THE IMPORTANCE OF THE INFORMATION PROVIDED BY THE VEHICLE FROM THE DRIVER'S POINT OF VIEW

Jakub POVÝŠIL[1], Sudeep Sangamesh BABU[1], Michal HRUŠKA[1], Stanislav JELEN[1], Petr VACULÍK[1], Petr BENDA[2], Anna Maria ZIFIA[3]

[1]Czech University of Life Sciences, Faculty of Engineering, Department of Technological Equipment of Building, Kamýcká 129, 165 21 Prague 6, Czech Republic
[2]Czech University of Life Sciences, Faculty of Economics and Management, Department of Information Technologies, Kamýcká 129, 165 21 Prague 6, Czech Republic
[3]Tilburg University, Department of Psychology, Warandelaan 2, 5037 AB Tilburg, Netherlands

Abstract
The article is aimed at evaluating the subjective opinions of drivers on the information provided to them by the vehicle through the communication interface. A quantitative methodology using an online questionnaire was chosen to obtain data. For this research, only the information provided to the driver by the vehicle systems was used that can be described as unnecessary and that is not essential for the operation of the vehicle or traffic safety. The aim is to find out whether drivers are willing and can do without some information when driving vehicles. The results of this study could provide an expert opinion for manufacturers, who could achieve a reduction in the driver's information burden by appropriate modification of dashboards. This could in the long term, contribute to reducing driver physical and mental fatigue and as a result increase traffic safety.

Key words: *cockpit; dashboard; displays; driver; vehicle; ergonomics.*

INTRODUCTION

The automotive industry has undergone significant changes in the exterior and interior areas since its inception. Engines have become more efficient and reliable, cockpit structures are more stable, and additional features have been added to the vehicle to ensure driver safety. At the same time speed; power of vehicle engines and the density of traffic have increased significantly (*Regan et al., 2017*). In the last decade, more emphasis has been placed on the comfort and safety of drivers. Audio-visual technologies, newly used in vehicles provide the driver with a wide range of information, which on the other hand, represents an ever-increasing cognitive load to which the driver is exposed (*Häne et al., 2017*).

Just as the number of information inputs and outputs in the process of driving a passenger vehicle continues to increase, the demands on the drivers' cognitive functions logically also increases (*Hruška, 2016*). Along with the increasing psychological demands on the driver, the influence of the human factor in accidents caused by the inability to control the car, misinterpretation of the provided information or overloading of the driver's cognitive functions is becoming increasingly common (*Edwards et al., 2011*). Today, these situations increasingly lead to considerations of replacing the human factor with completely autonomous driving of vehicles. However, this technology still has a long way to go and therefore it is necessary to choose other solutions (*Huhtamo, 2020*). One such solution could be the creation of a minimalist cockpit, through which the driver would receive only the necessary information, thereby significantly reducing the cognitive load on drivers while driving.

The aim of this article is to find out the meaning of individual information available in the cockpit of a passenger car from the driver's subjective point of view, and further to find out which of the selected information provided by the vehicle could be omitted in the process of controlling the vehicle. Another goal is to confirm or refute the existence of statistically significant dependencies, how drivers of diverse groups divided by gender, age or experience approach this issue. In the case of this study, the research hypothesis is defined in such a way that it can be assumed that some of the commonly found information in passenger vehicles will be considered unnecessary from the point of view of the respondents.

MATERIALS AND METHODS

A quantitative research strategy using a questionnaire was chosen to obtain data for this study. Two entry conditions were set for the research, firstly that the volunteer must be over 18 years old and secondly to have a group B driver's license. A total of 386 respondents filled out the entire questionnaire. The questionnaire contained a total of 33 questions, which were divided into two basic sets. The created questionnaire was available online and the questions in the questionnaire were supplemented with a description or a picture so that each respondent knew exactly what the question was about. Due to the planned scope of this work, only ten significant questions were selected regarding the information commonly found in most of today's passenger vehicles.

In the first part of the questionnaire, socio-demographic information was obtained about the respondents such as age, gender, as well as information on kilometers driven, type of car they currently drive and in which large cities they drive most often. For the purposes of this study, the selection was again narrowed down to three basic data, namely age, gender and the number of kilometers driven, which represented the respondent's driving experience.

The second part of the questionnaire was focused on the several types of information that the vehicle provides to the driver. The participants were asked to rate the importance and necessity of the audio-visual information based on their opinion and experience.

RESULTS AND DISCUSSION

A homogeneous group of 386 participants from the Czech Republic took part in the survey. Selected basic socio-demographic parameters were, as independent input data, collected from the participants for further statistical analysis. A total of 194 men and 192 women successfully completed the questionnaire. The participants primarily consisted of university and secondary school students and their employees together with a small group of anonymous people who were interested in the survey. In addition to gender and age, parameters related to personal driving experience and the total number of kilometers driven are shown in Tab. 1.

