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Ángel Serrano Alarcón and Andrei Boiko

Estimation of Stress Perception Using Mobile Devices and Emotional Stability in Students while Driving in a Simulator

Wilhelm Daniel Scherz[1] [0000-0002-5435-2349], Ralf Seepold[1] [0000-0002-5192-2537], Natividad Martínez Madrid[2] [0000-0003-1965-9481] and Juan Antonio Ortega[3] [0000-0001-9095-7241]

Abstract. The purpose of this paper is to examine the effects of perceived stress on traffic and road safety. One of the leading causes of stress among drivers is the feeling of having a lack of control during the driving process. Stress can result in more traffic accidents, an increase in driver errors, and an increase in traffic violations. To study this phenomenon, the Stress Perceived Questionnaire (PSQ) was used to evaluate the perceived stress while driving in a simulation. The study was conducted with participants from Germany, and they were grouped into different categories based on their emotional stability. Each participant was monitored using wearable devices that measured their instantaneous heart rate (HR). The preference for wearable devices was due to their non-intrusive and portable nature. The results of this study provide an overview of how stress can affect traffic and road safety, which can be used for future research or to implement strategies to reduce road accidents and promote traffic safety.

Keywords -- Stress, Worries, Heart Rate, Stress Perceived Questionnaire (PSQ).

I. INTRODUCTION

The purpose of this study is to investigate the estimations of stress perception and emotional stability while driving in a simulator while using a mobile device and show the different emotional states and the perceived stress of different drives while. Road safety and stress have a relationship. Drivers may experience stress when they feel they are unable to handle the driving process or are losing control. Stress can be defined as a psychological factor that, on high levels, has long-term adverse effects on the heart [1], and extreme acute levels of stress can induce immune dysfunctions [2] and even trigger panic attacks [3]. These can be hazardous for traffic safety because they can lead to unexpected and difficult-to-manage circumstances. The daily presence of stress is not necessarily seen as a negative element but more a mechanism to cope and react fast to demanding situations [4].

Stress can be defined as a mechanism that is active in the presence of danger or situations that demand height attention and fast response. Stress helps us to react faster to these situations and reorganizes body functions prioritizing functions that help us achieve maximal reaction and performance [4]. Stress is helpful in our daily life to cope with demanding situations, and triggers that can induce stress are called stressors. In additionally to the previously mentioned effects of stress, there are also negative severe long-term effects of high levels of stress like difficulties responding adequately to fiscal, mental, and emotional demands [5-8], also known in burnouts and cardiac diseases [9-10].

II. METHODS

The study consists of five male and female volunteer participants from the university student population. The age range of the participants was between 18 and 35 years old. The selection criteria were: the volunteers had to be healthy, have no cardiac health problems influencing the heart variability, and have good vision. The participants underwent two phases of the experiment, which were conducted using a driving simulator. In the experiment first phase, the volunteer had to answer a Stress Perceived Questionnaire (PSQ) and listen to relaxing music. In the second phase, the volunteers were asked to drive in the simulator, taking on a range of tasks, such as maintaining a safe speed, using the brakes correctly, and navigating a course over a period of 25 minutes.

Additionally, some random situations that induce stress were created. In both phases, the heart rate was collected and stored. Both phases were conducted over a period of 30 minutes.
Each volunteering participant was equipped whit a chest strap that collected different biocidal parameters. In this study, we focused on the Heart rate and R-R Intervals. The R-R interval is the time between two beats. As a result of this study, a tendency between worries and the subject experienced stress while driving in a simulator is expected. Depending on the answers given in the Stress Perceived Questionnaire (PSQ), the volunteer will be categorized into one of the three levels of worries and stress. The results should help to compare the relationship between worries and perceived stress.

The Stress Perceived Questionnaire (PSQ) is one of the most commonly used questionnaires for the estimation of personal stress [11]. In this context, stress is defined as the strain people perceive when they feel their needs are too much to handle.

[1] HTWG Konstanz, Alfred-Wachtel-Str. 8, 78462 Konstanz, Germany
{wscherz,ralf.seepold}@htwg-konstanz.de
[2] Reutlingen University, Alteburgstr. 150, 72762 Reutlingen, Germany
natividad.martinez@reutlingen-university.de
[3] University of Seville, San Fernando 4, 41004 Sevilla, Spain
jortega@us.es

The driving simulator used in the study implements realistic car physics and allows the configuration of the behavior of pedestrians and other drivers and customization of the traffic density.

