

## RHW SUMMER RESEARCH PROGRAMS

Each summer, students and schools from across Ohio and the nation collaborate with the Warfighter Interactions and Readiness Division through research and internship programs. These programs are a great opportunity for interns, students, and researchers to gain invaluable experience, further the scientific community, and provide valuable contributions to today's (and tomorrow's) warfighters. The articles in this issue of *Fight's On!* highlight only a few of the exciting projects and developments achieved this summer.

### COLLABORATIVE TECHNOLOGIES

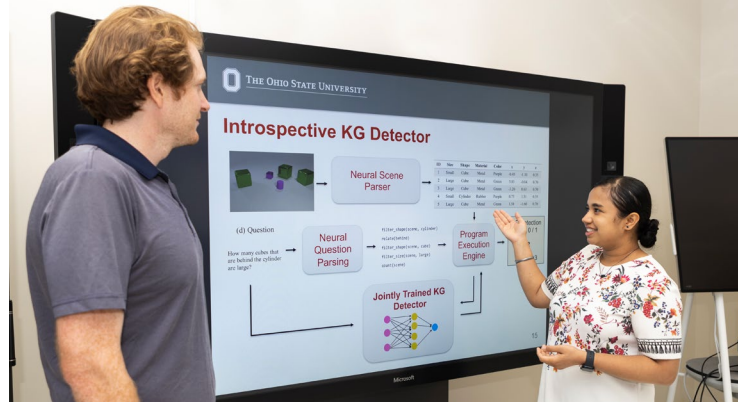
Despite recent advances in machine learning (ML) and artificial intelligence (AI), human-machine communication is often strained by factors such as personality and communication style mismatches, differing mastery levels of common language, and the difficulty of synthetic actors using and understanding idiomatic phrasing. This summer, RHW interns worked toward meeting a diverse set of challenge objectives for AI and ML models to improve human-machine teaming and language learning. This program developed real-world technical skills while providing valuable contributions to AFRL and the scientific community.

Working under the mentorship of Emily Conway, students applied math and computer science skills towards creating and customizing chatbots, data systems, and neural networks, developing language classification models, and better representing emotion in synthesized speech. Work on these and other topics have promising uses in foreign language learning, synthetic teammates and assistants, and phishing mitigation.

### WARFIGHTER INTERFACES

Maia McDaniel and Dr. Pamela Tsang (Wright State University) conducted research aimed at better understanding the expert decision-making process for time-critical events in dynamic, complex, uncertain environments. The Prepar3D flight simulation platform was used to implement flight scenarios that examine the roles of intuitive and deliberative decision making. What specific knowledge about the functional relationships of system components is essential for making effective decisions is tested with a host of neuroergonomic measures. The Prepar3D scenarios and measures validated in this research will add to the assessment toolbox that will ultimately serve multiple studies, fostering collaborations with other scientists. The results will shed light on the theoretical debate on the characterization of expert decision making, help identify efficacious training approaches for developing operational agility and superior decision speed, and inform the design of automation aids to support rapid, effective decisions.

Continued on next page



(Top) Ms. Goonmeet Bajaj discusses her work with mentor Mr. Sean Kennedy.

(Middle) The Collaborative Technologies interns worked together (under the mentorship of Ms. Emily Conway) at the Wright Brothers Institute.

(Bottom) Dr. Pamela Tsang and Dr. Mike Vidulich collaborate using the Prepar3D flight simulation.

