MINDS IN SYNC: EXPLORING THE NEXUS OF HUMANS ON A CHIP AND WEARABLE TECHNOLOGIES ON COGNITIVE MEASURES OF HUMAN PERFORMANCE

An Applied Risk Assessment Methodology For Identification, Prioritization, And Mitigation Of Adverse Events From Emerging Neurotechnology

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Background: Neuroscience and neurotechnological advances are at an inflection point in their potential for neuromodulation, brain machine interfaces, and neural prostheses for research, therapeutic, and augmentation purposes. Key capabilities driving technological innovation and progress in the field of neuromodulation are device miniaturization, increased complexity of tasks that can be implemented, and an improved understanding of neural response to stimulation. These drivers are fed by increasing computational power, increased data acquisition and processing, better communication technologies, nanotechnology, biomaterial advances, and national-level research projects seeking breakthroughs in understanding the brain. However, preparedness for the widespread availability and adoption of neurotechnology, facilitated by enabling technologies, remains largely a policy and regulation problem, without sufficient technical safety and security measures.
Technical methods to detect, prevent, and mitigate risks from the implementation and adoption of emerging neuroscience and neurotechnical advances are urgently needed to secure and assure future use of these tools. The ability to define ever more complex physiologic and pathophysiologic states and connect them with potential impacts must be addressed. Designing neuroscience tools with security and functional assurance in mind will be of paramount importance.

Objective: While the promises the neuroscience and neurotechnology field holds are great, the adoption and integration of these tools across end user groups will bring also new risks across these spaces. We sought to identify gaps in security and assurance measures for converging and emerging tech areas that center on novel neuroscience and neurotech that may present a slew of novel and unaddressed risks. With these risks laid out, security measures for mitigating or preventing these risks can be explored for feasibility and can be prioritized using an integrated deterrence-informed consideration of the technical gaps. Early requirements and security method integration into these emerging tools will be much easier to achieve than retroactively imparting security.

Methods and results: A risk analysis based approached to understand the potential vulnerability mechanisms and consequences of concern for the span of neurotechnology tools was developed. This enabled a relative prioritization of scenarios, and we identified potential detection and interdiction methods for the higher priority disruptions.

Impact: In order to predict cognitive and human health performance, we need technologies that have clear functional baselines, are robust to environmental changes, and that can assure function and status during human machine teaming or in augmentation regimes. This study lays the foundation for identification of risks and solution methods for these emerging tools. Future directions include the initial development of security methods laid out in this effort.

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