



## **Resting-State EEG Biomarkers in Adult-Onset PTSD**

### *Exposé of Ben Erdeli's Master's Thesis*

Post-traumatic stress disorder (PTSD) represents a serious global health issue that is associated with significant individual, social, and economic consequences (e.g. Balayan et al., 2014; Scoglio et al., 2022; von der Warth et al., 2020). Triggered by traumatic events such as war, sexual violence, natural disasters, or severe accidents, PTSD is characterized by persistent symptoms including re-experience of the traumatic event, avoidance of trauma-related stimuli, trauma-related negative thoughts or feelings, and trauma-related arousal and reactivity. According to the Diagnostic and Statistical Manual of Mental Disorders – Fifth Version – Text Revision (DSM-5-TR), a diagnosis of PTSD requires that these symptoms persist for more than one month, cause significant distress or functional impairment, and are not attributable to medication, substance use, or another illness (American Psychiatric Association [APA], 2022).

PTSD is currently diagnosed based on self-reported symptoms and clinical interviews, following diagnostic classification systems such as the DSM-5 or the International Classification of Diseases – 10th Revision (ICD-10), as recommended by evidence-based clinical guidelines (Department of Veterans Affairs & Department of Defense, 2023; National Institute for Health and Care Excellence, 2018; Phoenix Australia – Centre for Posttraumatic Mental Health, 2013; Schäfer et al., 2019). However, it is questionable whether a diagnostic approach based solely on the criteria of the DSM-5 or ICD-10 is sufficient to allow for a nuanced diagnosis of mental disorders such as PTSD (Galatzer-Levy & Bryant, 2013; Newson et al., 2021). This critique is embedded in

longstanding calls for reform in psychiatric diagnostics, which emphasize the need for approaches that better capture the complexity and heterogeneity of mental disorders. This perspective is reflected, for example, in the Research Domain Criteria (RDoC) framework as an alternative to DSM and ICD. Instead of symptom-based categories, RDoC focuses on dimensional constructs across neurobiological, behavioural, and cognitive systems, integrating multiple levels of analysis to improve diagnostic validity and support more precise, personalized treatments (Cuthbert, 2014).

Building on this multi-level conceptualization of mental disorders, neuroimaging techniques have become increasingly important for empirically linking brain structure and function to cognitive and behavioural domains, as proposed by the RDoC framework (Etkin, 2019; Insel et al., 2010). Among these neuroimaging techniques, electroencephalography (EEG) is particularly valuable in both research and clinical contexts. It provides direct, real-time measurements of neuronal activity with high temporal resolution, making it well-suited for investigating the dynamic properties of brain function, such as oscillatory activity. Oscillatory activity refers to rhythmic fluctuations in neuronal activity, where groups of neurons repeatedly increase and decrease their activity in a coordinated, cyclical pattern over time (e.g., brain waves at different frequencies). In addition, compared to other techniques like functional magnetic resonance imaging (fMRI) or positron emission tomography (PET), EEG is relatively inexpensive, portable, and non-invasive, which enhances its applicability across diverse populations and clinical settings (Biasiucci et al., 2025). EEG can be recorded in different conditions, each providing distinct information about brain function. While task-related and sleep EEG capture evoked activity and sleep-related processes, respectively, resting-state EEG (rsEEG) is particularly useful for examining the brain's intrinsic functional organization in the absence of a specific task while being awake (Blinowska & Durka, 2006; Mueller-Putz, 2020).

While recent rsEEG studies have begun to reveal altered neurophysiological patterns in PTSD, particularly in terms of oscillatory activity, the overall number of investigations remains

limited, and the findings to date are mixed and inconclusive. Compared to other psychiatric conditions such as ADHD or depression, the field is still in an early stage of systematically characterizing the neurophysiological correlates of PTSD using rsEEG (Clarke et al., 2020; Newson & Thiagarajan, 2019). In addition, most rsEEG studies to date have been conducted in Western, Educated, Industrialized, Rich, and Democratic (WEIRD) populations. As emphasized by Tindle (2021) and Caspar (2024), psychological and neural processes are shaped by sociocultural and environmental factors, and findings derived solely from WEIRD samples may lack cross-cultural validity. To address this gap, the present work is guided by two main research questions: (1) To what extent is PTSD and its symptom severity associated with rsEEG oscillatory activity? (2) Can findings on rsEEG oscillatory activity in PTSD, primarily derived from WEIRD samples, be replicated in a non-WEIRD sample from rural Rwanda?

To investigate these questions, a unique dataset collected in rural Rwanda in 2021 by Emilie A. Caspar and colleagues will be analysed. It comprises 108 family dyads (N = 216), each including one individual officially recognized either as a genocide survivor or as a former genocide perpetrator, and one of their offspring aged between 15 and 35 years. Participants were instructed to relax and avoid focusing on any particular thoughts during the five-minute rsEEG recording, which alternated between 20-second eyes-open fixation-cross and 40-second eyes-closed conditions. Continuous EEG activity was recorded from the scalp using a 64-channel electrode cap with the ActiveTwo system (BioSemi) which was placed according to the 10-20 system and sampled at 2048 Hz. Followingly, participants completed the Post-Traumatic Stress Disorder Checklist – Civilian Version (PCL-C; Fodor et al., 2015), providing total PTSD symptom severity and symptom cluster scores for intrusion, avoidance/numbing, and arousal. Additional information on participant recruitment, data acquisition procedures, and relevant contextual background is provided in Caspar et al. (2022).

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