The level of driver personality and stress experienced as factors influencing behavior on the road

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Abstract

The aim of the study was to describe the relationship between personality traits, stress levels, and the way of participating in the traffic. The authors wish to draw attention to the fact that the nature of man and the way how he/she copes with stressful situations can have a decisive influence on behavior on the road. The study group included 25 active professional drivers, with the right to conduct trucks (driver license cat. C and C + E), in good psychophysical condition. Studies were conducted in the laboratory, simulated (truck driving simulator) and in real conditions. In the laboratory, participants performed psychological tests aimed at identifying the characteristics of personality, the estimation of psychomotor skills and the level of stress and how to deal with it. For this purpose, test and questionnaire methods were used, including the Vienna Test System, Impulsiveness Questionnaire – Impulsiveness, Venturesomeness, Empathy (IVE), Perceived Stress Scale–10 (PSS-10), Coping Questionnaire in stressful situations (CISS). The results helped to confirm the assumption about the essential relationship between personality characteristics, the level of stress experienced, and the way of participating in the traffic. Studies have shown, among other things, that a high level of stress is associated with a tendency for people to make mistakes. The authors therefore point out the necessity of reducing the stress and tension of drivers, which may lead to wrong decisions, and thus result in dangerous behavior.

Keywords: personality, stress, road safety, style of coping with stress.
1 Introduction

Previous research shows that car accidents are the main cause of disability and death of road traffic participants out of which up to 90% of road incidents are caused by driver behavior [1]. In the face of the abovementioned statistics, it is of utmost importance to discover the factors which determine how vehicle users behave.

A driver participating in the road traffic finds himself/herself in a whole system of reciprocal influences of many stimuli which may be a potential source of stress. Literature provides various conceptualizations of the term “stress”. Hans Selye (in [2]) described stress as a non-specific reaction of the organism to demands and environmental requests. The response of the organism to these demands is strongly connected to memory processes, attention and psychomotor performance [3]. Driver’s stress occurs when the road user perceives their driving ability as insufficient to react appropriately to appearing stimuli. Such impressions are frequently accompanied by negative emotions, inter alia aggression, frustration, anxiety and hostility [4]. Research shows that there is a link between stress felt while driving and safe behavior on the road. High level of anger causes loss of control over the vehicle and decrease of attention and concentration of the driver. Additionally, in young drivers, a high level of aggression combined with a low empathy level leads to failure to comply with traffic regulations, speeding and drunk driving among others [3, 5].

The occupation of a driver is linked with specific work environment, i.e. irregular schedule, driving very long distances, shift work and maintaining vigilance [6, 7]. Tiredness, caused by, among others, driving car at night, can be another stressor to road traffic participants. Research shows that chronic sleep insufficiency and growing sleepiness connected with driving long distances are one of the most common causes of car accidents. Akerstedt et al. [8] compared task performances in drivers in a full rest state and after a night shift at work. It was proven that driving after a night shift resulted in more frequent transgressions of lane marking and increased risk of car accident by four times.

Stress resulting from driving a car is an outcome of combination of personal variables such as: age, sex, experience in driving a car [9, 10]. Driver personality can be described as a set of mechanisms concerning road traffic rules and within given driving license category [11]. There is a number of studies in literature addressing the link between personality and behavior on the road. It has been found so far that male drivers and drivers with shorter experience express anger in a stronger way [3, 5]. Women driving vehicles and elderly people cope better with the consequences of anger experienced and do not have to vent it on other traffic participants. Research on the link between personality traits and safe behavior on the road showed that drivers who made more mistakes on the road were characterized by a higher level of impulsiveness and empathy [12].

There are universal stimuli which cause stress but many of them may be perceived by people as a threat, depending on their personal life situation and competences to cope with that challenge. Lazarus paid attention to the nature of efforts made by people to reduce or remove the stress and described the
phenomenon as coping with stress [2]. Based on a transactional model, three basic styles of coping were identified: task-oriented, emotion-oriented and avoidance-oriented [7, 13, 14].

Task-oriented style (TOS) characterizes people who take efforts leading to solution or planning of solving strategy in stressful situations. The individual puts major emphasis on the task at hand and tries to change that situation or solve the problem by cognitive reappraisal.

Emotion-oriented style (EOS) characterizes people who have a tendency to concentrate on own emotional experience, i.e.: sense of guilt, anger, anxiety. Such individuals often have a tendency to fantasizing and wishful thinking, which are supposed to decrease emotional tension caused by a stressful situation. Sometimes it has a paradoxical outcome, increasing the level of stress experienced as well as sadness and tension.

