

Reduced attention allocation during short periods of partially automated driving: An event-related potentials study

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Research on partially automated driving has revealed relevant problems with driving performance, particularly when drivers' intervention is required (e.g., take-over when automation fails). Mental fatigue has commonly been proposed to explain these effects after prolonged automated drives. However, performance problems have also been reported after just a few minutes of automated driving, indicating that other factors may also be involved. We hypothesize that, besides mental fatigue, an underload effect of partial automation may also affect driver attention. In this study, such potential effect was investigated during short periods of partially automated and manual driving and at different speeds. Subjective measures of mental demand and vigilance and performance to a secondary task (an auditory oddball task) were used to assess driver attention. Additionally, modulations of some specific attention-related event-related potentials (ERPs, N1 and P3 components) were investigated. The mental fatigue effects associated with the time on task were also evaluated by using the same measurements. Twenty participants drove in a fixed-base simulator while performing an auditory oddball task that elicited the ERPs. Six conditions were presented (5-6 min each) combining three speed levels (low, comfortable and high) and two automation levels (manual and partially automated). The results showed that, when driving partially automated, scores in subjective mental demand and P3 amplitudes were lower than in the manual conditions. Similarly, P3 amplitude and self-reported vigilance levels decreased with the time on task. Based on previous studies, these findings might reflect a reduction in drivers' attention resource allocation, presumably due to the underload effects of partial automation and to the mental fatigue associated with the time on task. Particularly, such underload effects on attention could explain the performance decrements after short periods of automated driving reported in other

studies. However, further studies are needed to investigate this relationship in partial automation and in other automation levels. © 2017 Solís-Marcos, Galvao-Carmona and Kircher.

Automated driving

Event-related potentials

Mental fatigue

N1

P3

Speed

Underload

adult

alertness

Article

attention

auditory evoked potential

auditory oddball task

automated driving

car driving

dysthymia

event related potential

female

fixed based simulator

human

human experiment

male

manual driving

mental performance

mental task

normal human

reduced attention allocation

resource allocation

self report

time

velocity

young adult