AFRL FIGHT'S ON!

THE AIR FORCE RESEARCH LABORATORY

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SPRING 2020

WARFIGHTER INTERACTIONS AND READINESS DIVISION

A New Division Built on a Resilient and Integrated History

One year ago, on 9 May of 2019, the Warfighter Readiness Research Division celebrated its 50th anniversary. The Air Force established the division in 1969 at Williams Air Force Base (AFB) as the Aircrew Training Research Division. Since then, the organization has gone through many changes. The following are some major highlights of the division's historical timeline.

1995 — Williams AFB closed under the Base Realignment and Closure (BRAC) process, leaving the Mesa Research Site as an Air Force operating location nestled between Arizona State University's Polytechnic Campus, which took over many of the facilities at Williams AFB, and Williams Gateway Airport, which took over the runways and flight line

1998 — The division became the Warfighter Training Research Division of the new Air Force Research Laboratory's (AFRL) new Human Effectiveness Directorate, and its organizational symbol was HEA

2004 — The division was renamed the Warfighter Readiness Research Division after expanding its mission to include logistic research

2005 — The Mesa Research Site was identified for closure and realignment to Wright Patterson AFB in Ohio during another round of BRAC

2006 — The AFRL's technical directorates were relabeled and the organizational symbol became RHA

2007 — The Warfighter Readiness Research Division became part of the new 711th Human Performance Wing

2011 — The Mesa Research Site closed, and RHA was relocated to Building 852 at Wright Patterson AFB, bringing with it an unprecedented percentage of its workforce, which continued the research mission uninterrupted

Throughout this history, the Warfighter Readiness Research Division has maintained a focus on advancing training and readiness science and technology to provide the Air Force with the capabilities needed to ensure the operational readiness of Airmen. To gain efficiencies, on both the administrative and research fronts, we are currently engaged in the process of merging this mission with the mission of the Warfighter Interface Division; another division within the Air Force Research Laboratory's Airman Systems Directorate. The Warfighter Interface Division's history is no less storied than our own, having pioneered the application of human factors to the design of weapons systems since the earliest days of Air Force research.

This new integrated organization now consolidates research on the science and technology of human cognitive performance, readiness and interaction under a single new division—the Warfighter Interactions and Readiness Division. The organizational symbol for our new division will be RHW, to emphasize the continued commitment to ensuring the dominance of our Airmen and our Air Force in today's and tomorrow's conflicts.

We look forward to sharing more information about our new division and continuing its legacy as we move forward with this broader scope and vision. ☆

Dr. Glenn Gunzelmann, Core Technical Competency Lead
Dr. Winston "Wink" Bennett, Readiness Product Line Lead

Photos by 711 HPW/RHA

FATIGUE RISK MANAGEMENT

Examining Limitations and Developing Solutions

The Cognitive Science, Models and Agents Branch in collaboration with Air Mobility Command (AMC) is examining the limitations of AMC's fatigue risk management tool in their broad Aviation Operational Risk Management (AvORM) program and developing solutions and tools to address these limitations. The tool creates mission effectiveness (ME) graphs that include recommended sleep schedules to maximize performance effectiveness during a mission based on available mission data (e.g., flight start and end time and location).

We have collected activity data during multi-day, multi-leg C-17 operations that indicate aircrews' sleep tends to not align with these recommended sleep schedules, often resulting in lower performance effectiveness (i.e., increased fatigue) than predicted by the mission plan. Aircrew commonly do not have access to updated versions of the ME graph when mission changes occur, though it is clear they would benefit from a tool that is readily accessible and allows for real-time updating based on changes to the mission and their actual sleep and nap times.

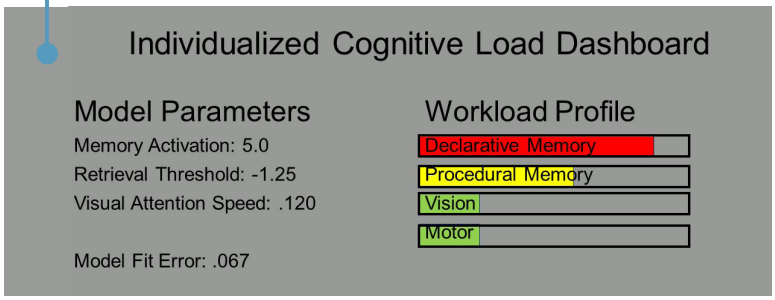
Air Mobility Command has recently developed a new AvORM application for the electronic flight bag that will provide aircrew improvements in the ability to see updated ME graphs. However, this system does not offer the ability to adjust effectiveness estimates based on an individual aircrew member's actual sleep experience.

