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THE EFFECTS OF COMMUNICATION BY INTERACTIVE ROAD SIGNALING ON BEHAVIOR WHILE DRIVING

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Abstract

In this study was analyzed the effect of communication by interactive road signaling on the behavior of the drivers. A study published in 2013 by Scott & Parker, obtained the results that high reward-sensitivity drivers are considered to be risky drivers, as they report higher risky driving behavior and are likely to infringe traffic rules. This two factor theory based on punishment and reward was revealed by neurophysiological studies that discovered a pleasure center in the brain. Starting from Mowrer's theory came the claim that reward and punishment are different processes that express an emotion that can serve as internal motivators of behavior. A road signal that is showing the speed and give a "smiley" feedback was used as a reward for the drivers that did not violated the speed limit and a road signal that is showing the speed and give a "sad face" was used as a punishment for the drivers that violated the speed limit. The results of this study is that the mean of the speed measured shown with the presence of message is reducing the risk of big speed violations (54.85km/h) compared with the hidden condition that is showing a mean of speeds of 67.73km/H.

Keywords: *inforcement, road signaling, communication, traffic safety campaigns*

1. INTRODUCTION

Research on automotive user interfaces has for a long time focussed on how to optimize user experience and minimize distracting effects for the driver (Kun, Paek, Medenica, Memarovi´c & Palinko, 2009). Approaches to this fundamental need for road safety (Tchankue, Wesson & Vogts, 2011) have been developed along with the technical possibilities in cars. Today, researchers of automotive human-machine interaction aim for a natural experience with different communication channels of persuasive and inforcement (Meschtscherjakov, Wilfinger, Scherndl &Tscheligi, 2009). Such systems can improve the safety of

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traffic participants by observing driving performance and to influence the driving style and to regulate speeding. Other systems monitor and react to the driver's emotional state in order to keep them safe (Nass, Jonsson, Harris & al, 2005) as driving performance can be influenced by positive or negative emotions (Jeon, Yim & Walker, 2011).

This study applied reinforcement sensitivity theory (RST, specifically reward sensitivity and punishment sensitivity) to explore drivers perceived risk and self-reported risky driving engagement, while accounting for potential influences of age, sex and driving experience.

According to a study published in 2011, cognitive process that can lead to risky driving involves perceiving and recognising a risk, to estimate the level of risk (probability of negative consequence) and a willingness to accept the risk level for the behavior (McKenna & Horswill, 2006; Nordfjærn, Jørgensen & Rundmo, 2011).

High reward-sensitivity drivers are considered to be risky drivers (Scott-Parker et al., 2013), as they report higher risky driving (Constantinou et al., 2011; Harbeck & Glendon, 2013), and are likely to infringe traffic rules (Castellà & Pérez, 2004). Additionally, the sex effect studied by Begg & Langley, that led to the valid hypothesis that males report higher reward sensitivity and male drivers have been found to engage at higher rate over a broader range of risky driving behaviors when compared with females (Begg & Langley, 2001; Boyce & Geller, 2001).

Reinforcement learning algorithms have been some of the most influential theories in neuroscience for behavioral learning that is dependent on reward and penalty, correlated with positive or negative emotions (Seo & Lee, 2017).

The definition of the reinforcement learning is where a system, or agent, tries to maximize some measure of reward while interacting with a dynamic environment. If an action is followed by an increase in the reward, then the system increases the tendency to produce that action (Braun, Pfleging & Alt, 2018).

In one of the studies of Mowrer, he argued that the learning process is composed of two other processes. The first process is associative (Pavlovian) conditioning and the second in the instrumental learning. In addition, Mowrer also concluded that the effects of reward/punishment had different behavioral effects as well as different underlying bases emotion was introduced in this learning account by Mowrer's theory that such states played the role of the internal motivator of behavior (Lovibond et al., 2009). This two-factor (punishment/reward) theory was supported by neurophysiological findings (Braun, Pfleging & Alt, 2018), the discovery of the 'pleasure centres' in the brain (Delgado et al., 2009). Starting from Mowrer's theory came the claim that reward and punishment are different processes and different states of emotion serve as internal motivators of behavior.

