



# Human Systems Community of Interest (HS Col) Newsletter



Jun 2021



**Senior Leader Perspective:** The objectives of Department of the Air Force's S&T 2030 strategy are to develop and deliver transformational strategic capabilities, and deepen and expand the scientific technical enterprise. The Air Force Research Laboratory (AFRL), one lab serving both the Air and Space Force, has embarked on addressing these objectives. One of the five transformational strategic capabilities is focused on *rapid, effective decision making*. The increasing complexity and speed of future battlespace requires faster, better and effective decision making to stay ahead of our adversaries. As we rely on automation and autonomous systems, including artificial intelligence, to support the human in/on-the-loop in decision making, the cooperative collaboration between the machine and the human is becoming ever so critical. Growing our research capabilities in cognitive sciences, warfighter-centered design of systems, building effective human-machine teams, brain-machine interfaces and training is needed to address the S&T challenges associated with *rapid, effective decision making*. At 711 Human Performance Wing at AFRL, we have redefined some of our core technical competencies to address these S&T challenges in order to deliver knowledge and capability products to our airmen and space guardians. For example, our S&Es are developing calibrated, adaptable and institutive human-machine interfaces to support all-domain operations. By leveraging the HS Col community, we seek to deepen and expand our S&T enterprise to address not just the DAF's most important challenges but that of the Department of Defense as well. The diverse and inclusive HS Col portfolio is critical in ensuring we can rapidly field technologies for the human operator to employ in order to dominate in time, space and complexity in future conflict. **Dr. Rajesh Naik, 711 Human Performance Wing, Col Steering Group Member.**

## HUMAN SYSTEMS Col

**Vision:** Develop & deliver technologies to enable, sustain, enhance & quantify human performance for measurably improved mission effectiveness

**Mission:** Enhance mission effectiveness through:

- 1) Integrated sims for mission training & experimentation
- 2) Human-machine designs for mission effectiveness,
- 3) Assessment of operator effectiveness
- 4) Operating through battlespace stresses, and
- 5) Mastering the PMESII battle space.

**Key Products:** Integrated service roadmaps; Col taxonomy, budget & programs; seedling and ARAP proposals, success stories and new collaboration opportunities.

### Key Personnel:

**OSD Chair:** Dr. Ben Petro, OUSD (R&E)

**Col Chair:** Dr. Michelle Zbylut, Army Research Institute

**Navy Lead:** Dr. John Tangney, Office of Naval Research

**Air Force Lead:** Dr. Rajesh Naik, Air Force Research Lab

**Army Lead:** Dr. Corde Lane, Army Research Lab

**Army Lead:** Dr. Robb Wilcox, Army Research Lab

**SOCOM Rep:** Ms. Lisa Sanders, SOCOM

**WG Chair:** Dr. Kelly Ervin, Army Research Institute

**PAE&T Lead:** Dr. Kendy Vierling, Navy

**SI&CP Lead:** Dr. Mark Draper, Air Force Research Lab

**PSWP Leads:** Dr. Peter Squire, Office of Naval Research  
Dr. Mike LaFiandra, Army Research Lab



## Hails & Farewells

**Hail** - Dr. Christian Whitchurch, Director of the Human Systems Portfolio at the Defense Innovation Unit (DIU), is our newest Steering Group member. Their mission is to accelerate transition of commercial innovation and technology, including safety and survivability, training and simulation, and prevention/treatment of combat injuries. He'll be supported on the Working Group by CDR Niels Olson. Welcome!

**News** - Dr. Rajesh Naik, Chief Scientist, 711th Human Performance Wing, is now the permanent Air Force Lead.

**Questions or Feedback?** Please send your comments to our Col's email at [hscoi-contact@sainc.com](mailto:hscoi-contact@sainc.com). Thanks!

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## Col Highlights - Past Events

**Applied Research for Advancement of S&T Priorities (ARAP) Program.** There were 17 collaborative and original submissions from the Col's for this year's ARAP award, with three teams selected to brief the S&T Executive Committee (ExCom). After careful deliberation, the winner was "Surface Morphing and Adaptive Structures for Hypersonics (SMASH)". POC: Katie Smith Stilling, Strategic Analysis, Inc.