Avoidance-oriented style (AOS) describes people who in the face of a stressful situation do not try to solve the problem. Instead, they avoid living, thinking about and experiencing burdening situations. This style has a two distinct forms: engaging in surrogate activities (distraction) and searching for social activities (social diversion). Distinguished styles are independent from each other (with the exception of distraction and social diversion which are both subforms of AOS).

Choice and use of a particular coping strategy depends on the type of stressor, social context in which coping takes place and personality traits of the person involved [9]. Kuhlmann [7] showed that bus and tram drivers use task-oriented strategy more often in case of stress experienced at work. It probably results from the fact that stress at work does not only concern personal, individual problems but also stressful episodes, humans and incidents included, for example: accidents. If, on the other hand, drivers experience restlessness and anxiety, they tend to use the emotion-oriented strategy [15].

2 Materials and methods

2.1 Participants

The study group included 25 active professional drivers (N=25), with the driver right to conduct trucks (driver license category C and C+E). Participants were male, aged 23–50 (M=33.36; SD=7.29), out of which 14 drivers lived in the village, 7 drivers in a city with a population of up to 50,000, 2 participants in a city with a population of 50–100,000, and 2 participants in a city with a population larger than 500,000.

2.2 Tools

*Impulsiveness Questionnaire – Impulsiveness, Venturesomeness, Empathy (IVE):* it comprises 54 items in a form of questions with yes/no answers. IVE addresses three personality traits: impulsiveness, venturesomeness and empathy.

*Perceived Stress Scale (PSS-10):* the questionnaire comprises 10 questions and is used to assess intensity of stress connected to one’s own life situations during the
last month. In research PSS-10 authored by S. Cohen, T. Kamarck and R. Mermelstein in a Polish adaptation by Zygfryd Juczynski and Nina Oginska-Bulik was used.

*Coping Inventory for Stressful Situations (CISS):* contains 48 statements related to various activities undertaken in stressful situations. Participants were asked to mark the right number (on a scale from 1 to 5) next to every statement describing how often they engage in a given activity in a stressful situation. Scales of the questionnaire (16 items each) enable to distinguish three coping styles: task-oriented style (TOS), emotion-oriented style (EOS) and avoidance-oriented style (AOS) having two forms: distraction seeking (DS) and social diversion (SD).

*Vienna Test System:* is a comprehensive set of computer tests used for professional selection of, among others, drivers. In the presented research the following tests were used:

- Determination Test (DT): used to measure weakening of attention, stress tolerance and reaction to long-term engagement with quickly changing stimuli.
- Double Labyrinth Test (B19): used to measure eye-hand coordination in conditions with imposed operation speed.
- Visual Pursuit Test (LVT): used to measure speed of visual processing in conditions of tracking simple optical structures in the background of relatively complicated surrounding and with the time limit.

*Truck driving simulator:* is a stationary device comprising driver’s cab, traffic simulation system and wide-angle presentation system of the image seen from the cab. The device enables to monitor psychophysical parameters of drivers in conditions of simulated road traffic mimicking truck functions based on the example of Mercedes Benz Actros.

### 2.3 Procedure

Research was conducted during 9 months and took three stages. Drivers were examined in the laboratory of Military Institute of Aviation Medicine (with use of a truck driving simulator), in real-life conditions while working as a professional driver (driving a truck) and during driving a passenger car on route Warsaw – Kielce – Warsaw.

Lab tests in MIAM in Warsaw always took place at the beginning of the week in assumed rested state of the driver and entailed collecting basic information about the participant, including among others the estimation of psychomotor skills by the use of the Vienna Test System and determination of personality traits, level of stress currently experienced and coping styles by the use of tests and questionnaire methods. Afterwards the participant was directed to truck driving simulation.

The second stage of research took place on Friday, near the end of the week, in assumed tired state of the driver. Research took place during actual driving, during driver’s working hours and was aimed to monitor environmental (inside the truck)
and physiological parameters in a typical working mode. After returning from the road the participant solved tests from the Vienna Test System.

The third stage addressed real driving at night hours on route Warsaw – Kielce – Warsaw starting at night hours (usually after the whole series of tests on Friday). The aim of this research was to monitor car, environmental and driver physiological parameters during a drive in a passenger car in night conditions in assumed tired state and during monotonous ride conditions. Participating drivers after driving to Kielce and back participated in laboratory tests again (psychological test using the Vienna Test System) and in truck driving simulation. Those tests were carried out between midnight and 5 a.m. in the majority of cases.

Such a scenario allowed us to assess the change in psychomotor skills of the participants in conditions of assumed tiredness, rest and during real-life driving at night.

3 Results

Within the conducted analysis of the results, relationships between personality traits, level of stress experienced and tendency to make mistakes in tests measuring psychomotor skills directly after finishing a drive were searched for.

Due to the difficulty to standardize the value of a drive in car, it was assumed during data analysis that values obtained via the Vienna Test System (especially both results of B19 such as the number and duration of mistakes made) would show the level of executive abilities of the drivers.