To address this gap, our team is developing a mobile fatigue application that can be put into the hands of aircrew. Individuals can input sleep or nap times and receive real-time updates to their personal fatigue estimates. Additionally, we are incorporating knowledge from several of the Branch's foundational research efforts to further develop novel, individualized functionality within this application. This includes an effort to increase the individualization of predictions with Psychomotor Vigilance Test reaction time data. We are also incorporating individualized models of stimulant (e.g., caffeine) and depressant (e.g., alcohol) effects on fatigue and cognitive performance based on aircrew consumption input. Lastly, we are working on understanding how task workload interacts with fatigue to impact cognitive performance; information that once incorporated into the application will provide more accurate fatigue and performance estimates.☆

Dr. Megan Morris
Dr. Glenn Gunzelmann
Dr. Christopher Myers
Dr. Christopher Stevens

MOCK-UP OF COGNITIVE LOAD PROFILING INTERFACE

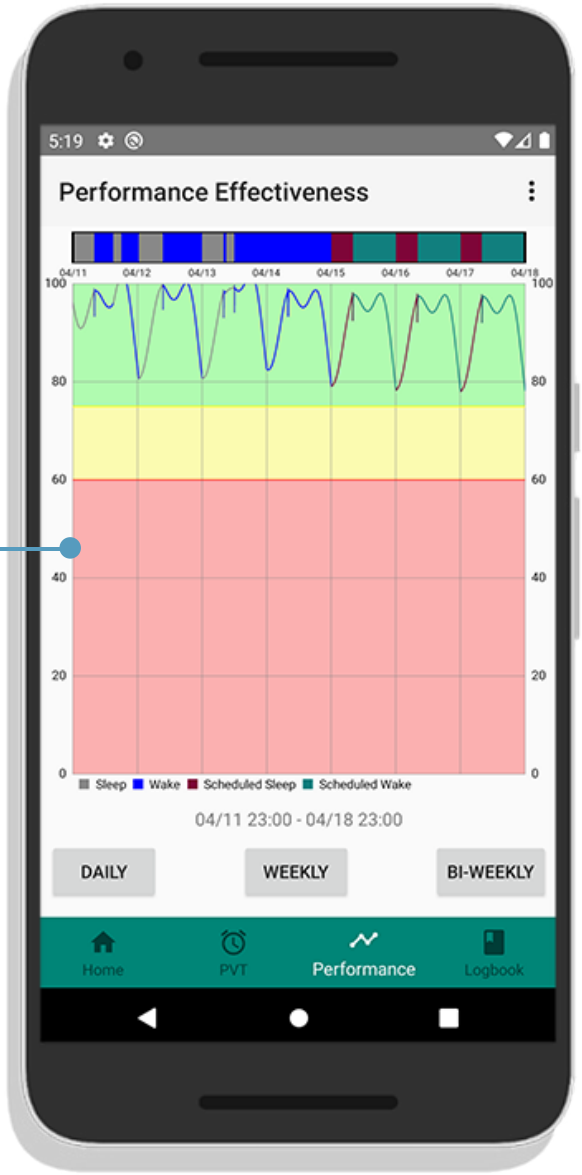
On the left panel are the parameters of the best fitting model and the quality of the fit of its predictions to the user's current data. The right panel depicts the extent to which different cognitive capacities are utilized by the best-fitting model to complete the task.



Graphic by Dr. Christopher Stevens

MOBILE FATIGUE APPLICATION PERFORMANCE EFFECTIVENESS PAGE

The current view shows performance effectiveness over a week based on actual and scheduled sleep.