The statistical software platform SPSS was used for the analysis of the obtained data, which is used to extract information. Thanks to the advanced procedures and feature set, it was possible to ensure high accuracy. The data from the questionnaire survey were exported to the SPSS program, where descriptive statistics were subsequently performed, from which it was possible to secure socio-demographic or other data about the respondents. Subsequently, Chi-square was chosen for the treatment of variable relationships due to the nature of nominal and ordinal data. The data was further processed in the MS Excel program.

Tab. 1 Primary information on the participants concerning the measurements

Gender		Age			Number of km driven		
Man	Woman	18-30	31-50	51+	0-50.000 km	50.000-200.000 km	200.000 km+
194	192	240	104	42	144	138	104

The questionnaire was divided into 2 main categories. The first category consisted of questions related to socio-demographic data while in the second, participants answered specific questions that related to the information that a modern passenger vehicle provides to the driver. A total of 7 questions (marked as A – G) were used for the purposes of this work, the exact wording and percentage results are shown in Tab. 2. All the questions below were about the commonly found audio-visual information in many passenger vehicles. The participant also had the option to indicate as an answer that he had no experience with the given technology, in which case this participant was not used for statistical evaluation.

Tab. 2 Questions used for clinical data collection

#	Questions	Answers	
		I can do without it	I cannot live without it
A	Is it important for you to have the rev. indicator displayed?	272 (70.5%)	114 (29.5%)
B	Is it important for you to have the continuous coolant temperature displayed?	194 (50.3%)	192 (49.7%)
C	Is it important for you to have information displayed in your car about the total kilometres driven, on the given day, etc.?	284 (73.6%)	102 (26.4%)
D	Is it important for you to have the currently engaged gear visible?	356 (92.2%)	30 (7.8%)
E	Is it important for you to be warned about speeding if you have active driving assistants?	314 (81.3%)	72 (18.4%)
F	Is it important for you to be warned about exceeding the recommended driving time?	348 (90.2%)	38 (9.8 %)
G	Is it important for you to be alerted to a low fuel level?	74 (19.2%)	312 (80.8%)

Data collection and statistical processing were achieved with high quality, most of the data were verified as valid and the results can be used for further research or development of production solutions. Thanks to the participation of mostly technically educated experts in the field of automotive, the results can be given immense importance. Furthermore, the adjusted residuals method was used for further refinement and better interpretation of the found dependencies. The results with statistical parameters and with an evaluation of whether there was a statistical dependence on specific input data are shown in Tab. 3. Based on the results presented in Tab. 3, there are several significant statistical dependences between the questions from the questionnaire and the data collected in Tab. 1 and Tab. 2.

Tab. 3 Dependency of questions from the questionnaire (questions A to G from Tab. 2) on driver parameters as specified in Tab. 1 evaluated using Pearson's chi-squared test

#		Gender	Age	Number of km driven
	Critical value	3.841	5.991	5.991
A	χ^2	0.024	4.083	1.126
	P-value	0.875	0.130	0.569
	Cramer V	0.008	0.103	0.054
	Dependence	None	None	None
B	χ^2	3.43	1.300	19.364
	P-value	0.053	0.522	0.0000623
	Cramer V	0.098	0.058	0.223
	Dependence	None	None	Confirmed
C	χ^2	6.143	1.295	14.692
	P-value	0.013	0.523	0.00064
	Cramer V	0.126	0.058	0.195
	Dependence	Confirmed	None	Confirmed
D	χ^2	0.167	3.093	7.305
	P-value	0.681	0.213	0.025
	Cramer V	0.020	0.090	0.137
	Dependence	None	None	Confirmed
E	χ^2	0.326	6.713	9.100
	P-value	0.567	0.035	0.010
	Cramer V	0.020	0.132	0.153
	Dependence	None	Confirmed	Confirmed
F	χ^2	0.094	1.064	3.539
	P-value	0.758	0.587	0.170
	Cramer V	0.015	0.052	0.095
	Dependence	None	None	None

G	χ^2	0.527	4.551	11.189
	P-value	0.467	0.103	0.003
	Cramer V	0.036	0.109	0.170
	Dependence	None	None	Confirmed

The results obtained during the measurements were statistically processed and evaluated using Pivot tables and Pearson's chi-squared test at a significance level of 0.05.

In general, it is very remarkable how large a percentage of people do not want to let the car talk into their own decisions. People do not want the car to check how tired they are, what speed they are driving and, paradoxically, they are not even interested in, for example, a warning about potential ice on the road. They also have the opinion that by knowing the coolant temperature they can have better control of the car, which is not logical considering that the most of cars today cannot be repaired without the assistance of a technician.

From the obtained data, it can be concluded that the respondents do not consider the speed indicator (Question A) to be relevant, given that more than 70 percent of them would do without this information as shown in Tab. 2. No dependence was also demonstrated for this question, which can be seen as a certain surprise.

The data for the information on the coolant temperature (Question B) was remarkably interesting, where a high dependence on the level of the respondent's driving experience was also confirmed. Based on the statistical dependence found, it can be concluded that less experienced drivers significantly want to have this information available (statistically 92 wanted, while 52 did not want to display the information), while medium and highly experienced drivers would not miss this information (64/72 and 38/ 66). This shift in opinion can be precisely explained by higher experience of the second and third groups of drivers, who are more aware that they would not use this information in practice anyway.