**NDIA Human Systems Conference.** The NDIA Human Systems Division held the 2021 Human Systems Digital Experience each Tuesday throughout March featuring a Col Panel on Strategic Directions and Opportunities, each HS Col Subarea, and Advocacy and Metrics. The daily format included a series of presentations followed by a roundtable discussion with the full agenda and download presentations/posters found at <https://www.ndia.org/divisions/human-systems/past-events-and-proceedings>. Some featured speakers:

Major Annual Events/Activities 2021	
NDIA Human Systems Conference	Mar
ARAP Winner Announced	Apr
Seedling Proposal Data Call	Jun
Col Information Exchange & Review	Jun
Independent R&D (IR&D) TIM w/ Industry	Jun
Human Factors Engineering TAG	Jun
COI Annual Meeting	Sept
Roadmap Review w/OUSD (R&E)	Oct
I/ITSEC	Nov/Dec

- ◆ Maximizing "Human Readiness" in the United States Navy Surface Force. A keynote address by VADM Richard Brown, USN (Ret), President, Siren Consulting, LLC.
- ◆ Measuring and Predicting Soldier Performance and Lethality Through Soldier-Systems Modeling. Rob Wilcox, PhD, Lead, Science & Technology, Human Systems Performance, DEVCOM SC, U.S. Army.
- ◆ Leader's/Operator's Manual of Human, Multi-Domain. BG Peter Palmer, USA (Ret), President, P2 Consulting Service, LLC, Vice Chair, Human Systems Division, NDIA.
- ◆ Readiness in Real-Time: Using Cognitive Science and AI to Predict Human Capability. Iain Harlow, PhD, Vice President, Science, Cerego, Inc.

A total of 147 people from government, industry, and academia registered for the conference. Attendee survey data showed 100% of respondents indicated they liked the format, and a majority rated the presentations and discussions favorably.

**New Human Systems Division leadership.** For the next two years, Dr. Kara Orvis will serve as Chair and Dr. Lillian Asiala will serve as Deputy Chair. *Dr. Kara Orvis* is a Principal Scientist and Vice President of Research and Development at Aptima. She has over 20 years of experience in government research and development across the military services with expertise in the areas of training, leadership, teams, talent management, distributed work, and unobtrusive measurement for which she has over 80 publications/presentations. She also has been awarded patents within the domains of talent management and machine learning. *Dr. Lillian Asiala* is a cognitive scientist for Sonalysts, Inc. Her work has spanned several areas including reading comprehension, causal reasoning, decision-making, and most recently the development and validation of measures of performance for operators in specific military career fields.

Please reach out if you are interested in becoming a member of the division or participating in the 2022 Human Systems Division conference. POC: Dr. Kara Orvis, Aptima

## Col Highlights - "Next Up"

**2021 Col Information Exchange and Review.** This exchange will be held from 17-28 Jun and replaces the Col Annual Update normally held in January. All Cols are asked to share information on the state of technology investment in their portfolio and identify future technology opportunities to inform resource decisions. This event also serves as an opportunity to review and determine vectoring needs between the Cols and Modernization Priorities roadmaps. We will present along with the Biomedical and Biotechnology Cols on 17 Jun. POC: Katie Smith Stilling, Strategic Analysis, Inc.

**Tri-Col Independent Research & Development (IR&D) TIM:** Along with Bio-Medical and Biotechnology Cols, we are set to host the IR&D TIM from 21-24 Jun virtually. Government teams will be providing real time feedback as we engage with 13 companies presenting nearly 30 efforts in a joint effort to look for potential collaborations on their IR&D projects. The agenda and event information are available, with the announcement posted at <https://beta.sam.gov/opp/edee3eda632a4f3da74b137ee5b10ad1/view>. We look forward to another great event!

POC: Al Livada, 711 Human Performance Wing



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## Col Highlights - “Next Up” (Continued)

**DoD Human Factors Engineering Technical Advisory Group Virtual Event (VTAG).** The 2021 version of this event will occur June 29-30 on the Defense Collaboration Services platform. VTAG 2021 will focus on the theme “Data Driven Decision Making in HFE and Human Systems Integration”.