3.1 Descriptive statistics

The number of people presenting a given stress coping style was analyzed. In the analyzed research group there were 6 individuals presenting the emotion-oriented style, 6 persons with the avoidance-oriented style, and 13 participants presenting the task-oriented style. Numbers of people representing particular coping styles are presented in a figure below (fig. 1).

![Figure 1](image.png)

Figure 1: Percentage of people representing particular stress coping styles.

3.2 Correlation analysis

Two stages of tests were analyzed: at the beginning of the week and after driving in real-life conditions. During the analysis of the obtained results, correlations of
certain parameters were emphasized, out of which those presented in Table 1 underwent further analysis.

Table 1: Correlation table.

<table>
<thead>
<tr>
<th></th>
<th>PSS-10</th>
<th>B19 NM</th>
<th>EOS</th>
<th>TOS</th>
</tr>
</thead>
<tbody>
<tr>
<td>PSS-10</td>
<td>-</td>
<td>0.427*</td>
<td>0.529**</td>
<td></td>
</tr>
<tr>
<td>B19 NM</td>
<td>0.427*</td>
<td>-</td>
<td>0.519**</td>
<td>0.397*</td>
</tr>
<tr>
<td>Impulsiveness</td>
<td>0.543**</td>
<td>-</td>
<td>0.519**</td>
<td></td>
</tr>
<tr>
<td>Empathy</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*P < 0.05.  
**P < 0.01.  

There was a perceptible significant positive correlation between the level of perceived stress (PSS-10 result) and the number of mistakes in Double Labyrinth Test B19 of r = 0.427 (P < 0.05). Such a result shows a tendency to make mistakes by people whose perceived stress level was high. Similar results were obtained irrespectively of time and place of performing a test, so at the beginning of the week (in full rest state) and at the end of the week (in assumed tiredness state) equally.

The significance of differences between average results obtained in Vienna Test System tests in two experimental conditions i.e. assumed rested and tired state was assessed using Tukey and Scheffe post hoc test. Statistically significant differences between means achieved by the drivers in Determination Test (P<0.05) were shown. It therefore confirmed the existence of statistically significant differences between average median reaction times results, median reaction times 1, median reaction times 2, and median reaction times 3 between examinations on Monday and in night conditions (results are presented in Table 2). Shorter reaction time to a stimulus was perceived in drivers when tests took place in tired state. Longer reaction time was observed in participants during tests at the beginning of the week.

It was not possible to show the link between the amount of stress (PSS-10 test result) and performance level in Visual Pursuit Test (LVT). Correlation coefficients between PSS and LVT from Vienna Test System results turned out to be very low and statistically insignificant revealing that the level of perceived stress did not influence directly the level of attention and coordination of the participants. Verification of obtained results would demand additional tests in a sample larger in number and more diverse.

The conducted data analysis also proves that a high level of stress (high result in PSS-10 test) is accompanied by the use of the emotion-oriented style. Statistically significant correlation of PSS-10 results and CISS questionnaire in EOS scale equaled r = 0.529 (P<0.01).

Significant, positive correlation between stress levels described by PSS-10 results and personality trait such as impulsiveness (described by Impulsiveness
Questionnaire results) also emerged during analysis. That correlation was 0.543 in participants. It means that the influence of stress on impulsive persons is significant. The level of significance of this correlation was P<0.01.

Table 2: Determination test: multiple comparisons – Tukey test results.

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Median reaction times</th>
<th>Median reaction times 1</th>
<th>Median reaction times 2</th>
<th>Median reaction times 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Day of the week Mon-night</td>
<td>Mon-night</td>
<td>Mon-night</td>
<td>Mon-night</td>
<td>Mon-night</td>
</tr>
<tr>
<td>Difference between means</td>
<td>0.06400*</td>
<td>0.06000*</td>
<td>0.07320*</td>
<td>0.06080*</td>
</tr>
<tr>
<td>Standard deviation</td>
<td>0.02243</td>
<td>0.02086</td>
<td>0.02374</td>
<td>0.023</td>
</tr>
<tr>
<td>Significance</td>
<td>0.015</td>
<td>0.014</td>
<td>0.008</td>
<td>0.027</td>
</tr>
<tr>
<td>Lower limit of the 95% confidence interval</td>
<td>0.0103</td>
<td>0.0101</td>
<td>0.0164</td>
<td>0.0058</td>
</tr>
<tr>
<td>Upper limit of the 95% confidence interval</td>
<td>0.1177</td>
<td>0.1099</td>
<td>0.13</td>
<td>0.1158</td>
</tr>
</tbody>
</table>

*0.05 significance level.

