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Measuring Construction Workers' Real-Time Situation Awareness: Using Wearable Technologies

Behzad Esmaeili
George Mason University, USA

Abstract

Human error (e.g., poor decisions or unsafe actions) are a main casual factor in up to 80% of all workplace accidents across a breadth of industries. To the extent our limited capacity for information processing capacity is a major source of such errors, better understanding of cognitive processes will yield more effective methods for predicting and reducing the poor decisions that put workers at risk. Accordingly, this study will complete a series of eye-tracking experiments to build an error-detection framework - the Human-Error Detection Framework - that computes the likelihood of human error in occupational settings to enable proactive countermeasures to keep workers safe. Subsequently, to extend the value of this framework, this project will enrich and expand research-based educational materials, outreach, and engagement activities to spread awareness about this framework to communities and workers. To achieve these goals, this multidisciplinary project blends research linking eye movements and workers' attention with research focused on working-memory load and decision making in order to discover how and why workers in dynamic work environments fail to detect, comprehend, and/or respond to physical risks. Using the dynamic and high-risk environment of construction as a testbed, the proposed framework will connect eye movements and cognitive manipulations in laboratory and field experiments with worker demographics to identify precursors that predict accident-causing human errors in dynamic worksites. In all, this project will demonstrate the value and effectiveness of synthesizing cognitive psychology, engineering, and advanced computation to improve decision making and occupational safety.

The Human-Error Detection Framework will harness real-time eye-movement patterns to identify human errors and thereby lay the foundation for synthesizing technology with data analysis to automatically identify and interrupt human decision-making errors before injuries occur. Using the predictive models resulting from this study will not only contribute to significant accident reduction but will also provide a critical validation measure to confirm the effectiveness of training programs in enhancing workers' risk-analysis skills. Furthermore, since this project provides tools and insights for researchers, students, and workers to use to enhance occupational safety and multidisciplinary research, this project will evolve the broader pedagogical landscape of the decision, risk, and management sector. As this innovative research challenges the conventional, reactionary paradigm of safety-risk management by enabling the identification of at-risk workers using a measurable indicator of their cognitive processes, i.e., their eye movements, the proposed proactive approach to occupational safety has the potential for averting occupational accidents across industries and thereby will foreseeably prevent the injuries that undermine the well-being of millions of American workers and their families.