**Background:** Humans are often required to make decisions under time and contextual pressures, ever-changing environments, and incomplete or unclear data. Under these conditions, factors such as competing priorities, human condition, and perceived risk may compound to negatively impact the quality of these decisions.

Technologies such as Artificial Intelligence and Machine Learning can ingest and integrate real-time information and metrics at volume and speeds beyond human capacity to support Data Driven Decision Making (DDDM) and outcomes. Employing underlying algorithms, data repositories, and intuitive visualization they enhance human capacity for making strategic, agile decisions and help mitigate impacts of human factors such as subjectivity, emotion, and disposition from the decision making process.

In order to have an effective, sustainable DDDM program, consideration of topics such as data security, accessibility, trust, integrity, visualization, analytics, recency, as well as transactional and mass validity are paramount. The individual and compounding effects of these topics, in conjunction with human factors of performance, can manifest as positive or negative impacts to decision making and significantly influence outcomes. Understanding the outcome variance related to these human performance shaping factors and integrating their effects algorithmically with system performance models will strengthen readiness transparency and enable predictive, strategic planning for resilience.

Advances and achievements in this area are anticipated to have broad application and implication across DoD and beyond. However, the efficacy of the approach to enhance decision quality is heavily dependent upon the quality of the underlying elements. Therefore, it is imperative that the HFE government, industry, and academic communities of interest work together to ensure best practices are balanced with security and governance as these core capabilities are developed.

VTAG 2021 will provide a collaboration environment for discussion of human centric challenges and potential solutions in order to forge the future of DDDM cross-service solutions.

**Deadline to Register** is Friday, June 25 at <https://events.sa-meetings.com/hfevtag21/>.

**Website:** Visit the DoD HFE TAG website <https://rt.cto.mil/ddre-rt/dd-rtl/hfetag/> or social media (@DoDHFETAG).

**POCs:** Dr. Ben Petro (HFE TAG Proponent) or Dr. Liana Algarín (HFE TAG Coordinator), OUSD (R&E)

## From Our Stakeholders and Partners

**2021 Virtual Advanced Distributed Learning (ADL) Initiative Principal Investigator Meeting.** The ADL Initiative held its Principal Investigator meeting 19-20 May as the yearly portfolio review of its R&D projects. The Investigators presented their respective projects which collectively contribute to achieving the vision of a DoD future learning ecosystem. The meeting featured a panel discussion, *Life in the Sandbox*, which examined progress of the Total Learning Architecture (TLA), an effort to create a business enterprise architecture for learning (training/education) systems.

The TLA includes a set of technical specifications, standards, and policy guidance that define a uniform approach for integrating current and emerging learning technologies into a learning services ecosystem. The 4-pillar TLA data strategy is built around a set of international data standards that combine to increase the granularity and fidelity of learner data. The panelists were government leaders from the U.S. Army (Program Executive Office for Simulation, Training and Instrumentation/Synthetic Training Environment), the U.S. Navy (Naval Education and Training Command/MyNavy Learning) and the Defense Health Agency (Military Health Systems) who shared their TLA journey to date. Government stakeholders were invited to the meeting to learn about opportunities to use the ADL-sponsored science and technology and help shape future work. Learn more about the ADL Initiative FY21 R&D Portfolio by visiting <https://adlnet.gov/research> and request meeting notes.

POC: Dr. Sae Schatz, The ADL Initiative





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## From Our Stakeholders and Partners (Continued)

**DoD Directive 3235.02E, "DoD Combat Feeding Research & Engineering Program".** Dr. Liana Algarín drafted, staffed, and obtained Deputy Secretary of Defense Kathleen H. Hicks' approval for reissuance and publication which occurred 6 April on the Washington Headquarters Services DoD Directives website at <https://www.esd.whs.mil/Portals/54/Documents/DD/issuances/dodd/323502e.PDF>.

