

Assessing reliability and sensitivity of the Psychomotor Vigilance Task in a long-term longitudinal study of sleep EEG: the impact of task length on sleep-related measures.

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SUBMISSION DETAILS

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Methodological Issue Being Addressed The present study aimed at investigating the reliability and sensitivity of various reaction time (RT) variables obtained from the Psychomotor Vigilance Task (PVT) in a longitudinal dataset, while assessing the impact of task length on sleep-related measures.

Introduction The PVT is a RT task widely implemented in clinical research for its effectiveness in measuring sustained attention without practice effects, while being sensitive to sleep quality. Although RT data has been traditionally analysed with simple indices (e.g., mean RT, or RT > 500ms), modern approaches have shown the importance of alternative variables such as response variability, or linear changes over time. The reliability and sensitivity to sleep quality of these variables is, however, yet to be determined. Furthermore, multiple versions of the task with differing number of trials exist, which may impact the validity of the task.

Methods 25 participants performed a 45-trials PVT with variable compliance for a maximum of 399 sessions over a span of 459 days of testing. An implanted two-channel subcutaneous EEG provided an objective index of total sleep time.. Daily subjective sleep quality was obtained with the Karolinska Sleepiness Scale questionnaire. Multiple variables were obtained from the RT data including traditional metrics, Ex-Gaussian distribution parameters, performance change over time and percentile-based indices. Reliability was firstly investigated by determining the stability of the variables by linear modelling which provided an indication of the longitudinal changes over testing sessions, then by Intraclass correlation (ICC) analysis. ICC was obtained separately using whole individuals' datasets, and using data from both consecutive and cumulative random sessions for each variable. Sensitivity to sleep indices was determined with multi-level modelling. Finally, the impact of task-length was determined both on reliability and sensitivity.

Results The first analysis tested whether Ex-Gaussian parameters showed any changes over longitudinal testing and showed that tau (attentional lapses) increased over time. The effect size was however small ($\beta = 0.10$), which confirmed the absence of practice effects in PVT. In terms of ICC, the most reliable variables were speed (mean 1/RT, ICC = 0.79), mean RT excluding lapses (RT below individuals' 80th percentile, ICC = 0.77) and mean RT including lapses (ICC = 0.74). The same patterns were obtained when looking at ICC longitudinally, which showed stability over testing sessions. Sensitivity analysis to sleep indices highlighted the importance of measures of mean RT: highest effect sizes were shown in total sleep time by mu (Ex-Gaussian mean, $\beta = 0.041$) and mean RT excluding lapses ($\beta = 0.026$); whereas in subjective sleep quality by speed ($\beta = 0.073$) and mean RT excluding lapses ($\beta = 0.069$). Finally, the impact of task-length on RT variables

was significantly reduced after 15 trials, and it did not interact with reliability and sensitivity.

Conclusion The present study highlighted the importance of several PVT variables of mean RT both in terms of reliability and sensitivity. Furthermore, it indicated that reliable and stable measures could be obtained with just 15 trials, suggesting that shorter versions of the task may be effectively implemented in future investigations which require less-demanding cognitive testing.

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