Photos by Mr. Will Graver (Ball Aerospace) and Dr. Mike Vidulich (RHW)

## OHIO SCHOOLS

- Kent State University
- Miami University
- The Ohio State University (2)
- Wright State University (4)
- Archbishop Carroll High School
- Beavercreek High School (3)
- Bellbrook High School (2)
- Centerville High School (6)
- Dayton Regional STEM School (3)
- Legacy Christian Academy
- The Miami Valley School (2)
- Milford Exempted Village Schools
- New Albany High School
- Oakwood High School
- Springboro High School (3)
- Stivers School for the Arts
- Tri-County North (2)
- Trotwood-Madison City Schools
- Valley View Schools
- Walter E. Stebbins High School
- Warhill High School
- Wayne High School
- West Carrollton Schools

## COGNITION AND MODELING

Alina Arakal is a graduate student at Rice University in Houston, TX. She is currently pursuing her master's degree in Human-Computer Interaction & Human Factors as a Civilian Associates Degree Program (CADP) recipient under the Cognition and Modeling branch (RHWE). She received her B.S. in Biomedical Engineering in spring 2019, and began working for AFRL with the Bioeffects Division (RHD) in San Antonio, where she first developed an interest in human factors engineering.

This summer, Alina has been working on efforts under two RHWE LOEs. She has been gaining experience in computational cognitive modeling under the mentorship of Dr. Alex Hough. This work utilizes the ACT-R cognitive architecture tool to better understand the underlying cognitive processes relating to multi-cue decision-making and reasoning.

Under the mentorship of Dr. Christine Vitiello, Alina has been exploring how the rapidly shifting landscape of technology and social media is influencing military operational environments via cognitive warfare. Research efforts have focused on examining how message framing and biases can influence online/offline behavior.

## OPERATIONAL LEARNING SCIENCES

Goonmeet Bajaj (The Ohio State University) spent her summer internship collaborating with Dr. Chris Meyers and Sean Kennedy of AFRL and Srinivasan Parthasarathy of The Ohio State University to answer the research question, 'Can we automatically detect knowledge gaps (KGs) in Visual Question Answering (VQA)?' Work focused on building knowledge gap detection, identification, and resolution processes into artificially intelligent agents, similar to how humans can detect, identify, and resolve gaps in their knowledge. Goonmeet developed two KG detection models for VQA Agents. The first detection model is an extrospective KG detection model trained independently of the underlying VQA agent that learns the prediction patterns. The second detection model is an introspective model that is jointly trained with the underlying VQA agent to learn the prediction of its patterns. These detection models can then identify cases where the underlying VQA agent might face a KG, which type of KG it might face, and how to resolve the KG to provide a more accurate response. ★

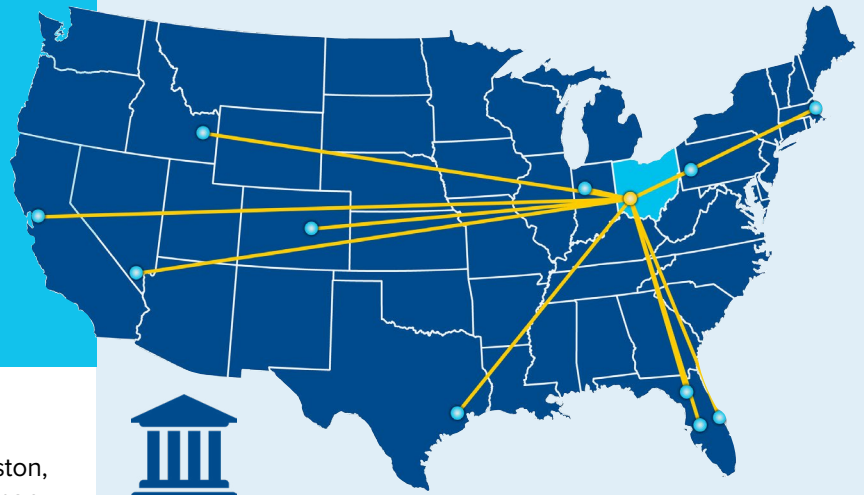
Ms. Alina Arakal, Graduate Student, Rice University

Ms. Goonmeet Bajaj, Graduate Student, The Ohio State University

Mr. Dave Hubbell, Sr. Technical Writer, CAE USA

Dr. Michael Vidulich, Research Psychologist, 711 HPW/RHWI

## INTERN/FACULTY LOCATIONS



- Florida Institute of Technology, FL
- Florida Southern College, FL
- Massachusetts Institute of Tech, MA
- Purdue University, IN
- Rice University, ID
- US Air Force Academy, CO (7)
- Univ. of California, Berkley, CA
- Univ. of Florida, FL
- Univ. of Nevada, NV
- Univ. of Pittsburgh, PA

