

Transformative S&T for Assessing and Strengthening Individual-to-Population Resilience under Societal and

Environmental Stress: A Workshop

KECK 100, 500 5th St NW, Washington, DC SEPTEMBER 26-27, 2024

Purpose

This two-day workshop will identify and explore transformative science and technology for assessing and strengthening individual and population resilience, including recent advances in computational social science, cognitive science, sensing, and artificial intelligence (AI).

Specific areas to be explored include the following: 1. Defining resilience along the continuum from individuals to populations;

2. Metrics of decision-making processes under stress;

3. Individual-to-group-to-population responses to stress, using natural, formal, and social sciences;

4. Techniques for measuring and assessing stress and resilience;

5. Population dynamics in response to stress and emerging technologies;

6. Insights from social and cognitive neuroscience, AI, and advanced sensing technologies that might mitigate stress; and7. Ethical, legal, and social issues related to these technologies.

AGENDA

THURSDAY, SEPTEMBER 26, 2024

CLOSED SESSION 8:00 – 8:30 AM BREAKFAST 8:30 – 9:00 AM Workshop Introduction and Goals Laura McNamara and Amina Qutub, workshop organizers **OPEN SESSION** 9:00 AM – 12:30 PM Frame Setting Talks (20 minute presentation followed by 10 minutes for Q&A) "DOD Research Perspective and Overarching Challenges" • David Montgomery, Director of Social Science, and Director, Minerva Research Initiative, OUSD (R&E), Department of Defense "Purpose in Life: A Resilience Factor that Helps People Maintain Health and Well-Being Amidst Adversity" • Eric Kim, Assistant Professor of Psychology, University of British Columbia "Brain electrical neuroimaging and brain-computer interface for measuring and assessing markers of stress and resilience, and developing countermeasures and resilience strategies" • Bin He, Professor of Biomedical Engineering, Carnegie Mellon University BREAK "Launching Satellites and Saving Lives: What It Takes To Break Through Climate Challenges in Water and Food Security" Joshua Fisher, Associate Professor of Environmental Science and Policy, Chapman University "Navigating Crisis: Leveraging Social Media for Disaster Management" Amanda Lee Hughes, Associate Professor of Computer Science, Brigham Young University "Ethical concerns of using AI in the context of population resilience" • Héctor Pérez-Urbina, Research Scientist, Google Research

CLOSED SESSION

12:30 – 2:00 PM 1:00 PM	WORKING LUNCH Attendee 1-Slide Introductions See attached template, 1-2 minutes per attendee.
2:00 – 2:45 PM	 Level Setting for Breakout Sessions Laura McNamara and Amina Qutub, workshop organizers
2:45 – 3:00 PM	BREAK, move to breakout rooms
3:00 – 4:30 PM	 Breakout Discussions, Part I – Identifying Opportunities "What opportunities exist for integration across varied levels of granularity and collaboration across domains?" Individual Level Sensing – Keck 100 Amina Qutub, moderator
	 Large Group Level Observation / Modeling – Keck 104 Richard Murray, <i>moderator</i>
	 Ethical, Legal, and Social Implications – Keck 210 Laura McNamara, <i>moderator</i>
4:30 – 4:45 PM	BREAK, reconvene in main room
4:45 – 5:45 PM	 Breakout Debrief, Fireside Chats "To make meaningful progress in assessing and strengthening human resilience, what S&T theme(s) should DOD prioritize?" Laura McNamara, moderator
6:00 PM	 GROUP DINNER – Keck Atrium (3rd Floor) Overview of NASEM Standing Committee on Transformative Science and Technology for the DOD Richard Murray, committee chair

FRIDAY, SEPTEMBER 27, 2024

	CLOSED SESSION
8:00 – 8:30 AM	BREAKFAST
8:30 – 9:00 AM	 Reflections on Day 1 Laura McNamara and Amina Qutub, workshop organizers

