AFRL FIGHT'S ON!

THE AIR FORCE RESEARCH LABORATORY

MODELING A BRIGHT GENERATION: SUMMER AT THE GRILL®

The Gaming Research Integration for Learning Lab® (GRILL®) hosted summer academic curriculums that provided students (high school to college) with hands-on learning opportunities for STEM fields. The STEMmersion and Academy programs, in particular, allowed students to learn and develop STEM-oriented skillsets.

STEM ACADEMY

Over the summer, the United States Air Force Academy (USAFA) cadets worked on an ongoing assignment that aligned with their capstone projects. The cadets integrated a jammer/detection system built from a Raspberry Pi® and commercial-off-the-shelf (COTS) parts into an ergonomically controlled device. As well, they integrated the system with a VR application to develop the interactive control system as an intermediate step. Notably, the projects ensured the cadets gained valuable skills that enhance their educational experience while allowing faculty-cadet research. The project itself is just a small piece in a much larger mission of establishing an off-base facility near the academy to provide STEM outreach programs and VR/AR solutions to the Air and Space Forces' training needs. This will enable current and future Warfighters through faculty-cadet research. ☆

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

STEMMERSION

STEMmersion is an internship program where students from the Dayton Regional STEM School (DRSS) come to the GRILL® to learn about Modelling and Simulation to gain hands-on experience in the fields they have studied during the school year. The students came to the GRILL® every day for two weeks, working with Jack Hu, a full-time software developer at the GRILL®, to create their own simulations. This year, the students were introduced to game design and familiarized themselves with concepts such as scenario development, user interfaces, saving and loading scenarios, and much more. This is a collaboration we have historically done with the DRSS and aim to continue for many more years. ☆

Lt Kyle Bucklew, GRILL Program Manager, 711 HPW/RHW
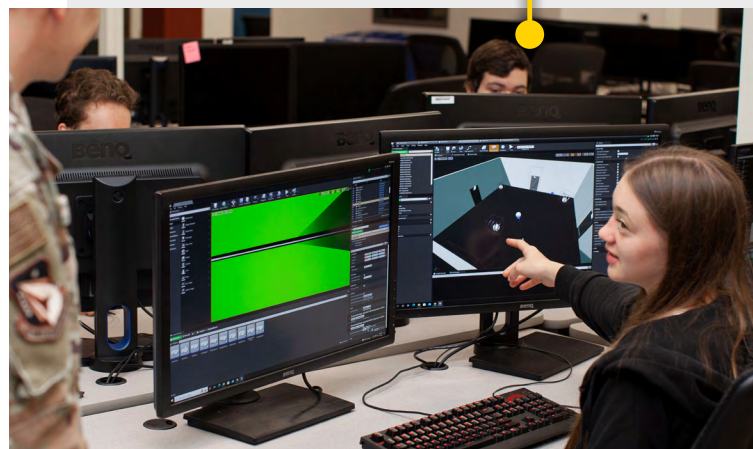
Photos by Mr. Will Graver

SKY-HIGH ADVANCEMENTS:
RHW Skyborg Team Updates

The RHW Human Systems Integration (HSI) Skyborg team increased support across the Directorates within the emerging collaborative combat aircraft (CCA) domain. While the initial focus was on how CCA human-machine interfaces (HMI) influenced aspects such as CCA operator cognitive workload, situation awareness (SA), and mission planning and debrief, the team has since added research elements of training, trust, and ethics. A subset of the team developed an initial Model Based System Engineering (MBSE) schema for CCA HSI applications while another group finished the Cognitive Task Analysis (CTA) for Air Battle Managers (ABM). The CTA team identified 58 areas where intelligent agents (IAs) can support ABMs by offloading tasks to IAs onboard manned collaborative aircraft. Shedding tasks to IAs can reduce and mitigate increases in cognitive workload when CCAs are integrated into the mission.