## SUMMER AT THE GRILL®

This summer, the Gaming Research Integration for Learning Laboratory (GRILL®) hosted 16 Wright Scholars, 4 undergrad interns, 8 teachers, 4 U.S. Air Force Academy (USAFA) cadets, 3 student interns, 2 Legacy students and the following faculty researchers: Kendall Carmody (Florida Institute of Technology), Dr. Stephanie Fussell (Kent State University) and Dr. Denny Yu (Purdue University). These participants worked collaboratively on community-driven challenge problems.

## STEM ACADEMY

This summer at the GRILL U.S. Air Force Academy (USAFA) cadets developed a new software for use in USAFA's Multi-Domain Laboratory (MDL). Overseen by the Military and Strategic Studies (MSS) Department, the MDL provides advanced wargaming capabilities for USAFA. The cadets' project, the Coalition Space Operation Console (CSOC), was developed to simulate space operations in higher fidelity than current MDL capabilities and was specially designed to fulfill the MDL's requirements. CSOC was developed in Unity, a powerful software made for game design, and is highly customizable. At the end of the cadets' six-week development timeframe, the main user interface is complete, and the current MDL scenario, Operation Northern Eclipse, is built into the program. Future development goals include integration with ASCOT 7 and MIRC chat, the primary wargaming software used in the MDL. CSOC will be used during the culminating wargame of MSS 251, a core course taken by all cadets, where the cadets will roleplay as space operators in a Combined Joint Task Force.

Continued on next page



(Top) Capt Eric Lawson poses with USAFA cadets Jayden Talt, Tyler Wright, and Daniel Hayase (not pictured: Michaela Kovalsky).

(Center and Bottom) Wright Scholars pose for a group photo and demonstrate their projects to RHW personnel.

Photos by Mr. Will Graver (Ball Aerospace)

The Cadets' development of the COSC at the GRILL this summer represents a step forward in military education, promising to enhance wargaming capabilities and provide immersive training environments for future leaders. The Air Force's push for immersive training solutions falls in line with General Brown's 'Accelerate Change or Lose' initiative and facilitates the production of quality warfighters.

## GRILL® SUMMER CHALLENGE PROBLEMS

The GRILL® summer participants worked together on community-driven challenge problems (listed below). Upon completion of these projects, the students presented their work to community stakeholders. This hands-on program provides opportunities to experience real-world research and gain invaluable career skills.

### CLAIM (ChatGPT Linguist Artificial Intelligence Mentor)

The Defense Language and National Security Education Office requested an AI-driven solution to their linguist training. GRILL participants used Unity and ChatGPT to create a complete solution with AI-driven dialogue and animations based on sentiment.

### FLARE

#### (Firefighting and Learning in Augmented Reality Environments)

The original fire extinguisher trainer was such a success that there was overwhelming demand for a flight line Halon extinguisher VR trainer. The completely immersive simulator features a decommissioned Halon extinguisher.

### GLIMMER (LUNAR LIGHT VIRTUAL REALITY)

#### (Geological Landscape Illumination and Mapping of Moon's Environment and Reflections)

NASA requested a simulated lunar environment with accurate moon effects to improve current safety measures. The south side of the moon has never been observed, but the GRILL is simulating it.

### POLLUTION PARTICULATE MODELING

The GRILL used the advanced computing power of gaming PCs to mathematically model pollution as it spreads. The maps were imported using Cesium to give a realistic depiction of how pollution is affecting the environment.

### VR MEDICAL KIT

The United States Air Force School of Aerospace Medicine (USAFSAM) is in need of a cost-effective solution to med kit training. The high price of med kits made their use in refresher training impractical, so the GRILL created a VR version that can be deployed almost anywhere.

