Yuxin Cai

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SUMMARY

Ph.D. student in Industrial and Systems Engineering specializing in human factors, with strong expertise in machine learning, wearable data analytics, and human-system interaction. Experienced in building predictive models of human performance and developing human-in-the-loop systems that enable data-driven decision-making in safety-critical environments such as emergency medical services and energy operations.

Skilled in:

- Developing predictive models using multimodal data (physiological, behavioral, and subjective)
- Applying machine learning techniques to real-world, noisy datasets for actionable insights
- Designing user-centered decision-support systems and interfaces for operational environments
- Translating complex human factors and physiological data into scalable, practical solutions

EDUCATION

University of Wisconsin – Madison — Wisconsin, USA
Ph.D. Industrial & Systems Engineering GPA: 4.0/4.0 — Sept 2024 – Present

Tsinghua University — Beijing, China
B.S., Mathematics and Physics GPA: 3.8/4.0 — Sept 2020 – July 2024
B.Eng., Industrial Engineering GPA: 3.8/4.0

TECHNICAL SKILLS & EXPERTISE

Programming & Data Analytics: R; Python (Scikit-Learn, Pytorch, Pandas, NumPy, Streamlit); MATLAB; machine learning; statistical modeling

Physiological & Behavioral Data: ECG/heart data (Actiheart, Empatica Watches); EEG (Matlab EEGLAB); fNIRs; eye tracking (Tobii Pro Lab); wearable sensing

Human Factors Research & Design: Experimental design, usability testing, human-centered design, Figma, Axure RP, Streamlit.

Core Competencies: Project management in interdisciplinary teams; cross-functional collaboration with engineers, researchers and designers; research planning and coordination; stakeholder communication

EXPERIENCE

University of Wisconsin – Madison — Madison, Wisconsin
Graduate Research Assistant – NeuroErgonomics Lab — Sept 2024 – Present

- Performed end-to-end data acquisition, preprocessing, analysis, and ML modeling of multimodal physiological data from wearable devices (Actiheart; Empatica Embrace Plus) to predict fatigue and characterize fatigue-related human factors and their impact on technical and non-technical performance in high-stakes operational environments.
- Collaborated closely with diverse stakeholders, including managers and frontline workers, in oil and gas industry to assess current fatigue risk management system (FRMS) and safety management system (SMS) adoption. Identified and proposed actionable, evidence-informed improvements through literature review and Delphi expert consensus study.
- Led an interdisciplinary development team, collaborating with designers, engineers, and researchers to develop human-centered, next-generation intelligent FRMS, including fatigue monitoring, fatigue risk alerts, and fatigue mitigation recommendation systems.

Institute for AI Industry Research (AIR), Tsinghua University — Beijing, China
Research Intern – HCI Group, Discover Lab — May 2023 – Oct 2023

- Provided human factors expertise in the design and execution of usability testing for external human–machine interfaces (eHMIs), including VR-simulated studies to assess pedestrian-AV interaction.

- Led multimodal data analysis in pedestrian–AV interaction contexts, analyzing wearable physiological data (electrodermal activity, EDA and blood volume pulse, BVP) to interpret human physiological responses and user experience.

National New Energy Vehicle Technology Innovation Center Beijing, China
Human Factors Engineering Intern – Vehicle Digitization Experience Laboratory June 2023 – Aug 2023

- Led a usability evaluation of voice user interfaces (VUIs) using multimodal measures, integrating physiological and subjective data to assess user interaction and usability.
- Supported the refinement of experimental design and the development of standardized data collection protocols for subjective and physiological measures in electric vehicle usability and performance studies.

Institute of Human Factors and Human-System Interaction, Tsinghua University Beijing, China
Undergraduate Researcher Aug 2022 – July 2024

- Performed end-to-end data acquisition, preprocessing and analysis of EEG and eye-tracking data, investigating relationships between cortical brain activity, pupillometric measures and contributors to cognitive workload, and developing composite metrics to predict workload from multiple sources using factor analysis techniques.

PUBLICATIONS

- Cai, Y., Iqbal, M. U., Yang, F., Payne, S. C., Sasangohar, F. S., Mehta, R. K. (under review). Bridging Scientific Evidence and Industry Practice to Inform Offshore Fatigue Risk Management Strategies: A Systematic Review and Delphi Study.
- Cai, Y., Payne, S. C., Driggs, T., Sasangohar, F., & Mehta, R. K. (under review). Fatigue risk management in offshore oil and gas operations: A longitudinal examination of organizational practices and individual strategies.
- Cai, Y., Payne, S. C., Sasangohar, F., & Mehta, R. K. (2026). A Knowledge-Based Recommender System for Personalized Fatigue Mitigation Strategies in Offshore Workers. *Proceedings of the Human Factors and Ergonomics Society Annual Meeting.* https://doi.org/10.1177/10711813261498763
- Cai, Y., Shanghavi, A. A., & Mehta, R. K. (2026). Identifying Robust Predictors of Operational Fatigue in Emergency Medical Services Providers: A Machine Learning Approach. *Proceedings of the Human Factors and Ergonomics Society Annual Meeting.* https://doi.org/10.1177/10711813261498776
- Shanghavi, A. A., Jayasuriya, J., Cai, Y., & Mehta, R. K. (2025). Pulse Rate Variability From Wearable Wristwatches as a Surrogate for Heart Rate Variability? We Think Not Yet. *Proceedings of the Human Factors and Ergonomics Society Annual Meeting*. https://doi.org/10.1177/10711813251357929
- Chang, X., Chen, Z., Dong, X., Cai, Y., Yan, T., Cai, H., Zhou, Z., Zhou, G., & Gong, J. (2024). "It Must Be Gesturing Towards Me": Gesture-Based Interaction between Autonomous Vehicles and Pedestrians. *Proceedings of the 2024 CHI Conference on Human Factors in Computing Systems*, 1–25. https://doi.org/10.1145/3613904.3642029
- Chen, Z., Yan, T., Cai, Y., Cui, T., & Chen, S. (2023). Using head-mounted eye trackers to explore children's color preferences and perceptions of toys with different color gradients. *Frontiers in Psychology*, 14. https://doi.org/10.3389/fpsyg.2023.1205213
- Meng, J., Yu, Z., Cai, Y., & Wang, X. (2023). K-Means++ Clustering Algorithm in Categorization of Glass Cultural Relics. *Applied Sciences*, 13(8), 4736. https://doi.org/10.3390/app13084736

AWARDS & AFFILIATIONS

Technology Innovation Excellence Awards, Tsinghua University 2022 – 2023
Student Affiliate Human Factors and Ergonomics Society (HFES) 2024 – Present