

Algorithm for Predicting Cognitive Exertion and Cognitive Fatigue Using a Portable EEG Headset for Concussion Rehabilitation

Authors : Lou J. Pino, Mark Campbell, Matthew J. Kennedy, Ashleigh C. Kennedy

Abstract : A concussion is complex and nuanced, with cognitive rest being a key component of recovery. Cognitive overexertion during rehabilitation from a concussion is associated with delayed recovery. However, daily living imposes cognitive demands that may be unavoidable and difficult to quantify. Therefore, a portable tool capable of alerting patients before cognitive overexertion occurs could allow patients to maintain their quality of life while preventing symptoms and recovery setbacks. EEG allows for a sensitive measure of cognitive exertion. Clinical 32-lead EEG headsets are not practical for day-to-day concussion rehabilitation management. However, there are now commercially available and affordable portable EEG headsets. Thus, these headsets can potentially be used to continuously monitor cognitive exertion during mental tasks to alert the wearer of overexertion, with the aim of preventing the occurrence of symptoms to speed recovery times. The objective of this study was to test an algorithm for predicting cognitive exertion from EEG data collected from a portable headset. EEG data were acquired from 10 participants (5 males, 5 females). Each participant wore a portable 4 channel EEG headband while completing 10 tasks: rest (eyes closed), rest (eyes open), three levels of the increasing difficulty of logic puzzles, three levels of increasing difficulty in multiplication questions, rest (eyes open), and rest (eyes closed). After each task, the participant was asked to report their perceived level of cognitive exertion using the NASA Task Load Index (TLX). Each participant then completed a second session on a different day. A customized machine learning model was created using data from the first session. The performance of each model was then tested using data from the second session. The mean correlation coefficient between TLX scores and predicted cognitive exertion was 0.75 ± 0.16 . The results support the efficacy of the algorithm for predicting cognitive exertion. This demonstrates that the algorithms developed in this study used with portable EEG devices have the potential to aid in the concussion recovery process by monitoring and warning patients of cognitive overexertion. Preventing cognitive overexertion during recovery may reduce the number of symptoms a patient experiences and may help speed the recovery process.

Keywords : cognitive activity, EEG, machine learning, personalized recovery

Conference Title : ICSCTBI 2021 : International Conference on Sports Concussion and Traumatic Brain Injury

Conference Location : Budapest, Hungary

Conference Dates : August 23-24, 2021