	OPEN SESSION
9:00 – 10:15 AM	 Short Seminar Presentations (10 minute presentation followed by 5 minutes for Q&A) "Emerging Neuro technologies for optimizing resilience: practical applications and ethico-legal and social implications" James Giordano, Professor of Neurology and Biochemistry, Pellegrino Center for Clinical Bioethics, Georgetown University
	 <i>"Resilience Pathways Identified by Spatial Omics in the Cardiovascular-Kidney Metabolic Syndroma"</i> Kumar Sharma, Director, Center for Precision Medicine, Chief, Division of Nephrology, and Vice Chair of Research, Department of Medicine, University of Texas Health San Antonio
	BREAK
	<i>"Wellbeing Implications of AI on Human Infrastructure and Society"</i>Jina Suh, Principal Researcher, Microsoft Research
	 "System Cards+: Fairness, Inclusivity, Ethical and Legal Accountability in AI Systems" Ioannis Kakariaris, Professor of Computer Science, Electrical & Computer Engineering, and Biomedical Engineering, University of Houston
10:15 – 10:45 AM	 Combined Q&A and Whole Group Discussions Amina Qutub, <i>moderator</i>
10:45 – 11:00 AM	BREAK
	CLOSED SESSION
11:00 AM – 12:30 PM	 Breakout Discussions, Part II – Actionable Next Steps "What specific opportunities should DOD pursue to advance research in assessing and strengthening human resilience?" Individual Level Sensing – Keck 100 Amina Qutub, moderator Large Group Level Observation / Modeling – Keck 104 Richard Murray, moderator

Ethical, Legal, and Social Implications – Keck 102

• Laura McNamara, moderator

12:30 – 1:00 PM	LUNCH
	OPEN SESSION
1:00 – 2:00 PM	Breakout Group Presentations
2:00 – 2:30 PM	Final Group Discussion
2:30 – 3:00 PM	 Organizers Discussion and Final Wrap-up Laura McNamara and Amina Qutub, workshop organizers
3:00 PM	ADJOURN

SPEAKER BIOGRAPHIES

David Montgomery is the director of social science for the U.S. Department of Defense, Office of the Under Secretary for Research and Engineering (OUSD-R&E), and director of the Minerva Research Initiative, a fundamental social science research program led by the OUSD-R&E/Basic Research office, in partnership with the OUSD-Policy/Strategy office and the Service research agencies.

Dr. Eric Kim is an Assistant Professor of Psychology at the University of British Columbia and a Research Affiliate at Harvard's Human Flourishing Program and Lee Kum Sheung Center for Health and Happiness. He received his Ph.D. in clinical psychology from the University of Michigan, and completed a postdoctoral fellowship in cardiovascular epidemiology at the Harvard T.H. Chan School of Public Health. His research focuses on older adults and aims to identify, understand, and intervene upon the individual and environmental determinants of psychological wellbeing that enhance healthy lifestyle behaviors and reduce the risk of age-related chronic conditions. He also investigates the mechanisms through which psychological wellbeing might influence our physical health. Around these topics, he has given invited lectures at Universities, policy organizations (National Academy of Sciences, National Academy of Engineering), corporations (UnitedHealth Care, IDEO, AARP, Samsung, Facebook), and also been invited for nationaland international-level think-tank working groups (U.S. Surgeon Generals Office, OECD, United Nations). He's been recognized as: one of Forbes 30 Under 30 in Healthcare, an Association for Psychological Science Rising Star, Gerontological Society of America's Margaret M. and Paul B. Baltes Award recipient, and American Psychological Association Early Career Achievement Award (Division 20 – Adult Development and Aging and Division 38 – Health Psychology). He enjoys spending time at the intersection of several disciplines and has published in a range of journals including: PNAS, JAMA Psychiatry, Circulation, Stroke, the American Journal of Epidemiology, and Milbank Quarterly. Insights from this work have been featured in a range of outlets including the New York Times, Wall Street Journal, The Atlantic, BBC, Time Magazine, Washington Post, and others.

