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► **To cite this version:**

Pauline Dreyer, Aline Roc, David Trocellier, Marc Welter, Raphaëlle N Roy, et al.. Investigating EOG markers of fatigue during motor imagery BCI tasks. Cortico 2024 - Collectif pour la Recherche Transdisciplinaire sur les Interfaces Cerveau-Ordinateur, May 2024, Nancy, France. hal-04579558

HAL Id: hal-04579558

<https://hal.science/hal-04579558>

Submitted on 17 May 2024

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INVESTIGATING EOG MARKERS OF FATIGUE DURING MOTOR IMAGERY BCI TASKS

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Brain-Computer Interface (BCI) performance is known to fluctuate due to the interaction of several potential sources of variability such as context, time and day, including intra-subject factors as user engagement and mental fatigue. While often measured by subjective reports, mental fatigue can also be assessed by blink parameters extracted from electro-oculography signals. In particular, frequency, duration, amplitude, opening and closing times are well known indicators of arousal. To our knowledge, no study has yet evaluated blink parameters during motor imagery (MI) BCI use to assess the potential development of mental fatigue. In this study we analysed the blinks of 23 MI-BCI participants using MNE Python and NeuroKit2. This analysis was performed alongside subjective reports (e.g. of fatigue or frustration) obtained through questionnaires and BCI performance. Our results showed that blink parameters were correlated with neither MI-BCI performance nor subjective reports. However, they revealed a positive correlation between time-on-task and both blinks number and mean duration (see Figure 1).

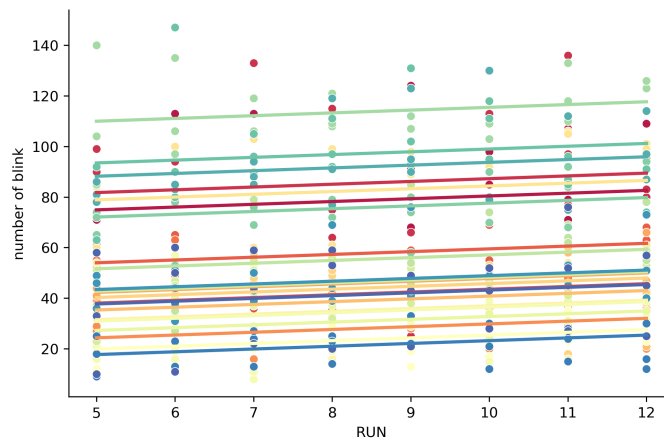


Figure 1: Repeated measure correlation between the overall number of blinks per run and time-on-task (as measured by the run index) per participant, $r=0.178$, $p<0.0005$ (one colour per participant).

Similarly, subjective fatigue was correlated with time on task, suggesting that a BCI session becomes increasingly tiring as time on task increases. However, in this context of MI-BCI (based on visual cues and feedback), blink parameters may be affected more by visual fatigue than by mental fatigue. Another notable finding is the slight negative correlation observed between frustration levels, performance and blink duration. This may suggest that increased frustration may result from suboptimal MI-BCI performance, leading users to increase their focus on the task. Altogether, this study shows that blink parameters reflect time-on-task. Overall, while blink parameters may be useful for BCI user monitoring, further studies are needed to fully understand the link between MI-BCI performance, subjective measures of mental state and EOG-related blink parameters.