

REPPERGER RESEARCH INTERN PROGRAM

RESEARCH PROJECT #: AFRL-RHW-25-09

Advancing Personalized Cognitive Technology through Integrated Cognitive, AI, and Statistical Approaches for Superior Decision-Making

PROJECT DESCRIPTION: We are interested in leveraging our understanding of human memory and cognition to ensure that learners have the knowledge and skills they need to be effective in specified performance domains, through the development and validation of cognitive technologies designed to capture, track, predict, and optimally prescribe learning regimens around individual and unique learning needs. Our objective is to develop and validate novel integrations of data-driven algorithmic approaches stemming from solid statistical and machine learning foundation, combined with highly principled cognitive modeling techniques designed to formally account for the nuances of human information processing and memory to better understand the complex interplay between temporal and interindividual dynamics associated with learning. Additionally, we aim to complement the cognitive modeling capabilities with learner performance visualization dashboards, to more intuitively display relevant information to the user, bolster trust in the automated personalization capabilities, and better motivate students to use the technologies to enhance or sustain their overall performance proficiencies. To do this effectively, we have interests in identifying and optimally interleaving the most relevant selections of new and review training materials, understanding the impact of presentation modality (e.g., multiple choice, fill in the blank, free recall) as it relates to types of human memory, and determining how input types may be optimally interleaved or scaffolded to bolster learning in an automated way.

LEARNING OBJECTIVE: The student intern will be reporting research updates in weekly meetings; participating in new study completion and the synthesizing of results from existing studies to address foundational and applied research gaps; assessing and analyzing quantitative data using statistical, mathematical, or machine learning modeling techniques; adhering to ethical and health safety protocols in the laboratory; and sharing research findings through publications and presentations. The student intern should expect to gain knowledge in (but not limited to) cognitive modeling, statistical modeling, computational modeling, and data visualization. During this internship, the student intern will participate in answering ANY of the following research questions:

- 1) What is the optimal timing for reviewing previously studied items and for introducing new items?
- 2) How should review materials be prioritized when the full set is greater than practice time will allow?
- 3) How should presentation formats be optimally scaffolded to bolster learning?
- 4) How can more intuitive interfaces be developed to guide and support human learning?

ACADEMIC LEVEL: Masters; Doctoral

DISCIPLINE NEEDED:

- Human Computer Interaction
- Data Science
- Probability and Statistics

RESEARCH LOCATION: Wright-Patterson Air Force Base, Dayton, Ohio

RESEARCH MENTOR: Tiffany Myers, Ph.D.
Psychology, Florida State University, 2006



Dr. Jastrzembski Myers is a Senior Cognitive Scientist with the Air Force Research Laboratory. She completed her undergraduate studies in cognitive psychology at Carnegie Mellon University, and attained her Masters and Doctoral degrees in the same field under the advisement of Dr. Neil Charness and Dr. Anders Ericsson at the Florida State University. Her research focuses on the development of integrated cognitive and machine learning models capable of handling the dynamics of human memory, for purposes of delivering a precision learning capability for individual learners; namely, proficiency-based, optimized, personalized learning regimens. She has made noteworthy contributions in highly

applied medical domains, linguist curricula at the Defense Language Institute, and total force training for all Air Force military and civilian personnel. She received the Air Force Research Laboratory's Early Career Award, the American Psychological Association's New Investigator Award, holds a patent on the Predictive Performance Optimizer software tool, and possesses a publication record of over 100 refereed papers.

RESEARCH MENTOR: Fairul Mohd-Zaid, Ph.D.
Applied Mathematics, Air Force Institute of Technology, 2016



Dr. Fairul Mohd-Zaid is a Mathematical Statistician at the Air Force Research Laboratory's Cognition and Modeling Branch conducting research in network analysis and statistical visualization with other research interests in machine learning and multivariate analysis. Dr. Mohd-Zaid received a BS in Mathematics from Southern Polytechnic State University and a MS in Operations Research and PhD in Applied Mathematics from the Air Force Institute of Technology. He is a three-time recipient of the DOD funded Science, Mathematics, And Research for Transformation (SMART) scholarship.