### VR ELEVATED RADIAL MAZE

GRILL participants created an immersive environment in which researchers can study performance and motivation in an environment that elicits innate fear without physical risk. Test subjects are in a simulated high-altitude maze with sensors that record biometric data and correlate it with performance. ☆

Capt Eric Lawson, GRILL Program Manager, 711 HPW/RHWE

**JOURNAL ARTICLES, CONFERENCE PROCEEDINGS, TECHNICAL REPORTS**

Borghetti, L., Fisher, C. R., Stevens, C., Houpt, J., Curley, T., Blaha, L., & Chadderdon, G. L. (2023, July). Evaluating the generalizability of diverse models of interference effects. *Abstract published at MathPsych/ICCM/EMPG 2023*. Via [mathpsych.org/presentation/1100](http://mathpsych.org/presentation/1100)

Capiola, A., Fox, E., Stephenson, A., & Hamdan, I. A. (2023). "Is This Even Relevant?" Investigating the Relevance of Antecedents to Trust in Ad Hoc Dyads. In *Proceedings of the Hawaii International Conference on System Sciences*.

Casey, M. P. (2023). Bulk Johnson-Lindenstrauss Lemmas. *arXiv preprint arXiv:2307.07704*.

Collins, M. G., Sense, F., Krusmark, M., & Myers, T. (2023, July). Modeling change points and performance variability in large-scale naturalistic data. *Paper presented at MathPsych/ICCM/EMPG 2023*. Via [mathpsych.org/presentation/1223](http://mathpsych.org/presentation/1223)

Curley, T. (2023, June). Bayesian estimation of category typicality using ordered probit models. *Abstract published at Virtual MathPsych/ICCM 2023*. Via [mathpsych.org/presentation/1277](http://mathpsych.org/presentation/1277)

Fenstermacher, L., Uzcha, D., Larson, K., Vitiello, C., & Shellman, S. (2023, June). New perspectives on cognitive warfare. In *Signal Processing, Sensor/Information Fusion, and Target Recognition XXXII* (Vol. 12547, pp. 162-177). SPIE.

Fisher, C. R., Borghetti, L., Houpt, J., & Blaha, L. (2023, July). Comparing classical and quantum probability accounts of the interference effect in decision making. *Paper presented at MathPsych/ICCM/EMPG 2023*. Via [mathpsych.org/presentation/1083](http://mathpsych.org/presentation/1083)

Fisher, C. R., Curley, T., & Stevens, C. (2023, July). Using neural networks to create fast and reusable approximate likelihood functions for ACT-R. *Paper presented at MathPsych/ICCM/EMPG 2023*. Via [mathpsych.org/presentation/1041](http://mathpsych.org/presentation/1041)

Fox, E., Bowers, G., Capiola, A., & Stephenson, A. (2023). The Design of an Ostensible Human Teammate. In *Proceedings of the Hawaii International Conference on System Sciences*.

Fox, E. L., Cook, A., Yang, C. T., Fu, H. L., Latthirun, K., & Howard, Z. L. (2023). Influence of dual-task load on redundant signal processing. *The Quantitative Methods for Psychology, 19*(1), 84-99.

Fox, E. L., Stephenson, A. L., Stevens, C. A., & Bowers, G. (2023, March). Predictors of Human Efficiency in Radar Detection Tasks. In *ICCWS 2023 18th International Conference on Cyber Warfare and Security*.

Glavan, J. J., Houpt, J., Havig, P., Mohd-Zaid, F., Bennett, M., Chen, Y.-Y., & Fox, E. L. (2023, June). Toward the adaptive design of general recognition theory experiments: a control study. *Paper presented at Virtual MathPsych/ICCM 2023*. Via [mathpsych.org/presentation/1292](http://mathpsych.org/presentation/1292)

Honn, K. A., Morris, M. B., Jackson, M. L., Van Dongen, H. P., & Gunzelmann, G. (2023). Effects of Sleep Deprivation on Performance during a Change Signal Task with Adaptive Dynamics. *Brain Sciences, 13*(7), 1062.