The negative relationship between perceived risk and reported risky driving was consistent with other research (Harbeck & Glendon, 2013; Machin & Sankey, 2008; Rhodes & Pivik, 2011) and was the strongest relationship within the model. Research confirming successful behavior change through application of rewards might assist in creating more targeted intervention programs for this high-risk group. The intervention based on integrating emotions, by being aware of the emotion and stop the destructive behavior seems to be more effective (Rizeanu, Gatej, Ciolacu, 2017).

2. OBJECTIVE AND HYPOTHESES

2.1. OBJECTIVE

The objective of this study is to reveal the importance of safety communication process among city drivers. Many times the information given about their speed could work as an enforcement factor. Being present on road as a social moderator between law and those who must obey traffic rules is most of the times the job of those who have to build communication on road and to sustain campaigns visible by those who are using the road.

2.2. HYPOTHESES

We presume that a road signal that is showing the speed and give a "smiley" feedback (DataCollect®) will work as a law enforcement factor and moderate the speed variable.

We presume that being present on road with a mobile laboratory that is part of a communication campaign and signaled on road will reduce the number of traffic rules violation.

3. METHOD

To test the hypothesis we have measured speed and number of violations on a city road using DataCollect® and DigitalAlly® equipments. We have measured these parameters in two experimental conditions: using the presence of a mobile laboratory signaled on road and the same laboratory in a "hidden" condition.

4. RESULTS

The results are showing significant differences between the two experimental conditions: the mean of the speed measured shown that with the presence of

message is reducing the risk of big speed violations (54.85km/h) compared with the hidden condition that is showing a mean of speeds of 67.73km/H.

Table1 - Descriptive statistics

Group Statistics					
	SAMPLE	N	Mean	Std. Deviation	Std. Error Mean
SPEED	1.00	100	54.8500	4.82706	.48271
	2.00	100	67.7300	9.57042	.95704

Table 2- Independendent Samples t Test

Independent Samples Test										
		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
SPEED	Equal variances assumed	50.004	.000	-12.016	198	.000	-12.88000	1.07188	-14.99377	-10.76623
	Equal variances not assumed			-12.016	146.308	.000	-12.88000	1.07188	-14.99838	-10.76162

Based on the results shown above, the research hypothesis that assumes significant differences between subjects that have seen a road side communication regarding their speed and those who didn't revived any message is accepted for a sample of 100 subjects. Results on driving behavior regarding speed were significantly different between the two samples (M1 = 54.85, M2 = 67.73, t = 12.01, p <0.05). Data revealed by the table above accept the existence of significant differences between the two samples.

Table 3 - Descriptive statistics

Group Statistics					
	SAMPLE	N	Mean	Std. Deviation	Std. Error Mean
VIOLATIONS	1.00	100	1.6000	.79137	.07914
	2.00	100	4.6200	1.20420	.12042

Table 4- Independendent Samples t Test

Independent Samples Test										
		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
VIOLATIONS	Equal variances assumed	17.304	.000	-20.958	198	.000	-3.02000	.14410	-3.30416	-2.73584

	Equal variances not assumed			-20.958	171.069	.000	-3.02000	.14410	-3.30444	-2.73556

Based on the results shown above, the research hypothesis that assumes significant differences between subjects that have seen a road side communication regarding their rule violation behavior and those who didn't received any message that they are under observation of a mobile laboratory is accepted for a sample of 100 subjects. Results on driving behavior regarding rule violation were significantly different between the two samples ($M1 = 1.60$, $M2 = 4.60$, $t = 20.95$, $p < 0.05$). Data revealed by the table above accept the existence of significant differences between the two samples.

5. CONCLUSIONS

The communication campaigns that aimed to improve road safety are still the exception rather than the rule. Because of this, interactive campaigns and interactive communication techniques should be allowed to be utilized without question, because of new methods of behavior modification. This study, based on the theory of reward and punishment, used a road signal that is showing the speed and give a "smiley" feedback was used for the drivers that did not violated the speed limit and a road signal that is showing the speed and give a "sad face" was used as for the drivers that violated the speed limit. The results of the study are that there are significant differences between subjects that have seen a road side communication regarding their speed and then the inforcement modify the driving behavior.

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