AFRL's Supervisory Handling Platform for Remote Direction (SHPRD) system now serves as a foundational air and ground command and control system to support human-autonomy teaming research with, and separate from, manned flight lead (MFL) integration. The team used SHPRD to explore CCA transit control to include grouping and handoffs of CCAs to/from other SHPRD systems that acted as Air Traffic Control and additional airborne control elements (e.g., Airborne Warning and Control System (AWACS)), as well as maintained SA while the CCAs were under a forward deployed fighter aircraft. Integration of MFL capabilities, such as commanding CCA air-to-air-like engagements/searches from fighter cockpits, are being researched and shared with our research partners.

Finally, the team has rapidly integrated operator and subject matter expert (SME) feedback data to support ground integration and flight test events on the General Atomics MQ-20 and the USAF Test Pilot School's X-62A (VISTA) platforms. The team's air and ground HMIs are also in place at the Emerging Technology-Combined Test Force (ET-CTF) HSI section at Edwards AFB to support subscale unmanned aerial vehicle (UAV) flight test activities. The ET-CTF has provided initial heuristic assessments and feedback on HSI areas, such as mission planning considerations, execution, workload, and training. SHPRD and the tablet HMI have been integrated with the Skyborg Autonomy Core System (ACS) and into the Skyborg Digital Test Environment, supporting ACS development. Flight tests on the X-62A are scheduled for later this year. ☆

Ms. Kristen "Cuda" Barrera, Principal Research Psychologist, 711 HPW/RHW

Top Image: Integration and ground testing on the VISTA

Bottom Image: AFRL Team during VISTA integration: Left to right: Lt Patrick Mei, Mr Jerry VanPelt, Cuda Barrera, Mr Charles Lockhart, and Mr James Tokarz

Photos by 711 HPW/RHW

711 HPW/RHW
HAILS

Mr. Daniel Akim
2nd Lt Griffin C. Keune
Capt Kristopher Kilpatrick
Capt Marshal Quebatay
Mr. Austin Robles
Lt Col Scott Storm
Capt Paige Taylor
2nd Lt David Uzcha

FAREWELLS

1st Lt Kyle Bucklew
Mr. Joe Budinger
1st Lt Alex Ciolek
Ms. Alexandra Colwell
Mr. Matthew Cusumano
1st Lt Jacob Ehrenstrom
Capt Robert Floyd
Capt Davis Foster
1st Lt John Gillispie
Dr. Marla Kennedy
Maj Kyle Knight
Mr. David Neufang
1st Lt Chao Pan
1st Lt Andrew Kinzinger-Petrowski
1st Lt Corey Rucker
Capt Meghan Strang
1st Lt Emmie Swize
Dr. Tim Webb

RHW PROMOTIONS

NAME	PROJECTED GRADE
2Lt Samuel Braudt	1Lt
1Lt Corey Rucker	Capt

FINE-TUNING THE HUMAN TOUCH:
Human Representation in Digital Engineering

Human performance is variable and subject to influence by several factors, including environmental stressors, fatigue, injury, and communication disruption. However, this variability is not currently well represented in many formal engineering, training, and wargaming systems. The Human Representation in Digital Engineering (HRDE) effort aims to enhance the fidelity of human representation in these systems, improving both the product design and training that better accounts for human abilities and limitations.
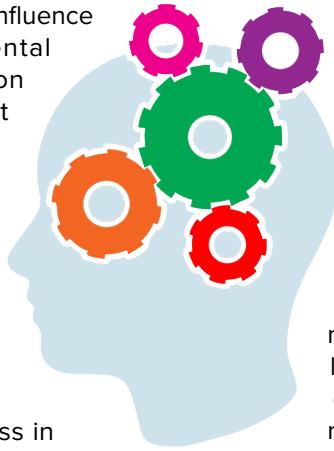
This year, our team made significant progress in empirically-validated human modeling within a variety of Warfighter-relevant domains, including flash bang effects, electronic warfare, mission modeling, time out of action, and fatigue. Moreover, the resulting human models are being adapted for inclusion into a comprehensive, cohesive library to support applications that require high-fidelity human simulation. The core of the library is a set of models built in the model-based systems engineering (MBSE) framework - a formal approach for representing the structure and behavior of complex systems. We are also exploring plugins for interfacing with models that are built by using other formalisms.