Key elements of DoDD 3235.02E:

- Establishes policy and assigns responsibilities governing combat feeding R&E in the DoD
- Establishes DoD Combat Feeding Research and Engineering Board (CFREB) to conduct R&E related to combat feeding
- Establishes the DoD Nutrition Committee to carry out activities related to nutrition
- Designates the Secretary of the Army as the DoD Executive Agent for the DoD Combat Feeding Research and Engineering Program (CFREP) in accordance with DoDD 5101.01

**CFREB** - Dr. Ben Petro, on behalf of the Under Secretary of Defense for Research and Engineering (R&E), chairs the CFREB with Army, Navy, Air Force, Marine Corps, Space Force, Defense Logistics Agency, and Joint Staff reps with a professional role and expertise in combat feeding (rations, field food service equipment, or field feeding systems). Each has one vote.

**CFREP** - Designed to develop or improve general and specialized DoD combat feeding programs in response to changing modes of warfare and industry capabilities, such as: (1) applied nutrition and nutritional biochemistry; (2) food engineering; (3) nutrient analysis, preservation, and stabilization; (4) food protection and microbiology; (5) food defense; (6) food service equipment engineering; (7) food packaging and polymer science; (8) food product development, testing, and technical evaluation; (9) ration systems and menu design; and (10) combat feeding logistics.

POC: Dr. Liana Algarín (DoDD 3235.02E Action Officer), OUSD (R&E)

**Register for Advanced Distributed Learning (ADL) Initiative's iFEST 2021!** In collaboration with the National Training & Simulation Association, the ADL Initiative will host iFEST 2021 as an online conference from 30 August to 1 September. This is the premier event for Distributed Learning S&T, attracting senior leaders, decision makers, and technology experts from around the world who represent military, industry, and academic stakeholders. More than 60 ideas have been accepted for presentations, tutorials, posters, and activities. Join us to discuss the latest challenges, innovations, and collaborations in the field. Details on the agenda, registration, and exhibit and sponsorship opportunities are available at <https://www.trainingsystems.org/events/2021/8/30/ifest>. POC: Dr. Sae Schatz, The ADL Initiative

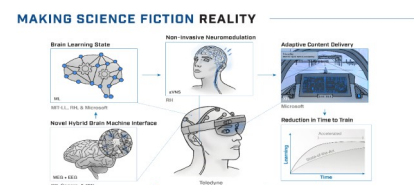
## Col Opportunities

**711 HPW Developing Advanced Neural Interfaces to Accelerate Learning.** Current state-of-the-art training pipelines are failing to keep up with Air Force operational demands to maintain critical mass of Airman expertise through training and skill acquisition. We are making advanced technological systems, but forgetting the human being at the center of these systems while our adversaries are investing more heavily in neuro-technologies that create better symbiotic relationships with man and machine.

To address these challenges, we seek to develop a capability for our Airman to rapidly acquire knowledge and skills through more direct interfaces with neuro-technology. Our proposed Intelligent Neural Learning System is a closed-loop training approach that will leverage in-house AFRL and 711 HPW capabilities to develop a novel magnetoencephalographic-based hybrid Brain Machine Interface.

The ultimate system will be used to accelerate learning, reduce training time and create an enhanced man-machine symbiosis with technological systems. We believe iNeuralS will enable our Airman to acquire skills on the fly in the matter hours instead of days, facilitate super-adaptability in dynamic chaotic environments with rapidly changing requirements and short timelines, and save millions of dollars on training that could instead be used to win wars. For more, visit link at <https://www.flightglobal.com/defence/us-air-force-aims-to-train-pilots-faster-using-brain-electrode/140554.article>

POC: Dr Gaurav Sharma, 711 Human Performance Wing





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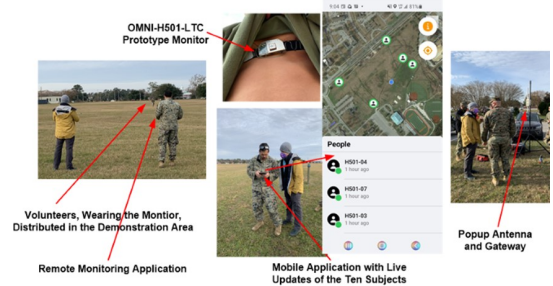


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## Col Accomplishments

**ONR Conducts Cold Weather Monitoring.** From Dec 20 to Jan 21, ONR conducted several successful engineering test and evaluation events of government-off-the-shelf (GOTS) technology in support of health status monitoring during extreme cold environments. GOTS Health Status Monitors (HSMs) equipped with communications capabilities were successfully tested with the 2nd Anglico II MEF Unit. During the initial technology demonstration in Camp Lejeune, Marines were able to try on chest strap-based HSMs and observe real-time changes in their physiological parameters on a tablet running a mobile-app with data communicated via LoRa terrestrial comms (LTC). The technology was well received with a CO letter of support for future engagements.