In view of these results, the team conducting the research was also interested in the relationship between impulsiveness and stress coping styles. A significant, strong correlation between impulsiveness and an emotion-oriented coping style of 0.519 (P< 0.01) was discovered.

Also, a correlation between a task-oriented coping style and empathy was proven. The correlation coefficient was 0.397 (P<0.05) in that case. It means that people with high levels of empathy resorted to using the task-oriented style in a stressful situation.

4 Conclusions

The paper was aimed to present the influence of perceived stress level and personality on behavior on the road. First of all, it was expected that stress would
have a negative influence on task performance. Data analysis enabled us to partially support the hypotheses.

Participants made more mistakes on Double Labyrinth Test B19 when the level of their perceived stress was high. Former research studies [3, 5] showed a strong, negative influence of stress on task performance. Accompanying emotional tension probably excessively preoccupied participants’ attention and thus led to making wrong decisions. In the context of road safety it is an observation of tremendous importance because driving a car is connected with numerous, often unconscious mental processes [18]. The decreased level of perception can cause a traffic hazard a lead to accident as a consequence.

Determination Test results showed that a high level of stress was accompanied by changes in reaction times on particular days of the experiment. It may therefore be concluded that tiredness felt by the participants could be a factor augmenting stress. What is interesting, the drivers who performed tasks in tired condition (i.e. near the end of the week and at night) had a shorter reaction time. Literature [6, 11] provides information that driving at night and lack of sufficient amount of sleep significantly increase the level of tiredness; deteriorating a driver’s psychomotor performance. Probably the perceived stress motivated the study participants enabling them to act effectively and quickly. Another explanation of such a result might be the discovery of higher endurance and lower susceptibility to fatigue among professional drivers. People working as drivers are used to driving long distances and to monotony accompanying several-hour drive [19]. It was also impossible to show that the stress level influences the reaction time during Visual Pursuit Test LVT. Apparently, the proposed test turned out to be a too insensitive indicator of driver fatigue in the case of this professional group showing stable psychomotor performance in participants. It is worth to conduct this research on a larger sample to confirm the observed relationship.

Data analysis also enabled to confirm the existence of a relationship between perceived stress level and stress coping strategy. Participants with a high level of stress presented an emotion-oriented style. Persons with such a style have a tendency to concentrate on own emotional experiences [13]. It means that in situations on the road those individuals can stop reacting on external stimuli and thus have a delayed response which leads to dangerous situations.

Previous studies [3, 9, 14, 20] focused on a relationship between perceived stress and safety on the road and feeling anger. Authors of this paper decided to indicate some trends analyzing the following personality traits: impulsiveness and empathy.

It turned out that there is a correlation between results of Impulsiveness Questionnaire and PSS-10. It might mean that impulsive, and therefore reacting abruptly, individuals when under the influence of stress can make rash decisions. It may lead to dangerous behaviors on the road such as: emergency braking or changing lanes without proper caution [5, 20].

Impulsiveness Questionnaire results correlated with emotion-oriented coping style (EOS). An impulsive individual experiences a variety of emotions, often negative ones, and concentrates on himself/herself [16]. It is a reaction of the organism aimed at reducing the tension. Unfortunately, it often has a paradoxical
outcome leading to maximization of stress. It may result in an emotional “attack” on other road users in the form of unmannerly behaviors.

Discovery of the relationship between empathy and task-oriented stress coping style was an interesting result. Empathic people are in other words compassionate [13, 16]. The task-oriented style describes an individual focused on solving the problem. Probably the individuals feeling the burden of responsibility stemming from using the road are determined to obey the traffic rules and therefore safely participate in the road traffic.

In a current experiment a specially prepared truck driving simulator was utilized. Its purpose was to possibly most faithfully mirror the workplace (vehicle) and environment in which the driver functions (road, traffic). It enabled to check and record driver’s reactions in situations occurring on the road. The majority of the tests on drivers are conducted in real-life conditions, thus causing additional and unnecessary road hazards. The presented research justifies the use of a simulator to examine the drivers while avoiding the provocation of dangerous situations, yet at the same time allowing to subject the driver to multiple stressors, including extreme fatigue of the vehicle user.

The presented research was conducted on a small sample, which does not allow for generalization of its conclusions. However, the results merit further research in this field because they show that personality and perceived stress determine driver’s behavior. Reduction of stress experienced by the drivers seems to be one of the most important tasks to undertake in order to reduce the risk of road accidents. Stress can motivate a driver shortening the reaction time. Nevertheless, the decision made at the spur of the moment is not always adequate and may often cost lives.

In the interests of safety it is worth to conduct further research on a personality profile of road traffic participants and on the choice of a stress coping strategy because it not only concerns professional drivers, but also people who use vehicles merely to commute (e.g.: driving to work every day).

References


