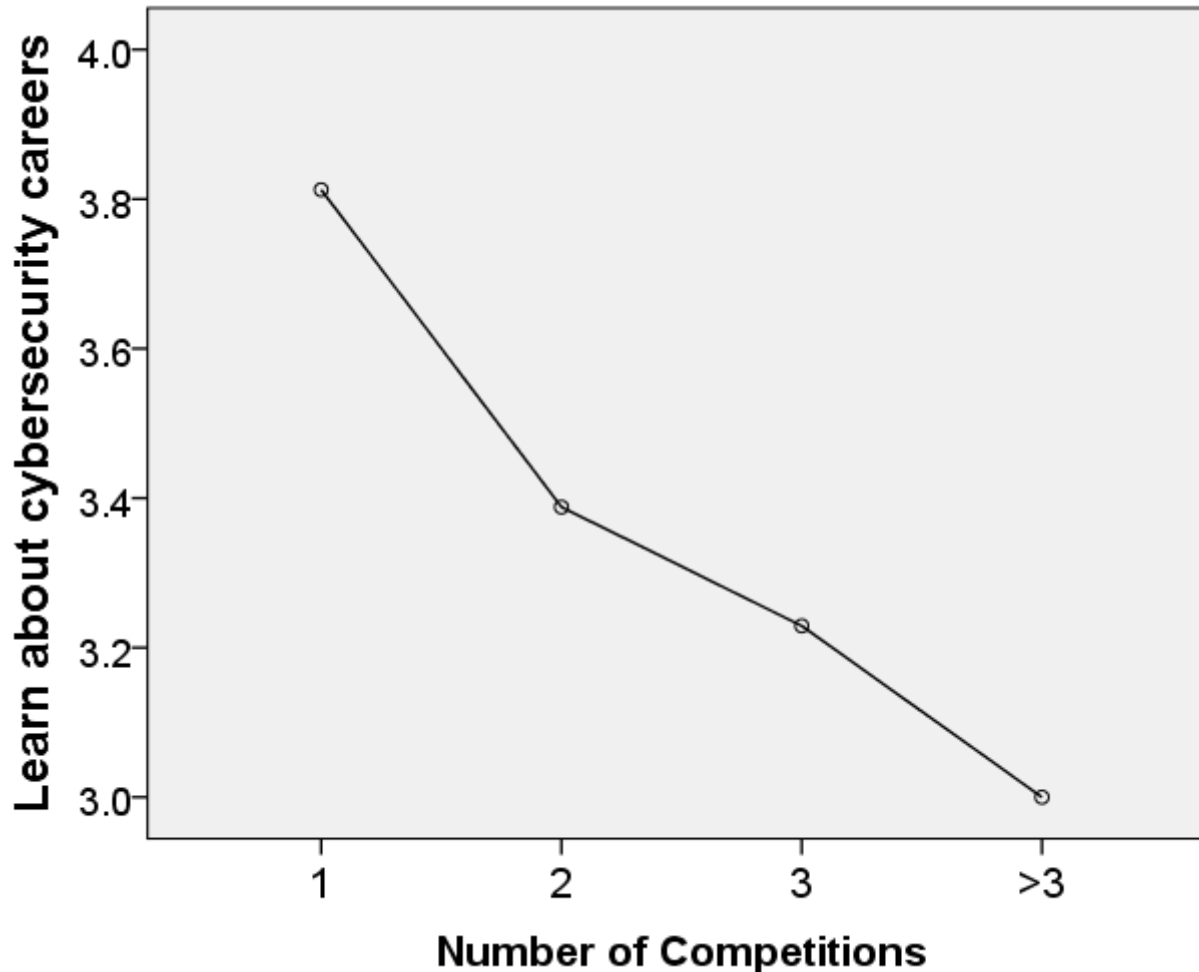
RQ1: Survey Question & Result



Top Reasons:

- Problem solving
- Skill mastery

RQ1: Further Analysis



Question:
Does the reason for entering differ between first-time and repeat participation?

RQ2: Self-Efficacy & Outcomes

- **How does self-efficacy relate to competition effectiveness and career intent?**
- **Administered established psychological measures**
 - Rosenberg (1965) General Self-Efficacy Scale
 - Chen (2001) Self-Esteem Scale
- **Also developed new measure of self-efficacy in cybersecurity-specific tasks**

RQ2: Measures

- **Cybersecurity Self-efficacy: Belief in own ability to meet demands in cybersecurity tasks**
 - 20-item measure pre-tested in university students
- **Two classes of dependent measures: organizational outcomes; competition-related outcomes**

RQ2: Results

Organizational Outcomes (N = 88):

Who is more likely to be satisfied with their jobs?

- Individuals who are generally confident
- Also those confident at cybersecurity tasks

	M	SD	Self Esteem	General Self-Efficacy	Cybersecurity-Specific Efficacy
Job Satisfaction	0.72	0.4	0.29*	0.33*	0.32*
Perceived Fit	3.77	0.65	0.18	0.37*	0.37*

RQ2: Results

Competition-related Outcomes:

- **Cybersecurity-specific self-efficacy was better at predicting performance within the competition**
- **Participants w/high self-esteem & self-efficacy were likely to learn more & be satisfied w/their performance**

RQ2: Results

Competition-related Outcomes:

- **Participants w/higher general self-efficacy & self-esteem report competition was effective at recruitment**
- **Same group thought competition increased the appeal of cybersecurity to the public**
- **No relationship found with career influence - possibly due to way question was phrased**

Limitations

- **Sample: only CSAW capture-the-flag participants**
 - **Should study participants engaged in other competition formats**
- **Self-report; retrospective data over 10 years**
 - **Conduct future longitudinal studies on current CSAW participants**

Discussion

- **People with higher confidence in performing cybersecurity tasks most likely to do well and be satisfied with their competition performance**
- **No significant relationship found between competition score (low/high) and view competition is effective**
- **Explore relationships between self-efficacy & job outcomes - highlight value of cybersecurity self-efficacy**

Conclusion

- **Cybersecurity career recruiters may want to target first-time participants**
- **These participants are most motivated about cybersecurity careers**
- **Need to encourage participants they are capable of handling difficult cybersecurity challenges**
- **Encouragement may enhance the recruitment rate of new cybersecurity employees from competitions**

Thank You!

Questions?

Selected Related Research:

Bashir, M., Lambert, A., Wee, J.M.C., & Guo, B. (2015, 11 August). An examination of the vocational and psychological characteristics of cybersecurity competition participants. *Proceedings of the USENIX Summit on Gaming, Games and Gamification in Security Education*, Washington, D.C.

Bashir, M., Lambert, A.D., Wee, J.M.C., Guo, B., & Memon, N. (2015, 15-17 June). Exploring the vocational interests of cybersecurity competition participants. Colloquium for Information Security Education (CISSE), Las Vegas, NV.

Lambert, A.D., Bashir, M., Guo, B., Memon, N., & Halevi, T. (2015, May 18-20). Are competitions effective in increasing the cybersecurity workforce? *Proceedings of IEEE Security & Privacy*, San Jose, CA.

Bashir, M. & Jeon, G. (2014, 11-12 Apr). An examination of psychological factors underlying the gender gap in cybersecurity. *Proceedings of the 2014 Women in Cyber Security Conference (WiCyS)*, Nashville, TN.

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