In January 2021, ONR continued the engagement with 2nd Anglico with a test and evaluation event at Camp Grayling. Ten Marines donned the Health Status Monitors for roughly 6 hours during a marksmanship event. ONR successfully demonstrated full physiologic waveform capture and real-time on-device health status summary as well as iridium satellite based comms and LTC. The team also demonstrated significantly improved geolocation capability through the HSM's internal GPS function when compared to iridium based geolocation. The Monitor's internal GPS capability comes at the expense of overall battery life and the team is currently working to optimize this battery expenditure. Operator feedback was favorable. POC: LCDR Joshua Swift, Office of Naval Research



**Army Research Institute (ARI) Researchers Develop Tools to Improve Enlisted Developmental Counseling.** Working in collaboration with the Combined Arms Center, ARI developed the Counseling Enhancement Tool (CET) to improve the quality of enlisted developmental counseling by guiding NCOs and Soldiers through an interactive, collaborative conversation. In addition, ARI developed "Talk Like a Leader" (TLAL) training designed to enhance the two-way communication skills required to conduct effective counseling and mentoring.

Both the CET and TLAL are based on motivational interviewing, a collaborative, goal-oriented style of communication designed to strengthen personal motivation for, and commitment to, a specific goal by eliciting and exploring the person's own reasons for change. Unlike current Army communication trainings, motivational interviewing focuses on change talk, which is any talk that favors movement toward a particular change goal. This method has been shown to increase behavioral change. A formative evaluation of the CET was conducted with over 1000 Soldiers and was endorsed by CAC, TRADOC, and Sergeant Major of the Army, with full fielding across the Army expected in 2021. An evaluation of TLAL training is also currently being conducted in collaboration with the Noncommissioned Officer Leadership Center of Excellence, with fielding of the training to NCO Academies to follow soon afterwards.

POC: Dr. April Sanders, Army Research Institute - Fort Hood

**Emerging 711 HPW Technologies Requested for Arctic Eagle 22 (AE22) Employment.** 711 HPW briefed the AE22 exercise team on inclusion of new technologies at the Initial Planning Meeting hosted in Wasilla AK in April 2021. Arctic Eagle 22 specifically addresses the DoD's direction to emphasize improving capabilities in extreme cold environments. Exercise planners and participants were especially interested in new capabilities that enhanced hardware and human performance in extreme cold environments including physiological/patient monitoring, CBRN communications and "electronics-warmers." AE22 will occur Feb-Mar 2022 across four venues including Kodiak Island, Anchorage, Joint-Base Elmendorf/Richardson and Nome where the 123rd Kentucky Air National Guard requested to evaluate multiple technologies. A Mid-Planning-Meeting is scheduled for 24-26 Aug in Anchorage where exercise scenarios will be further refined.

POC: Mr. Michael Sedillo, 711 HPW



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## Col Accomplishments (Continued)

**Supporting Air Combat Command (ACC) in Augmented and Virtual Reality Innovation.** Augmented and virtual reality (AR/VR) has come a long way over the years in 711 HPW, which is currently supporting two previous ACC taskers through innovation of the AR/VR experience in both Air Force Training and Readiness Technologies and AR/VR Training Effectiveness.

**Training and Readiness Technologies.** (SBIR Phase III) is aiming to develop a searchable, web-based repository that will allow training content developers, instructional designers, and instructors to share 3D models, source code, and executable code with one another. The intended outcome is the repository will facilitate development and fielding of AR/VR-based solutions more quickly and cost-effectively by not having to “reinvent the wheel” every time a new application is developed. By surveying tactical air and maintenance units in the Combat Air Force (CAF), this allows for identifying critical features and functionality, in addition to designing/developing the system using an “agile development” approach. The 1 year survey effort to identify/prioritize end user needs is nearly done with interactive software design and development set to begin the summer of 2021.