Finally, the team is working to improve model interoperability, verification, and validation within the library. This includes the development of precise data standards and style guides for models. Moreover, the team is developing software tools to be used for evaluating the composability of models into larger integrated models. The completed library advances the state-of-the-art in formal modeling of humans at a systems level and will enable more realistic simulations for mission planning and training, help identify human systems integration issues, and evaluate mitigation strategies early in product development. ☆
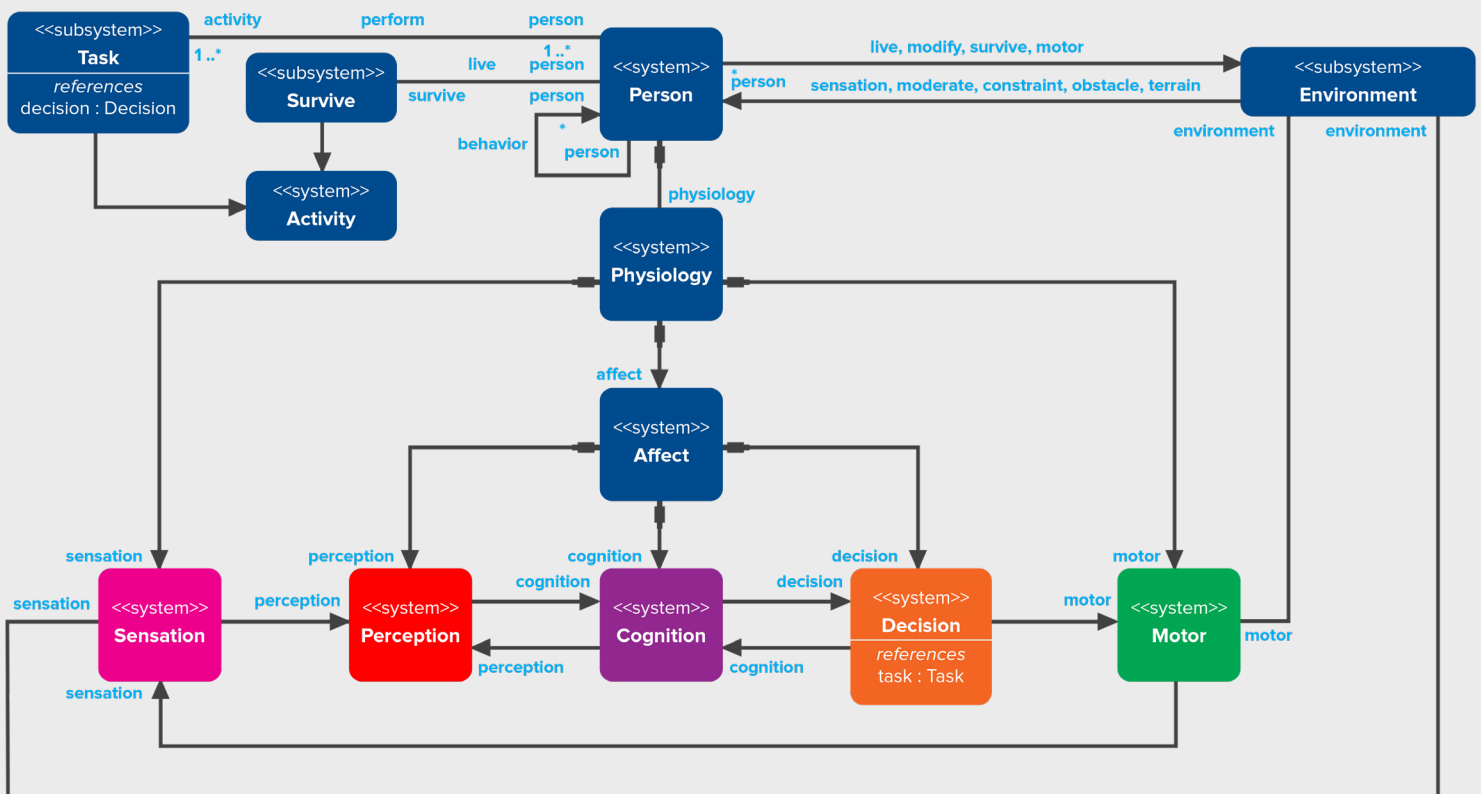
Dr. Christopher Stevens, Research Psychologist, 711 HPW/RHW
Dr. Tamera Chelette, Strategic Planning Chief, 711 HPW/RHW
Ms. Roxanne Constable, Branch Chief, 711 HPW/RHW