Dr. Bin He is Trustee Professor of Biomedical Engineering, Professor of the Neuroscience Institute, and Professor by courtesy of Electrical and Computer Engineering at Carnegie Mellon University. Previously, he served as the head of the Department of Biomedical Engineering at Carnegie Mellon University, and as the director of the Institute for Engineering in Medicine at the University of Minnesota. His research focuses on noninvasive neurotechnology, with a specialization in brain-computer interfaces, neuromodulation, and electrophysiological neuroimaging. His work aims at better understanding brain functions and aiding in the management of neurological disorders. Dr. He's contributions have been recognized by several prestigious awards, including the IEEE Biomedical Engineering Award, the IEEE EMBS Academic Career Achievement Award, the IEEE EMBS William J. Morlock Award, and the Earl Bakken Distinguished Lecture Award from the American Institute of Medical and Biological Engineering. He served as Chair of the International Academy of Medical and Biological Engineering from 2018-2021 and Past

President of the IEEE Engineering in Medicine and Biology Society. Dr. He serves as the Editor-in-Chief of IEEE Reviews in Biomedical Engineering, and is the sole editor of the textbook "Neural Engineering," initially published in 2005 and subsequently released its 3rd edition in 2020.

Dr. Joshua B. Fisher is a Climate Scientist focusing on terrestrial ecosystems, water, carbon, and nutrient cycling using a combination of remote sensing, supercomputer models, and field campaigns from the Amazon to the Arctic. He completed his undergraduate and graduate degrees from UC Berkeley and his postdoctoral work from the University of Oxford. Dr. Fisher was a NASA Scientist at the Jet Propulsion Laboratory (JPL) for over a decade and the founding Science Lead for the ECOSTRESS mission on the International Space Station. Dr. Fisher is now the Science Lead for Hydrosat and Associate Professor of Environmental Science and Policy at Chapman University. With over 200 publications, Dr. Fisher has been named one of the world's "most influential" researchers, in the top 0.1% of scientists with papers in the top 1% by citations for the past 7 years in a row.

Dr. Amanda L. Hughes is an Associate Professor of Computer Science at Brigham Young University. As a recognized research leader in Crisis Informatics, her work investigates the use of information and communication technology during crises and mass emergencies with particular attention to how social media affect emergency response organizations. The goal of her research is to design, implement, and deploy software systems that improve crisis communications based on deep understandings of the social context in which they reside. Her research is funded by grants from NSF, the Knight Foundation, and NASA SERVIR. She also directs the Crisis Informatics Lab at BYU. Amanda received a bachelor's degree in Computer Science from Brigham Young University and a master's and PhD degree in Computer Science from the University of Colorado Boulder.

Dr. Héctor Pérez Urbina is part of the Research Center for Responsible AI and Human Centered Technology at Google; his work focuses on the production of trustworthy societal context knowledge to foster responsible AI. Prior to his current role, Pérez Urbina worked on maintaining and improving the Knowledge Graph—Google's massive knowledge graph used to enhance search results with semantic information. He holds a PhD in artificial intelligence from the University of Oxford, and he graduated summa cum laude from Universidad de las Américas, Puebla with a BSc in software engineering. His professional interests include knowledge representation and reasoning, ontology-based data access, and responsible AI.

James Giordano, PhD, DPhil (c), is the Pellegrino Center Professor in the Departments of Neurology and Biochemistry; and Chief of the Neuroethics Studies Program at Georgetown University Medical Center, Washington DC. Professor Giordano is Senior Bioethicist of the Defense Medical Ethics Center and Adjunct Professor of Psychiatry at the Uniformed Services University of Health Sciences; Distinguished Visiting Professor of Health Promotions, Technology and Ethics at the Coburg University of Applied Sciences (Coburg,

GER); Stockdale Fellow in Science, Technology, and Ethics at the United States Naval Academy; Senior Science Advisory Fellow of the Strategic Multilayer Assessment Branch of the Joint Staff, Pentagon; and Chair Emeritus of the IEEE Brain Initiative Project on Neurotechnology and Ethics. He previously was Fellow and Task Leader of the Neuroethics Study Section of the European Union Human Brain Project; an elected member of the Department of Health and Human Services Secretary's Advisory Committee for Human Research Protections; Fulbright Professor of Neuroscience and Neuroethics at the Ludwig Maximilians University, Munich, GER; Associate Fellow of the Oxford Centre for Neuroethics, University of Oxford, UK; and was an elected founding member of the Neuroethics, Legal, and Social Issues Advisory Panel of the Defense Advanced Research Projects Agency (DARPA). Prof. Giordano is the author of over 350 peer-reviewed publications, 9 books and 25 governmental reports on brain science, ethics and biosecurity, and is an elected member of the European Academy of Science and Arts, and an Overseas Fellow of the Royal Society of Medicine (UK).