**Training Effectiveness.** AR/VR focuses on documenting the science and best practices for using and evaluating those technologies for training. The ideal result is for framework and guidelines to assess AR/VR instantiations and establish a knowledge base from published literature to inform future research in AR/VR technology for training and derive empirically sound principles. The method has three phases:

1. Identify and document published AR/VR effectiveness studies and additional relevant research.
2. Populate the knowledge base with structured information based on training effectiveness framework, while iteratively evolving framework.
3. Derive general principles and lessons learned on the use of AR/VR for training and identify research gaps.

We’ve reviewed 70+ AR/VR effectiveness empirical studies, developed an initial framework, and structure and modified a framework based on relevant science and research. The overall framework is set to be delivered in the spring of 2022.

POC: Dr. Winston “Wink” Bennett, 711 Human Performance Wing

**Heat Related Injury (HRI) Monitoring.** For 15 months, the Office of Naval Research conducted several successful tests and evaluations of a mixture of commercial- and government-off-the-shelf (COTS & GOTS) technologies for HRI monitoring at the School of Infantry – East (SOI-E) during specific training events in the 10k, 15k and 20k hike marches. As a result, heat related injury cases during those events dropped, and the monitoring capability became part of standard training operations. Currently, SOI-E HRI monitoring has fully transferred use of the kits to the Regimental Corpsman team to monitor Marine Combat Training, Infantry Training Battalion, and Advanced Infantry Training Battalion during ruck marches. These heat monitoring kits, in conjunction with the standard operating procedures developed as part of the effort (i.e. Estimated Core Temperature cutoff of 103.5F), have allowed SOI-E to reduce their HRI by ~80%, and maintain a consistently low number of HRI incidences since the kits were first utilized in 2018.

POC: Dr. Peter Squire, Office of Naval Research



**711 HPW Hosts Multi-Mission Warfighter Meeting with OSD.** The Wing hosted a Virtual Just-in-Time Multi-Mission Warfighter Solutions Meeting with support from the OUSD (R&E) Rapid Reaction Technology Office (RRTTO). 33 companies (from over 300 responses) briefed capabilities and technologies related to this emerging research initiative in AFRL, supported by the Transformational Capabilities Office and the Air Force Futures Disruptive Technology Team. Broad areas considered included Modeling & Simulation, Health & Human Performance, Computing at the Edge, and finally Remediation, Tele-maintenance, and Psychometrics.

**Impact:** The event allowed a diverse cross-section of the Air Force and other DoD entities to connect and potentially identify game changing concepts and technologies that could be applied to operational needs in austere locations on tasks the warfighter may be unfamiliar with, as well as others with a broader purpose and applicability.

POC: Dr. Glenn Gunzelmann, 711 Human Performance Wing





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### Col Accomplishments (Continued)



**JTAC Virtual Trainer (JVT) and 3D Warfighter Augmented Reality (WAR) programs** were tested during an exercise at Marine Corps Base Camp Lejeune, North Carolina using a demo of two different Office of Naval Research (ONR)-sponsored training systems. Both systems—JTAC Virtual Trainer (JVT) and 3D Warfighter Augmented Reality (WAR)—are designed to make it easier to train Joint Terminal Attack Controllers (JTACs) and Fire Support Marines who support infantry forces by observing the ground situation and calling for necessary air, artillery, mortar or naval gun fire.

Their work requires hours of training and practice to stay proficient. However, getting regular practice time is challenging, since JTACs and Fire Support Marines have to book time in large indoor simulators or participate in live-fire exercises involving expensive ordnance and aircraft. To make training more mobile and convenient, ONR sponsored the development of JVT and 3D WAR. Both systems come in portable kits and are simple to carry. They use sophisticated, video game-style virtual- and augmented-reality software. And they're made with commercially available equipment.

