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

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• 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

<table>
<thead>
<tr>
<th></th>
<th>M</th>
<th>SD</th>
<th>Self Esteem</th>
<th>General Self-Efficacy</th>
<th>Cybersecurity-Specific Efficacy</th>
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</thead>
<tbody>
<tr>
<td>Job Satisfaction</td>
<td>0.72</td>
<td>0.4</td>
<td>0.29*</td>
<td>0.33*</td>
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<td>Perceived Fit</td>
<td>3.77</td>
<td>0.65</td>
<td>0.18</td>
<td>0.37*</td>
<td>0.37*</td>
</tr>
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</table>
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
Selected Related Research:


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