Temporal and spectral electrooculographic features in an aiming task

Gallicchio, Germano; Ryu, Donghyun; Tasker, Guy; Krishnani, Mudit; Pecunioso, Alessandra; Jackson, Robin

Published: 01/07/2022

Abstract of Contribution 518

ID: 518
Poster presentation
Topics: Research methods (qualitative & quantitative)
Keywords: psychophysiology, electrooculography (EOG), eye tracking (ET), quiet eye (QE)

Temporal and spectral electrooculographic features in an aiming task

Germano Gallicchio[1], Donghyun Ryu[2], Guy Tasker[2], Mudit Krishnani[2], Alessandra Pecunioso[3], Robin Jackson[2]
[1]Bangor University, United Kingdom; [2]Loughborough University, United Kingdom; [3]University of Padova, Italy

Electrooculography (EOG) studies in sport have focused on temporal oculomotor features such as the duration of the quiet eye (QE) period—the final fixation on the action's visual target. On the one hand, it is unclear whether EOG can provide valid QE measurements due to its poor spatial resolution relative to eye tracking (ET). On the other hand, due to its high temporal resolution, the EOG is better suited for time-frequency spectral decomposition. In this study, we aimed to (1) examine which EOG signal processing options and algorithm (based on EOG-position or EOG-velocity) yield the most valid QE measurements, (2) introduce a novel method—the EOG spectrogram—that describes both temporal and spectral oculomotor features, and (3) rank the utility of four oculomotor measures (QE-ET, QE-EOG-position, QE-EOG-velocity, EOG spectrogram) for predicting motor performance on unseen data. We co-recorded EOG and ET while 16 participants with varying expertise putted golf balls to a 4-m distance target on a flat surface. Concurrent validity and temporal discrepancy analyses revealed that QE-EOG-position and QE-EOG-velocity are valid and accurate for certain processing options (channel, filter, thresholds). The EOG spectrogram—obtained through multitaper Fast-Fourier-Transform—distinguished lower-frequency activity (saccades) and higher-frequency activity (fixational activity) before and during movement execution. Nested cross-validation estimated that the EOG spectrogram yielded the lowest generalization error and the greatest stability on unseen data, followed by a tie between QE-ET and QE-EOG-velocity, and then by QE-EOG-position. Correlational analyses suggested a monotonic association between better motor performance and greater EOG high-frequency fixational activity (> 25 Hz) during movement execution.