The answers to the question regarding the distance traveled (Question C) were also surprising, when most respondents are not interested in this information as shown in Tab. 2. In this case, no simple explanation for this result can be found. There is a possibility that people in the Czech Republic draw this information from external navigation applications and therefore do not consider the data provided by the vehicle to be essential. The observed statistical dependencies show that the demand for this information is in the group of women and subsequently in the group of less experienced drivers. For women it is 152/42, which is a ratio of about 15/4, and for men it is 132/62, which is a ratio of about 13/6. So, overall, drivers can get by without it, but women will miss that information less than men.

According to the results obtained, information about the currently engaged gear (Question D) is clearly indispensable, as over 92 percent of respondents could do without it. Based on the statistical evaluation, it can also be stated that no statistical dependence was confirmed for this question and the results can be perceived as evenly distributed.

The attitude towards information warning about exceeding the maximum allowed or set speed is also noticeably clear (Question E). Over 81 percent of respondents would easily omit this information in the cockpit. The weak statistical dependence that was confirmed for this question concerns older and less experienced drivers, who would like to see this information in the vehicle, even though they are a minority in the total numbers.

A significant percentage difference was shown between the answers to the question whether it is important to be warned about exceeding the recommended driving time (Question F). Over 90% of respondents do not want to be warned by the vehicle about exceeding the recommended time behind the wheel. In this case too, no statistical dependencies were confirmed, and the distribution can be described as equal. In addition, the two questions (Questions E and F) can be interpreted so that drivers do not want to let the car interfere with the way they drive and thus want to have everything under their own control.

The answers regarding the information about the low fuel level turned out to be completely in line with the assumption. Based on the survey, it can be said that most drivers want to be alerted to a low fuel level (Question G). In this case, a statistical dependence on the experience of the driver was confirmed, where it can be said that less experienced drivers required this information more often than more experienced ones.

CONCLUSIONS

This study looked at the essential information on the dashboard of a passenger car from the driver's point of view. The aim of the work was to find out the meaning of the individual information that is available in the cockpit of a passenger car from the driver's point of view. The evaluation took place depending on gender, age and kilometers driven. Based on the results that have been evaluated, it can be noticed that the tachometer is no longer the necessary information that the driver needs to see on his dashboard or virtual cockpit. Indicators such as a fuel gauge and associated signaling when the fuel level is low are desirable for all groups and for both genders.

According to the answers of the respondents, it was possible to find out the meaning of individual information available in the cockpit of a passenger car from the subjective point of view of the driver, and to find out which of the selected information provided by the vehicle can be omitted in the cockpit development process. Through omitting this unnecessary information, as described by the participants, the cognitive load of the driver was reduced, which has a direct impact on traffic safety and the ability to perform primary tasks, which in the case of a vehicle is driving, decreases with the amount of secondary information that the driver is forced to process as discussed in the study of *Hamish and Merat (2005)*. At the same time, it can be argued that with a higher load on cognitive functions, the probability of a bad assessment of the situation increases, which can lead to a decrease in traffic safety and, in extreme cases, to an accident, which supports with its results, in research of *O'Hare (2006)*.

If we start from the premise that too much received information leads to reduced performance of cognitive functions, it is clear, that the reduction of this information load will lead to an improvement in the driver's performance. Increased performance of cognitive functions affects the driver's attention while driving and this leads to an increase in traffic safety.

In conclusion, it can be said that younger drivers are more open to innovations in the cockpit of the car, as mentioned in a similar study (*Muslim, 2021*), but not every change in the driver assistance system is accepted. The aim of the research was verified, and the results showed that drivers are willing and can do without certain information while driving. Another goal was to confirm or refute the existence of statistically significant dependencies, how drivers of diverse groups divided by gender, age and experience approach this issue. The statistical analysis in this study clearly confirms the dependence of gender, age and driving experience on preferences in the display of individual indicators in the vehicle, like the study published by *Wechsler (2018)*. The research hypothesis, which assumes that some commonly found information in passenger vehicles will be considered useless from the point of view of the respondents, was confirmed.

The presented results can serve as a basis for further research that would help clarify the above or serve for further research that addresses the issue of cockpit technology and infotainment in vehicles or machines. Findings presented in this work could help to design a minimalist cockpit or a cockpit with less information load and thereby help reduce the information load on the driver's cognitive functions and, as a result, increase traffic safety. Cockpit design is a core area of human factors and ergonomics. Ideally, good design compensates for human capacity limitations by distributing task requirements over human and interface to improve safety and performance (*Sabatino, 2002*). The data and hypotheses presented in this thesis can serve as auxiliary factors in the car design process focused on optimizing human-machine interfaces to improve traffic safety and regarding potential target customer groups.

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Corresponding author:
Ing. Jakub Povýšil, Department of Technological Equipment of Building, Faculty of Engineering, Czech University of Life Sciences, Faculty of Engineering, Kamýcká 129, 165 21 Prague 6, Czech Republic, phone: +420 739 063 760, e-mail: povysil@tf.czu.cz