Kumar Sharma, M.D., is the chief of the Division of Nephrology and vice chair for research in the Department of Medicine. Dr. Sharma was professor of medicine and director of the Center for Renal Translational Medicine and director of the Institute of Metabolomic Medicine at the University of California San Diego. His research explores the mechanisms and treatment of diabetic nephropathy. Dr. Sharma has several National Institutes of Health-funded projects including a DP3: Type 1 diabetes targeted research award of \$6 million to identify novel paradigms in diabetic complications, more than \$3 million from the JDRF to identify novel biomarkers in an international cohort of studies in Type 1 diabetes and more than \$3 million for the Animal Models of Diabetic Complications Consortium and novel clinical trials in diabetic nephropathy from the National Institute of Diabetes and Digestive and Kidney Diseases. He serves on numerous study sections and is a standing member of the NIH Pathology of Kidney Disease study section. He plays a lead role in the NIH Kidney Precision Medicine program, and UT Health San Antonio will be the national hub for analysis of spatial metabolomic profiles of kidney tissues. As vice chair for research, Dr. Sharma will oversee the creation of a mentoring program for young investigators, the implementation of pilot programs and the organization of research themes across the department.

Dr. Jina Suh is a Principal Researcher in the HUE group at Microsoft Research Redmond Lab. She received her PhD from the Paul G. Allen School of Computer Science and Engineering at the University of Washington advised by James Fogarty and Tim Althoff. She is a proud alumnus of the Machine Teaching group where she grew her interest and passion for HCI and ML. Her current interests lie in the design of technologies and the application of data science and ML for improving mental health and well-being where she works with clinicians to deliver evidence-based interventions, collaborate with product groups to improve workplace wellbeing, or work with large datasets looking at population-level shifts in wellbeing. She has a master's degree in UW's Human-Centered Design and Engineering program. Prior to joining MSR, she worked in Xbox for 7 years, interned at MSR for World

Wide Telescope project, and got her a BA/MS in Physics from Columbia and Harvard where she once aspired to be an experimental astrophysicist and a particle physicist.

Professor Ioannis A. Kakadiaris, Ph.D., is a Hugh Roy and Lillie Cranz Cullen Distinguished University Professor of Computer Science at the University of Houston and directs the Computational Biomedicine Lab (CBL). Ioannis is an international expert in AI, biometrics, and digital health. Specifically, (i) Pioneered combining machine learning and game theory to predict adverse cardiovascular events. The ML Risk Calculator outperformed the ACC/AHA Risk Calculator by recommending less drug therapy (11% versus 46% being statin eligible), yet missing fewer events (14.4% vs 23.8%); (ii) Pioneered the research field of vasa vasorum imaging for patients at risk of having a heart attack, (iii) Invented and developed automated computational tools for processing large volumes of imaging data; (iv) Developed the first patient-centered software system for rendering patient-specific predictions of the post-operative breast shape for breast reconstructive surgery, (v) Invented a method and system that turns COTS mobile devices into Augmented Reality platforms able to visualize in real-time data "inside" a patient's body (as acquired during pre-operative scans). Ioannis most recently served as the Founder and Director of the Borders, Trade, and Immigration (BTI) Institute, a Department of Homeland Security Center of Excellence led by the University of Houston (UH). As director of the BTI Institute, Ioannis oversaw multiple projects undertaken by eighteen partners across eight states and the District of Columbia. The portfolio focused on homeland security enterprise research, education, and workforce development by studying complex, multi-disciplinary issues related to cross-border movements of people, goods, data, and financial capital. He earned his B.Sc. in Physics at the University of Athens in Greece, his M.Sc. in Computer Science from Northeastern University, and his Ph.D. at the University of Pennsylvania. In addition to twice winning the UH Computer Science Research Excellence Award, Ioannis has been recognized for his work with several distinguished honors, including the NSF Early Career Development Award, the Schlumberger Technical Foundation Award, the UH Enron Teaching Excellence Award, the James Muller Vulnerable Plaque Young Investigator Prize, the UH COSC Research Excellence Award (2 times) and most recently the IEEE Biometrics Council Meritorious Service Award. His research has been featured on Discovery Channel, National Public Radio, KPRC NBC News, KTRH ABC News, and KHOU CBS News.