III. Results

The results of the experiment revealed some tendencies of the volunteers, showing that most of the volunteers are generally not very worried (see Fig. 1). Fig. 1 shows that most of the volunteers were in the group with fewer worries from 0 to 33,33% to middle worries and the group of 33,34 to 66,67%. Table 1 shows the percentage of volunteers who have experienced different worries levels. 37,5% of the volunteers have a low level of worries, 37,5% have a medium level of worries, and 25% of people have a high level of worries. Although the participants reported a higher stress level when driving the simulator compared to listening to relaxing music. Table 2 shows the reported stress levels and the measured RMSSSD for each category. Table 2 indicates that 25% of the students have a low level of stress whit in an RMSSD score between 91,043 and 70.430, 25% have a medium level of stress whit in an RMSSD between 70,430 and 49,818 and 50% of the students reported a high level of stress whit an RMSSD between 49,818 and 29,205.

TABLE 1. WORRIES OF STUDENTS.

Worries Level	**%**
Low	37,5%
Medium	37.5%
High	25,0%

TABLE 2. REPORTED STRESS OF STUDENTS.

Stress Level (RMSSd)	**%**	**RMSSD**
Low	25,0%	91,043-70,430
Medium	25.0%	70,430-49,818
High	50,0%	49,818-29,205

IV. Discussion

The small sample size of the studies limits the reliability of the results. The results of this study show a tendency that driving in a simulator whit randomized traffic conditions has a negative effect on stress levels. The results could indicate that this situation imposes the driver with extra demands, resulting in an increment of stress. This suggests that drivers that reported a medium or higher level of worries might feel more stressed than those who reported less worried. It appears that drivers with higher levels of worry may experience more stress than less worried drivers. It might also suggest that it is essential to consider the effects of stress and worries when road safety is a concern.

Additionally, it is visible that the calculated RMSSD behaviors are very similar. As seen in table 2, the groups of volunteers that reported higher perceived stress also had a lower RMSSD.

Due to the limited amount of collected data, the effects of driving with different levels of stress and worries and their influence on road safety have to be explored more deeply and in detail. Due to the particular smal data size used in this experiment, it is important to mention that the result might not be generalizable. However, further research is needed and planned to confirm this tendency due to the limited data sample.

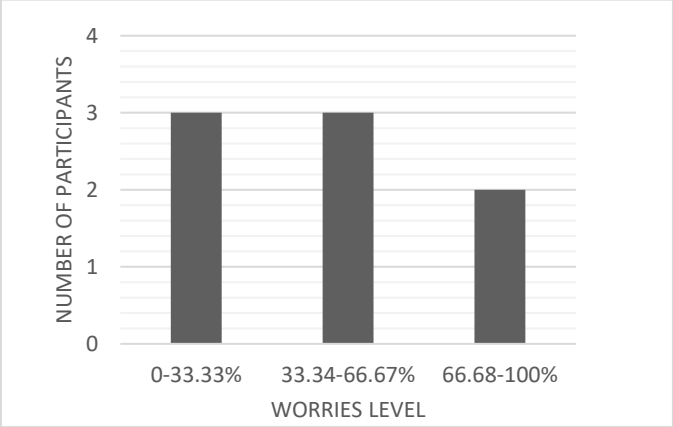

Fig. 1. Distribution of participants

V. Conclusion

Overall this study highlights shortly the importance of understanding the relationship between stress and worries and the need for future research to understand the relationship between stress and worries better. The study also shows the importance of reducing the negative impact of stress on worries.

The results suggest that driving in a simulator with randomized traffic situations can affect stress levels negatively. Additionally, it suggests that worried drivers are more prompt to feel more stress and, consequently, have a higher risk of causing a road accident and reducing traffic safety.

In addition, future studies should also look at the effects of different personality traits on traffic and driver safety and determine the relationship between personality traits and the effects of stress and could explore how interventions such as stress management training or cognitive-behavioral therapy could reduce stress levels and lead to an increment on road safety and safer driving. Finally, future studies can also help to understand how stress manifests differently in various populations and how to tailor intervention strategies depending on different personality traits to address various needs.

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