- ♦ *JVT*, developed by tech company Virbela, has video game software in a commercial gaming computer. It features a virtual-reality, head-mounted display that allows JTACs to operate in a fully immersive environment. Hand controllers enable users to interact with virtual equipment and tools used for calling various types of strikes.
- ♦ *3D WAR*, developed by Lockheed Martin and SRI International, uses augmented-reality (AR) technology to enable Fire Support Marines to see virtual targets, such as vehicles and aircraft, amid real-world settings. It comprises an AR backpack; a head-mounted viewing display with goggles, navigation sensors that track location and feed video to the head-mounted display, and a handheld tablet.

JVT and 3D WAR will make training more immersive and engaging with future training systems needing to be easily accessible and useable to Marines to complement the type of activities they perform during live-fire exercises. JVT and 3D WAR will undergo more testing before being distributed into the fleet and force. Learn more about both systems at the video promo link at <https://www.onr.navy.mil/en/Media-Center/Press-Releases/2021/ONR-Tests-Virtual-Training-Systems-for-JTACs-Fire-Support-Marines>.

POC: Dr. Peter Squire, Office of Naval Research

**MASTR-E Spotlight: Population-Level Performance Model.** The MASTR-E program is building user-friendly software to predict Soldier physical and cognitive readiness. The software currently analyzes data for Soldiers' stress, physical activity, sleep, hydration status, thermal load, and weapons proficiency. With that data, the software output predicts and informs on threat detection, decision making, marksmanship ability, and physical readiness. Trainers and leaders are notified how Soldier traits and states, in conjunction with physical and mental task demands, will impact Soldier readiness for training and operations.

#### Why is this important?

There is currently no useful method for predicting individual and team readiness. To assist leaders with decision making for readiness and operations, the MASTR-E program is providing a comprehensive predictive model, known as a population-level performance model (PLPM), allowing leaders and trainers to estimate Soldiers' mental and physical readiness. The innovative modeling approach will reside within a software tool.

#### Where are we at with this capability?

Currently, the PLPM allows leaders to learn how mental stress, physical exertion, and sleep status relate to the mental and physical performance elements underlying lethality and readiness. Future versions of the PLPM will increase the amount of Soldier predictors and outputs and will be able to take advantage of real-time body worn sensor data to provide continuous predictive capabilities. As the model and software continue development, they will be adapted to include more specificity for close-combat tasks.

POC: Ms. Karen Gregorczyk, USARMY DEVCOM



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## Publications/Articles

**Swift Trust: A Cognitive Task Analysis.** Authors *August Capiola* from 711 HPW along with *Holly C. Baxter, Marc D. Pfahler, Christopher S. Calhoun, and Philip Bobko* published an article titled “Swift Trust in Ad Hoc Teams: A Cognitive Task Analysis of Intelligence Operators in Multi- Domain Command and Control Contexts”.

**Abstract:** Trust is important for establishing successful relationships and performance outcomes; however, knowledge of and experience with a teammate is not always available to inform one’s trust despite being expected to work together toward common goals. This research investigated the antecedents to quickly- formed trust (often referred to as swift trust) in fast- paced, time constrained contexts. A cognitive task analysis was conducted based on 11 structured interviews of subject- matter experts in Intelligence—a heterogeneous job category comprising distributed and co- located personnel within multi- domain command and control (MDC2) environments. Eight antecedents to swift trust emerged from these interviews (i.e., ability, integrity, benevolence, communication, mission focus, self- awareness, shared perspectives and experiences, and calm), with further analysis implying that swift trust is a relevant and emergent state in MDC2 that facilitates reliance. These findings offer implications for teams operating in high- risk distributed contexts and should be expanded through basic experimental investigations as well as applied initiatives.

DOI: [10.1177/1555343420943460](https://doi.org/10.1177/1555343420943460), Journal of Cognitive Engineering and Decision Making

POC: Dr. August Capiola, 711 Human Performance Wing

**Sensor Development Strategy for Nano Devices.** *Dr. Michael Brothers, Dr. Daniel Sim, and Dr. Steve Kim* from 711 HPW published a journal article titled “Selective Electronic NO2 Sensors using Polydimethylsiloxane Filter on WSe2 Devices”. The article covers an in-house research on breath volatile gas sensor development and provides a key selective sensor development strategy for nano-devices. This work enables the molecular sensing and physiology core research area to move a step closer to achieving personalized wearable real-time monitoring technical solutions to both identify physiological changes as well as report environmental contaminants to enable airman exposure and health monitoring.