Graphic by Dr. Megan Morris

EXPLORATORY HOSPITAL ROLLOUT FOR PERSONALIZED CARDIOPULMONARY RESUSCITATION TRAINING

Through a collaboration with the American Heart Association, researchers from the 711th Human Performance Wing successfully completed the first of its kind, prescriptive field study investigating the effectiveness and efficiency of personally tailored cardiopulmonary resuscitation (CPR) refresher training schedules determined by the patented Predictive Performance Optimizer (PPO) technology. That 2-year longitudinal study assessed performance effectiveness and training time for 400 nursing student participants completing either PPO-prescribed regimens or fixed training protocols. Results revealed that PPO helped trainees better sustain CPR skills, while minimizing unnecessary and costly overtraining for trainees who demonstrated high levels of sustained proficiency.

Because the use of PPO for personalized scheduling simultaneously improved proficiency and mitigated risk in the field study, the American Heart Association and its spinoff company, RQI Partners, have extended the collaborative relationship through execution of a follow-on Cooperative Research and Development Agreement. The goal of this extension is to conduct phased, iterative quality improvement research and development that supports the exploration of RQI data and analytics. This foundational work will shape the design of an exploratory hospital rollout implementation. The research team seeks to apply the personalized learning capability into hospital environments spanning various types of personnel responsible for maintaining CPR certification in an effort to assess the feasibility and scalability of the approach in relevant, practicing environments.

This research and implementation will lay the groundwork for extensions to CPR, Advanced Cardiac Life Support, Neonatal Resuscitation Program training, trauma assessment and intracranial pressure monitoring skill sets. Negotiations are underway for additional validation studies to apply this technology to language learning, maintenance, pilot and total force training. ☆

Dr. Tiffany Jastrzembski, Team Lead and Senior Cognitive Scientist
Dr. Kevin Gluck, Principal Cognitive Scientist
Dr. Russell Griffin, American Heart Association
Mr. Michael Krusmark, Principal Research Scientist
Dr. Lauren Sanderson, Research Psychologist, American Heart Association
Dr. Florian Sense, Senior Cognitive Scientist

RQI RESUSCITATION QUALITY IMPROVEMENT®
An American Heart Association® and Laerdal® Program

American Heart Association. | Laerdal helping save lives

Graphics by Dr. Tiffany Jastrzembski

RECOGNITIONS

2019 ANNUAL AWARDS

711 HPW

Science, Technology, Engineering and Mathematics (STEM) Outreach Champion Award:
Gaming Research Integration for Learning Laboratory® (GRILL®) Team
Dr. Winston "Wink" Bennett, Lt Dave Clement, Mr. Jon Diemunsch, Ms. Kaylee Eakins, Mr. Quintin Oliver

RH

Live-Virtual-Constructive Modeling and Simulation:
Operation Jaded Thunder Training Research Team
Dr. Leah Rowe, Lt Kyle Bucklew, Ms. Katelyn Kay, Lt Tyler Lucas, Mr. Nicholas Oyler, Maj Miguel Valle III, Ms. Rachel Vickhouse

2019 TRAINING SYSTEMS PRODUCT GROUP AWARDS

Excellence in Team Performance:
Operation Jaded Thunder Training Research Team

Excellence in Technical Achievement:
Mission Planning and Debrief Team
Dr. Kevin Gluck, Dr. Leslie Blaha, Mr. Bruce Carpenter, Mr. James Cline, Dr. Don Duckro, Lt AaSHAE Eberle, Lt Lauren Gallego, Mr. Jonathan Hart, Mr. Sean Kennedy, Dr. Megan Morris, Dr. Luke Nelson, Mr. Brandon Nolan, Dr. Veda Setlur-Madhavan Ms. Meghan Sorensen, Mr. Zachary Wallace, Mr. Josh Ziegler