Hough, A. R. (2023). Challenges and strategies for extending act-r visual perception. In *Proceedings of the 30th Annual ACT-R Workshop*. Amsterdam, Netherlands.

Hough, A. R., Larue, O., Myers, C., & Leung, O. (2023, June). Integrated cognitive model framework for analogical reasoning. *Paper presented at Virtual MathPsych/ICCM 2023*. Via [mathpsych.org/presentation/1287](http://mathpsych.org/presentation/1287)

Hough, A. R., Stevens, C., Fox, E. L., & Myers, C. (2023). An initial cognitive model of a radar detection task. *Paper presented at MathPsych/ICCM/EMPG 2023*. Via [mathpsych.org/presentation/1103](http://mathpsych.org/presentation/1103)

Roessling, G. C., Halverson, T., & Myers, C. (2023, July). Improving Visuomotor control of a cognitive architecture. *Paper presented at MathPsych/ICCM/EMPG 2023*. Via [mathpsych.org/presentation/1218](http://mathpsych.org/presentation/1218)

Saad, L., Hough, A. R., Blaha, L., & Lebiere, C. (2023). A cognitive model of a temporal binding task. *Paper presented at MathPsych/ICCM/EMPG 2023*. Via [mathpsych.org/presentation/1115](http://mathpsych.org/presentation/1115)

Seals, S. M., & Shalin, V. L. (2023). Long-form analogies generated by chatGPT lack human-like psycholinguistic properties. *arXiv preprint arXiv:2306.04537*.

Sense, F., Collins, M., Krusmark, M., & Myers, T. (2023, July). Comparing model variants across experimental and naturalistic data sets. *Paper presented at MathPsych/ICCM/EMPG 2023*. Via [mathpsych.org/presentation/1233](http://mathpsych.org/presentation/1233)

Swan, G., Stevens, C., & Klosterman, S. (2023, June). A cognitive model of the effects of workload on perceptual span. *Paper presented at Virtual MathPsych/ICCM 2023*. Via [mathpsych.org/presentation/1288](http://mathpsych.org/presentation/1288)

Ugolini, M., Bowers, G., & Fox, E.L. (2023). Trimming automatically generated speech for temporal precision, In Technical Report AD1198114; Defense Technical Information Center (DTIC). Dayton, Ohio: Wright-Patterson Air Force Base.

**RHW RECOGNITIONS**



**711 HPW NOMINEES**

**Air Force Intelligence, Surveillance and Reconnaissance Awards Program:**

- Capt Andrew J. de Garmo
- Intel OSF
- TSgt Andrew C. Pauldine
- Maj Raphael Watson

**2023 Lance P. Sijan USAF Leadership Award Senior Officer Category:**

Maj Raphael Watson

**711TH HPW/RHW**

**Hails**

Gene Alarcon  
Lt Col Jeremy Baker  
2Lt Jacob Dutt  
Maj Matthew Fagan  
2Lt Andrew Ka  
Caleb Lees  
Nina Pryor  
Capt Shinae Wagner

**Farewells**

Leslie Blaha  
Capt Mitchell Cochell  
Michael Dougherty  
MSgt Paul Ducharme  
Nandini Iyer  
Lt Ludvig Oliver  
Capt Sarah Soffer  
Gina Thomas  
Lt David Uzhca  
Maj Raphael Watson



Published quarterly since 2001, Fight's ON! continues to serve as the Division publication for our partners and features innovative science and technology that is accelerating and revolutionizing readiness.

To view more issues, visit: [www.afresearchlab.com/FightsOn](http://www.afresearchlab.com/FightsOn)

Fight's ON! Point-of-Contact  
Patricia D. Wood, 711 HPW/RHW  
[patricia.wood.2@us.af.mil](mailto:patricia.wood.2@us.af.mil)  
Editor in Chief Mr. Dave Hubbell  
Cleared / Case # AFRL-2023-4240

711 HPW/RHW Core Research Areas:  
• Digital Models of Cognition  
• Distributed Teaming & Communication  
• Human-Machine Interactions  
• Learning & Operational Training