StayAwake_BCI Experimental Design

Vaibhav Agarwal
University of South Florida
Vagarwal1@mail.usf.edu

1. PROBLEM STATEMENT

With the advent of better and faster means of transportation, there has been a rapid rise in the use of personal vehicles for daily commute. However, this means more automobiles, henceforth, more accidents on the road. Out of all accidents that take place each year in the US alone, a shocking 328,000 happen because of drivers falling asleep behind the wheel. This when calculated amounts to roughly 25% of all accidents, in US alone. To top it all off, there are no good solutions available out there for this. When you search online for things that help you stay awake while driving, you find tips like proper rest, caffeine, energy drinks, loud music, etc. However, the problem with all this is that these means are very unhealthy and thus highly unsustainable. This paper tries to fashion a better solution towards this concern that faces our society today.

2. ONE RESEARCH QUESTION

'How can a BCI be used to reengage drivers when they start to feel drowsy while driving?'

3. One Hypothesis with its null hypothesis

Hypothesis: A BCI can reengage user concentration levels by providing a feedback of user engagement levels while driving on the road.

Null Hypothesis: Attention directed towards anything, not specifically on the road, can have same feedback from the BCI.

4. Variables: Independent and dependent

Independent Variable: Training the BCI for establishing user subjective baselines for determining optimum level of engagement for that specific driver.

Dependent Variable: Value of brain wave frequency data.

5. Type of Experimental Design

User engagement data acquired during experimental driving conditions against driver states of engagement and focus.

6. Experimental Tasks

Getting User Engagement values while driving under-

- routine driving conditions
- long/monotonous drives
- paying attention to something else
- feeling drowsy
- with BCI feedback

7. Experimental Procedure

- Establishing baseline values by training BCI for user specific brain wave frequencies. This is done by recording brain data under day-to-day conditions

using commands like stay neutral, try to focus, etc.

- Finding optimum user engagement level required while driving. This is done by recording test day while driving under ideal driving conditions. (Proper daylight, proper rest, etc.)
- Recording data while user is on long drives, monotonous drives, and while driving during the night.
- Collecting same engagement values while user is feeling drowsy/ has not taken proper rest. This will serve as a substantiation addressing to the problem statement.
- This will be final step towards recording data which will include providing user feedback of their engagement levels while they drive in form of a screen display of ideal and current engagement levels. This can also include creating alerts/notifications if engagement value drops to a certain level or matches test data from previous experiment. This will serve to prove/disprove the presented hypothesis and answer the research question.

8. Type of data that will be collected

Collected data will include three specific brain frequencies (alpha, beta and theta) which will be used to calculate Engagement Levels [2]. Data like driving conditions, user state while/before driving will also be monitored.

9. References

1. "STEER: Wearable Device That Will Not Let You Fall Asleep." *Kickstarter*, www.kickstarter.com/projects/creativemode/steer-you-will-never-fall-asleep-while-driving.

2. Pope, A T, et al. "Biocybernetic System Evaluates Indices of Operator Engagement in Automated Task." *Biological Psychology.*, U.S. National Library of Medicine, May 1995, www.ncbi.nlm.nih.gov/pubmed/7647180.

3. "How to Stay Awake on the Road: Tips to Combat Drowsy Driving." *National Sleep Foundation - Sleep Research & Education*, www.sleepfoundation.org/excessivesleepiness/sleep-news/how-stay-awake-the-road-tips-combat-drowsy-driving.

4. "Classification of Driver Fatigue State Based on EEG Using Emotiv EPOC+" Http://Ljournal.ru/Wp-Content/Uploads/2017/03/a-2017-023.Pdf." 2017, doi:10.18411/a-2017-023.