Generalized Cameo SysML model of a human operator.
(Based on the NATO MSG-127 Reference Architecture for Human Behavior Modeling)

PUBLISHED CONTENT

JOURNAL ARTICLES

Alarcon, G.M., & Lee, M.A. (2022). The Relationship of Insufficient Effort Responding and Response Styles: An Online Experiment. *Front. Psychol. 12:784375.* https://doi.org/10.3389/fpsyg.2021.784375

Gibson, A. M., Capiola, A., Alarcon, G. M., Lee, M. A., Jessup, S. A., & Hamdan, I. (2022). Construction and Validation of an Updated Perfect Automation Schema (uPAS) Scale. *Theoretical Issues in Ergonomics Science.* https://doi.org/10.1080/1463922X.2022.2081375

Lee, M.A., Alarcon, G. M., & Capiola, A. (2022). "I think you are trustworthy, need I say more?" The Factor Structure and Practicalities of Trustworthiness Assessment. *Front. in Psychol. 13, 797443.* https://doi.org/10.3389/fpsyg.2022.797443

McCormick, E. N., Cheyette, S. J., & Gonzalez, C. (2022). Choice Adaptation to Changing Environments: Trends, Feedback, and Observability of Change. *Mem & Cog.* https://doi.org/10.3758/s13421-022-01313-2

CONFERENCE PROCEEDINGS

Borghetti, L., Fisher, C. R., Houpt, J., Blaha, L., Gunzelmann, G., & Stevens, C. (2022, July). *Towards a Method for Evaluating Convergence Across Modeling Frameworks.* Paper presented at Virtual MathPsych/ICCM 2022. Via mathpsych.org/presentation/729.

Curley, T., & Morris, M. B. (2022, July). *Modeling short-term fatigue decrements in the successive/simultaneous discrimination task.* Paper presented at Virtual MathPsych/ICCM 2022. Via mathpsych.org/presentation/705.

Fisher, C. R., Borghetti, L., Houpt, J., Blaha, L., & Stevens, C. (2022, July). *A Comparison of Quantum and Multinomial Processing Tree Models of the Interference Effect.* Paper presented at Virtual MathPsych/ICCM 2022. Via mathpsych.org/presentation/726.

Fisher, C. R., Fegley, B. D., Stevens, C., & Myers, C. (2022, July). *On the Limits of Spreading Activation in ACT-R: Predictions and Testability.* Paper presented at Virtual MathPsych/ICCM 2022. Via mathpsych.org/presentation/725.

