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Original Articles

From Warning to Wallpaper: Why the Brain Habituates to Security Warnings and What Can Be Done About It

Bonnie Brinton Anderson, Anthony Vance, C. Brock Kirwan, Jeffrey L. Jenkins & David Eargle

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Abstract

Warning messages are fundamental to users' security interactions. Unfortunately, they are largely ineffective, as shown by prior research. A key contributor to this failure is habituation: decreased response to a repeated warning. Previous research has only inferred the occurrence of habituation to warnings, or measured it indirectly, such as through the proxy of a related behavior. Therefore, there is a gap in our understanding of how habituation to security warnings develops in the brain. Without direct measures of habituation, we are limited in designing warnings that can mitigate its effects. In this study, we use neurophysiological measures to directly observe habituation as it occurs in the brain and behaviorally. We also design a polymorphic warning artifact that repeatedly changes its appearance in order to resist the effects of habituation. In an

experiment using functional magnetic resonance imaging (fMRI; n = 25), we found that our polymorphic warning was significantly more resistant to habituation than were conventional warnings in regions of the brain related to attention. In a second experiment (n = 80), we implemented the four most resistant polymorphic warnings in a realistic setting. Using mouse cursor tracking as a surrogate for attention to unobtrusively measure habituation on participants' personal computers, we found that polymorphic warnings reduced habituation compared to conventional warnings. Together, our findings reveal the substantial influence of neurobiology on users' habituation to security warnings and security behavior in general, and we offer our polymorphic warning design as an effective solution to practice

Key words and phrases:

behavioral information systems security cybersecurity fMRI functional magnetic resonance imaging

habituation mouse cursor tracking neurobiology NeuroIS polymorphic warnings security warnings

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Supplemental File

Supplemental data for this article can be accessed on the publisher's website at http://dx.doi.org/10.1080/07421222.2016.1243947

Notes

1. See http://neurosynth.org/analyses/terms/visual; https://wikipedia.org/wiki/Visual_cortex.

2. http://neurosynth.org/analyses/terms/default; https://wikipedia.org/wiki/Default_mode_network.

3. hMT+ or human middle temporal complex; http://neurosynth.org/analyses/terms/motion; https://en.wikipedia.org/wiki/Visual_modularity.

4. As participants were allowed to complete the task naturally for ecological validity, they could potentially revisit websites, reinstall extensions, and see the warning for those extensions again.

Additional information

Notes on contributors

Bonnie Brinton Anderson

BONNIE BRINTON ANDERSON (bonnie_anderson@byu.edu) is an associate professor of information systems and director of the Master of Information Systems Management Program at the Marriott School of Management, Brigham Young University. She received her Ph.D. from Carnegie Mellon University. She researches the intersection of decision neuroscience and behavioral information security. Her work has been published or accepted in Information Systems Research, Journal of Management Information Systems, Journal of the Association for Information Systems, European Journal of Information Systems, and other venues.

Anthony Vance

ANTHONY VANCE (anthony@vance.name) is as an associate professor of information systems at the Marriott School of Management, Brigham Young University. He has earned Ph.D. degrees in information systems from Georgia State University, the University of Paris–Dauphine, and the University of Oulu, Finland. His research focuses on behavioral and neuroscience applications to information security. His work has been published in Information Systems Research, Journal of Management Information Systems, MIS Quarterly, Journal of the Association for Information Systems (JAIS), European Journal of Information Systems, and others. He is an associate editor at MIS Quarterly and serves on the editorial board of JAIS.
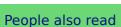
C. Brock Kirwan

C. Brock Kirwan (kirwan@byu.edu) is an associate professor of psychology and neuroscience at Brigham Young University. He received his Ph.D. in psychological and brain sciences from Johns Hopkins University. He has a decade of experience conducting functional magnetic resonance imaging (fMRI) scans with patient populations. He has published numerous papers reporting fMRI and neuropsychological results in Science, Proceedings of the National Academy of Sciences, Neuron, and the Journal of Neuroscience, as well as Information Systems Research, Journal of Management Information Systems, Journal of the Association for Information Systems, and European Journal of Information Systems.

Jeffrey L. Jenkins

Jeffrey L. Jenkins (jeffrey_jenkins@byu.edu) is an assistant professor of information systems at the Marriott School of Management, Brigham Young University. He graduated with a Ph.D. in management information systems from the University of Arizona. His research focuses on human–computer interaction and behavioral information security. His work has been published in Information Systems Research, Journal of Management Information Systems, MIS Quarterly, European Journal of Information Systems, and others.

David Eargle

David Eargle (dave@daveeargle.com; corresponding author) is a doctoral candidate in the Information Systems and Technology Management Area at the Katz Graduate School of Business, University of Pittsburgh. He is a National Science Foundation Graduate Research Fellow. His research interests include human–computer interaction and information security. He has published in Information Systems Research, Journal of Management Information Systems, Journal of the Association for Information Systems, European Journal of Information Systems, and others.

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