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Exploring the evolution of users' subjective ratings in three Motor Imagery (MI)-based BCI sessions

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Abstract

Many challenges remain to understand user-BCI interactions and make them easier, more effective, and more enjoyable - especially for Motor Imagery (MI)-based BCI (1).
Past research in MI without feedback showed possible relations between prolonged practice (time) and decreased EEG features separability or increased subjective effort and mental fatigue (e.g. (2)). In MI-BCI applications, varying results (e.g. (3–9)) suggest an unclear relationship between online performance and user subjective ratings e.g. fatigue or performance auto-evaluation. Often, studies show either very few subjects or one single session. Thus, how user experience evolves during standard training, both within- and between-session is still unclear.

Therefore, we investigated how users' subjective ratings vary in relation to time or online performances when training with the standard Graz cue-based MI-BCI (10).

24 participants engaged in 3 sessions of 12 short runs. Each short run (16 trials/run) was followed by self-reported ratings (Frustration, Anxiety, MentalDemand, SubjectivePerformance, MentalEffort, and MentalFatigue).

Statistical analysis indicated a significant time effect for user ratings, with an increase within-sessions of Frustration, MentalDemand, MentalEffort, and MentalFatigue. Session 1 was rated significantly more challenging than the other two regarding Frustration, Anxiety, MentalDemand, MentalEffort, and MentalFatigue. This highlights the importance of conducting studies across multiple sessions. BCI performances did not correlate with subjective ratings.

We provide a ground truth in a standard training paradigm to help elucidate the possible

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relationships between time, performance, and user ratings during prolonged BCI operation by novice users.

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