Swan, G., Stevens, C., Fisher, C. R., & Klosterman, S. (2022, July) *Exploring Multitasking Strategies in an ACT-R Model of a Complex Piloting Task.* Paper presented at Virtual MathPsych/ICCM 2022. Via mathpsych.org/presentation/719.
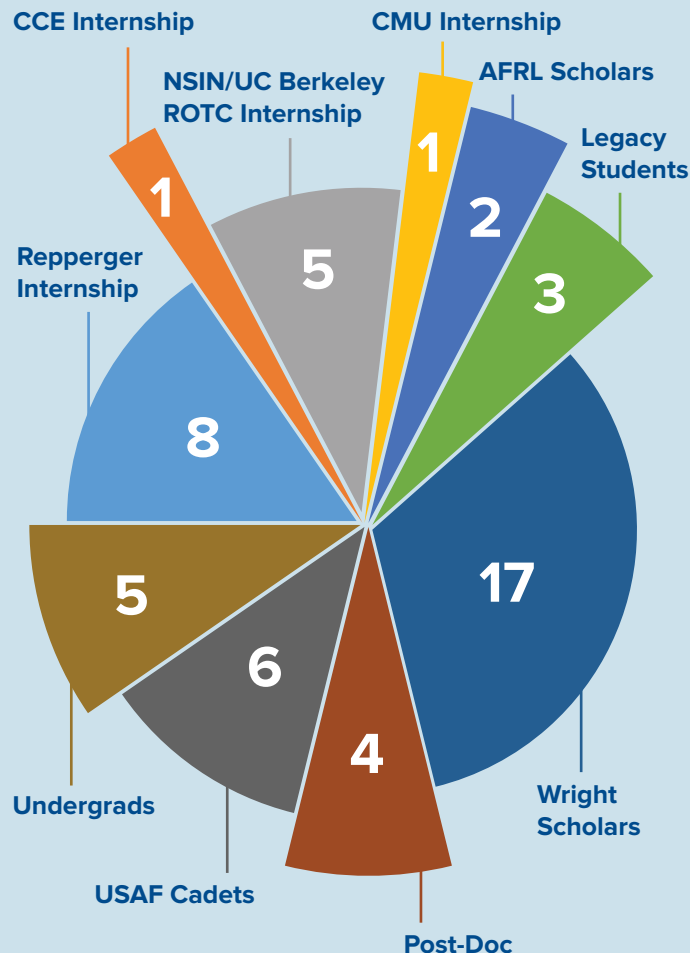
McCoppin, R., Kennedy, M., Lukyanenko, P., & Kennedy, S. (2022). *Overcoming Adversarial Attacks for Human-in-the-Loop Applications.* Proceedings of the 39th International Conference on Machine Learning. Via https://www.itsoc.org/event/2022-international-conference-machine-learning-icml2022

WORKSHOPS

Hough, A. R. (2022) *Exploring Analogical Reasoning Capabilities Within a Cognitive Model.* In Proceedings of the 29th Annual ACT-R Workshop. Toronto, Canada. Via https://tinyurl.com/2emyp3t2

BRIGHT FUTURES UNDER THE SUN
Summer Internship Program Overview

Every summer, the RHW reaches out to mentor communities, within and outside of the Dayton area, in the fields of STEM. Institutions and their interns have worked with the Warfighter Interactions and Readiness Division to provide fruitful research with various opportunistic programs. This summer, with their combined intelligence and innovative skills, research was produced that provided the participants with invaluable learning experiences and laid the path for their horizon-bound endeavors in STEM. Below is an overview of the interns and their programs.

CCE Internship — 1
NSIN/UC Berkeley ROTC Internship — 1
CMU Internship — 1
AFRL Scholars — 2
Legacy Students — 3
Repperger Internship — 8
Wright Scholars — 17
Post-Doc — 4
USAF Cadets — 6
Undergrads — 5
(center) 5

SECOND QUARTER AWARDS

711 HPW — **Company Grade Officer:** 1Lt Alexander J. Ciolek

RH — **Civilian-Category II:** Ms. Kirsten S. Rice

Collaboration Team Award: 711 HPW IMPACT Team (RHWC)

SPECIAL AWARDS

711 HPW CHIEF SCIENTIST JUNIOR FORCE SEEDLING AWARD

"Novel Model of Analogy to Facilitate Knowledge Gap Resolution and Knowledge Transfer"
Dr. Alexander Hough

"Low Frequency/Infrasonic Data Communication Profile (LowFin)"
Mr. Matthew Scharf