DOI: <https://doi.org/10.1021/acsapm.0c00969> American Chemical Society Applied Polymer Materials, 2021

POC: Dr. Steve Kim, 711 Human Performance Wing

**Trust and Reliance in Automation.** Authors *Lebiere C, Blaha LM, Fallon CK and Jefferson B* authored “Adaptive Cognitive Mechanisms to Maintain Calibrated Trust and Reliance in Automation”.

**Abstract:** Trust calibration for a human–machine team is the process by which a human adjusts their expectations of the automation’s reliability and trustworthiness; adaptive support for trust calibration is needed to engender appropriate reliance on automation. We leveraged an instance-based learning ACT-R cognitive model of decisions to obtain and rely on an automated assistant for visual search in a UAV interface. This cognitive model matches well with the human predictive power statistics measuring reliance decisions; we obtain from the model an internal estimate of automation reliability that mirrors human subjective ratings. The model is able to predict the effect of various potential disruptions, such as environmental changes or particular classes of adversarial intrusions on human trust in automation. Finally, the use of model predictions to improve automation transparency that account for human cognitive biases is considered in order to optimize the bidirectional interaction between human and machine through supporting trust calibration. The implications of findings for the design of reliable and trustworthy automation are included.

DOI: [10.3389/frobt.2021.652776](https://doi.org/10.3389/frobt.2021.652776) Front. Robot

POC: Dr. Glenn Gunzelmann, 711 Human Performance Wing





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## Publications/Articles (Continued)

**New Class of Therapeutics That Leverage the Tools of Synthetic Biology.** 711 HPW researchers led by *Dr. M. Tyler Nelson, Dr. Elaine Merrill, and Dr. Camilla Mauzy*, published “Characterization of an engineered live bacterial therapeutic for the treatment of phenylketonuria in a human gut-on-a-chip,” in *Nature Communications*, a high impact journal, highlighting application of organ-on-a-chip technology to answer human performance questions. In collaboration with industry partner Synlogic Inc., the team developed and validated a human gut-on-a-chip platform, highlighting the utility of organ-on-a-chip technology to screen and test the efficacy of synthetically engineered live bacterial probiotics. This work was supported by the Applied Research for the Advancement of Science and Technology Priorities Program on Synthetic Biology for Military Environments. Establishment of this capability furthers the Biotechnology for Health and Performance Core Research Area’s goals of developing physiologically relevant models to characterize and direct augmentation strategies in support of optimizing warfighter performance.

DOI <https://doi.org/10.1038/s41467-021-23072-5> *Nature Communications* (2021)

POC: Dr. M. Tyler Nelson, 711 Human Performance Wing

## Other “Of Interest” Publications/Articles

**Modeling Laser Irradiation of Skin Tissue.** *Drs Michael P. DeLisi, Nicholas J. Gamez, Clifton D. Clark III, Semih S. Kumru, Benjamin A. Rockwell, and Robert J. Thomas* published an article titled “Computational modeling and damage threshold prediction of continuous-wave and multiple-pulse porcine skin laser exposures at 1070 nm,”.

Abstract: Computational models are capable of simulating the expected thermal response of biological tissue to laser irradiation. A typical laser tissue model accounts for optical energy deposition, heat transfer, and damage assessment, with the latter often represented by calculation of the Arrhenius integral. Previous studies have successfully employed these methods to predict skin damage thresholds at laser wavelengths with high absorption in water, and usually for single continuous-wave exposures. However, there remains a need for a robust and accurate predictive model in low-absorption, high-scattering cases, such as for exposures in the near-infrared region near 1000 nm. This study presents a framework for modeling laser irradiation of skin tissue at 1070 nm for both continuous-wave and pulsed exposures at various durations. The techniques outlined by this study provide a useful tool in assessing potentially hazardous near-infrared laser exposure scenarios.

DOI: <https://doi.org/10.2351/7.0000367> *Journal of Laser Applications* (2021).

POC: Dr. Robert J. Thomas, 711 Human Performance Wing



# Human Systems Community of Interest (HS Col) Newsletter



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