Title: Precision and Transparency in EEG-Based Neurosensory Research: Individualised Single-Trial Estimation and Multiverse Methodology

Authors: Cassie Ann Short[1,2], Andrea Hildebrandt[1,2]

[1]Department of Psychology, School of Medicine and Health Sciences, Carl von Ossietzky Universität Oldenburg, Germany
[2]Forschungszentrum Neurosensorik, Carl von Ossietzky Universität Oldenburg, Germany

Abstract: Electrophysiological (EEG) neurosensory science relies on the precision and interpretability of EEG signal estimates in order to understand how individuals perceive and process sensory information. However, conventional EEG analysis pipelines often apply fixed spatial and temporal parameters to all trials within a task and to all individuals within a sample, which does not account for between- and within-person variability. This 'one-size-fits-all' approach can limit the reliability and validity of EEG-derived neurometrics, particularly in individual differences research. In this poster, I present two interrelated research areas aimed at improving the robustness and individual-level precision of neurosensory measurements. First, I introduce individualised, single-trial EEG parameterisation methods that adapt to variability in neural response timing and topology, and their psychometric evaluation, enabling more accurate estimation of sensory and cognitive processes across individuals. Second, I highlight my work on multiverse analysis in EEG research, which systematically quantifies the analytical flexibility inherent in preprocessing and analysis pipelines. By transparently reporting robustness across defensible alternatives, this approach reduces uncertainty in reported results. Together, these methods contribute to a more psychometrically informed and computationally rigorous foundation for neurosensory research, with implications for both basic science and translational applications such as individualised diagnostics and treatment evaluation.