

Cyber knowledge is here, but not evenly distributed

Susan G. Campbell, Sunhee Kim, Valerie P. Karuzis, Scott R. Jackson, Meredith M. Hughes, & Alison Tseng
University of Maryland Center for Advanced Study of Language

susanc@umd.edu | <https://www.casl.umd.edu/projects/cyber-u-s-air-force/>

Does selecting personnel based on cybersecurity knowledge exclude other talented candidates?

Background

- Cybersecurity knowledge is often used to select people for entry-level cybersecurity jobs
- Want candidates who are most likely to succeed
- Want to identify candidates with high aptitude and low knowledge as well as those with knowledge
- Part of larger study investigating predictors of success in cyber warfare operations

Data collection

- Psychometric study to determine characteristics of cybersecurity aptitude measures
- 290 individuals, mostly university students (94%), in two testing waves
 - 129 in wave 1 (CKA, NFC)
 - 161 in wave 2 (CKA, ADR, PF, RAT, SL)
- Demographic questionnaire, cyber knowledge assessment (CKA), cognitive and personality measures (NFC, ADR, PF, RAT, SL; described below)
 - Race/gender groups reported here included more than 30 individuals in each wave
- Measures chosen for this analysis based on whether they predicted success in cyber warfare operations training

Outcomes

- Combination of computer science (CS) background and gamer status accounted for 32% of the variance in CKA
 - People with a CS background were more likely to be black or Asian and more likely to be male
 - Gamers were more likely to be white or Asian and more likely to be male
 - Adding additional demographic information did not improve prediction
- ADR, PF, and NFC significantly related to CKA

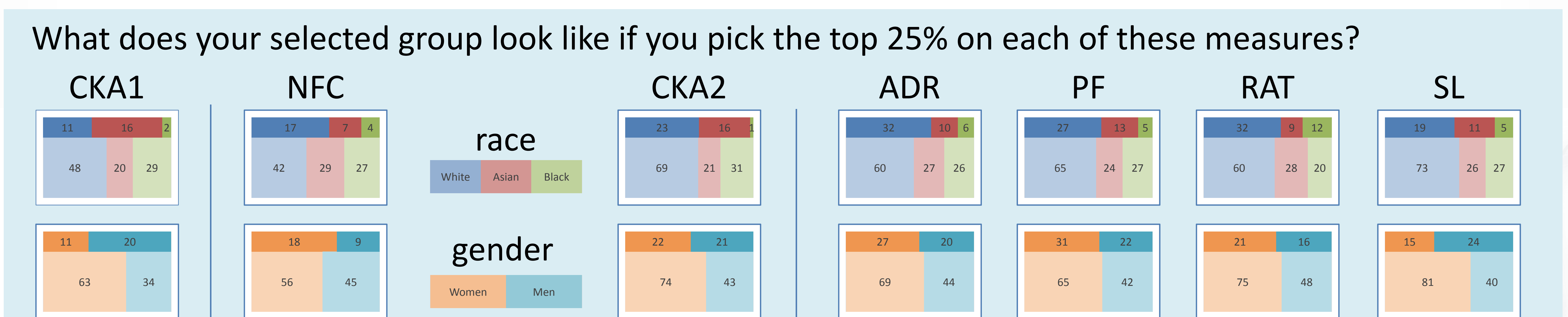
	correlation	NFC	ADR	PF	RAT	SL
CKA	.240	.190	.284	.021	.090	

- Simulated selection of the top 25% of participants in each wave on particular measures, as shown below
- *Selection ratio* = proportion of candidates selected from a particular group divided by the proportion selected from a reference group
 - any value less than 0.8 may be considered “adverse impact”
 - should combine measures for best prediction and least adverse impact

	Selection ratio	CKA	NFC
Wave 1			
Black/White	.35	.45	
Asian/White	2.38	.67	
Female/Male	.40	1.46	

	Selection ratio	CKA	ADR	PF	RAT	SL
Wave 2						
Black/White	.13	.54	.53	1.08	.76	
Asian/White	1.73	.78	1.20	.70	1.44	
Female/Male	.70	.90	.94	.88	.42	

Adding aptitude measures can increase representation without reducing projected success



Cyber Knowledge Assessment (CKA) content

General: 9 items, confidence in computer ability, experience configuring security/defenses, binary conversion

Forensics: 7 items, encryption, virus protection limitations, certificate issues, spread of malware

Developer: 6 items, programming experience, understanding code

Operator: 7 items, virus symptoms, command-line net operations, phishing, password security

Cognitive/Personality Aptitude Measures

Need for Cognition (NFC): Surveys enjoyment of effortful cognitive activities [1]

Rule-based Anomaly Detection (ADR): Measures the ability to apply given rules in a puzzle

Paper Folding (PF): Measures spatial visualization ability with folded paper and holes [3]

Remote Associates Task (RAT): Measures convergent creative thinking using words [2]

Statistical Learning (SL): Measures implicit sequence learning

References

- [1] Cacioppo, J. T., Petty, R. E., & Kao, C. F. 1984. The efficient assessment of need for cognition. *J. Pers. Assess.*, 48, 5, 306-307. DOI= http://dx.doi.org/10.1207/s15327752jpa4803_13.
- [2] Cropley, A. 2006. In praise of convergent thinking. *Creat. Res. J.*, 18, 391-404.
- [3] Ekstrom, R. B., French, J. W., Harman, H. H., & Dermen, D. 1976. *Manual for Kit of Factor-Referenced Cognitive Tests*. Princeton, NJ: Educational Testing Service.

Acknowledgments

The authors appreciate the efforts and support of the following people, whose help has been essential to the project: team members Nicholas Pandža, Adam Liter, S. Grace Goff, Lelyn Saner, Polly O'Rourke, Gregory Colflesh, Jessica Young, Jarrett Lee, John Romano, Victoria Chang, Christopher Gardner, and CASL IT support staff; former team members Amber Bloomfield, Bill Burns, Nina Hamedani, Isaiah Harbison, Alexa Romberg, and Arlo Sumer; MSgt Cochran & CMSgt Agard from USAF SAF/AG.

Disclaimer

This material is based upon work supported, in whole or in part, with funding from the United States Government. Any opinions, findings and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the University of Maryland, College Park and/or any agency or entity of the United States Government. This material is being made available for personal or academic research use. If the intention is to use it for commercial reasons, please contact University of Maryland's Office of Technology Commercialization at otc@umd.edu or (301) 405-3947.

Title with apologies to William Gibson.



HoTSoS Symposium and Bootcamp
HOT TOPICS in the **SCIENCE OF SECURITY**
APRIL 4-5, 2017 | HANOVER, MARYLAND