Excellence in Leadership:
Lt Col Jose Fadul

Excellence in Program Support:
Ms. Patti Wood

2020 FIRST QUARTER AWARDS

RH

Civilian Category II:
Mr. Joshua Ziegler

RHA

Company Grade Officer:
Capt. Nicholas Attillo

Field Grade Officer:
Lt Col Thomas Adams

Civilian Category I:
Ms. Annette Armstrong

Civilian Category III:
Dr. Megan Morris

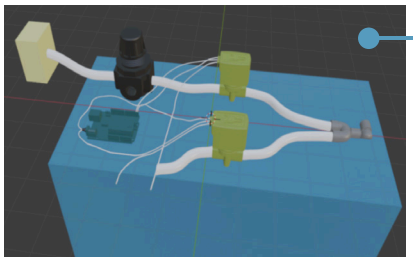
HACK-A-VENT INNOVATION CHALLENGE

The COVID-19 virus outbreak has caused drastic strains on medical supplies, such as N-95 respirators, ventilators and personal protective equipment (PPE). In response to these equipment shortages, the Department of Defense presented a challenge to its members to design and build a low-cost ventilator prototype, which if selected it would submit to the Food and Drug Administration for approval. Once submitted, a panel of experts would review and select the design proposals to create functioning prototypes. The intention of the innovation challenge was to pool the Department's expertise to rapidly develop a lifesaving machine using inexpensive, off-the-shelf components that are available for quick, local production.

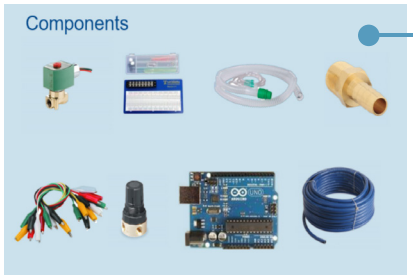
Due to the GRILL® (Gaming Research for Integration Learning Laboratory®) team's technical expertise, the team's engineers decided to collaborate with USAFSAM (United States Air Force School of Aerospace Medicine) medical experts to design a ventilator model and to submit their hack-a-vent design proposal.

Individuals and organizations submitted more than 150 proposals to solve the immediate problem, which is a tremendous accomplishment. Although, the GRILL team's proposal was not selected for prototype development, the proposal process sparked new collaborative research efforts for the GRILL and divisions within the 711 Human Performance Wing. The GRILL team's engineers, researchers and biomedical experts continue to test 3D printed PPE prototypes and to support other COVID-19 efforts, as needed.☆

The GRILL Team



Computer-aided design software drawing of the ventilator prototype



Ventilator components include (left to right, top to bottom): 12 VDC brass solenoid valves, breadboard/wire kit, oxygen reservoir, barbed hose fitting, alligator clip leads, air regulator, Arduino Uno microcontroller board, air hose

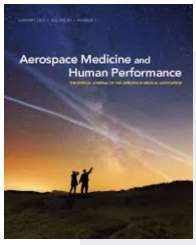
Screen Captures by GRILL Team

HOW DOES THE VENTILATOR PROTOTYPE WORK?

This very simple, low-cost prototype uses fundamental principles to help the patient inhale and exhale. The ventilator works by allowing oxygen to flow from the hospital supply through the air regulator to step down the very high pressure of the oxygen (2000 to 6000 cmH2O down to 5 to 40 cmH2O). To regulate the pressure, the ventilator uses an Arduino Uno microcontroller board to control two solenoid valves. While one valve opens, the other remains closed so that the oxygen can travel into the patient. After the patient inhales, the valves switch roles, closing or opening in order to direct the patient's exhaled air out into ambient air.

NEWS FLASH

PUBLISHED CONTENT



Morris, M. B., Howland, J. P., Amaddio, K. M., & Gunzelmann, G. (2020). Aircrew fatigue perceptions, fatigue mitigation strategies, and circadian typology. *Aerospace Medicine and Human Performance*, *91*(4), 363–368. (DOI: 10.3357 AMHP.5396.2020)

Gaines, A. R., Morris, M. B., & Gunzelmann, G. (2020). Fatigue-related aviation mishaps. *Aerospace Medicine and Human Performance, 91*(5), 440–447. DOI:10.3357/AMHP.5515.2020

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Hails

Mr. Kevin Davis • Mr. Josh Feichter
Dr. Justin Gallivan • Mr. Sean Kennedy
Mr. Logan Krause • Mr. Cameron Roudebush
Dr. Gaurav Sharma • Mr. Jack Smith
Lt Phitina Tran

Farewells

Ms. Janice Bradford • Dr. Jessica Cortez

EST. 2001

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.

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- **Operations Support (RHAO)**
- **Continuous Learning and Performance Assessment (RHAS)**