HUMAN (DRIVER) ERRORS

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Summary: Currently CTU FTS creates Road Safety Inspection (RSI) in Central Bohemia region. The survey is specialized in roads of class II. This article is a part of a new study which is created by CTU FTS and focuses on human (driver) errors. Research results will be used for a training of road safety inspectors.

Key words: road safety, road safety inspection, human error

INTRODUCTION

Road safety analysis requires comprehending of certain essential principles of the driving tasks and mechanisms of generating human errors in driving.

A driving performance is influenced by a workload level (Yerkes–Dodson law). Both, an information underload and overload may lead to errors and mistakes. Drivers' performance is the best when the information workload is maintained at the reasonable level. The information underload (Figure 1) decreases a driver's attention and awareness. Some drivers may compensate this by speed increasing. To reduce the monotony of a road environment may be made by changes of the road alignment, marking, planting, etc. The human information processing capacity is limited. The number of the information that can be processed simultaneously is 7 ± 2. Consequently, road engineers should avoid the superimposition of critical information at the locality (Figure 2).

Source: Author

Fig. 1 – Information underload (Veltrusy, CZ)

Source: Author

Fig. 2 – Information overload (Brandýs n.L., CZ)

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1. HUMAN (DRIVER) ERRORS

There is no universal model that can describe with total precision how errors are produced (PIARC, 2003). The models for analysing and classifying errors have evolved according to different research trends. These models can be divided by their error representation:

1.1 The error as a system overflow

The error occurs when the driver's information processing system is saturated, causing decline of vigilance and alteration of functional capacities or, more generally, an imbalance between the requirements of the task and the resources to perform them (e.g. loss of vigilance from fatigue, habituation, stress).

1.2 The error as a defect in elementary tasks

- inability to maintain the trajectory of the vehicle;
- poor coordination of simultaneous tasks;
- poor estimate of distances;
- misunderstanding of the road environment.

1.3 The error as a failure of reasoning

The error occurs when the driver's reasoning fails by solving a traffic problem.

1.4 The error as a distorted perception of the reality

The error occurs when the driver perceives the reality wrong (e.g. optical illusion; Figures 3 – 4).

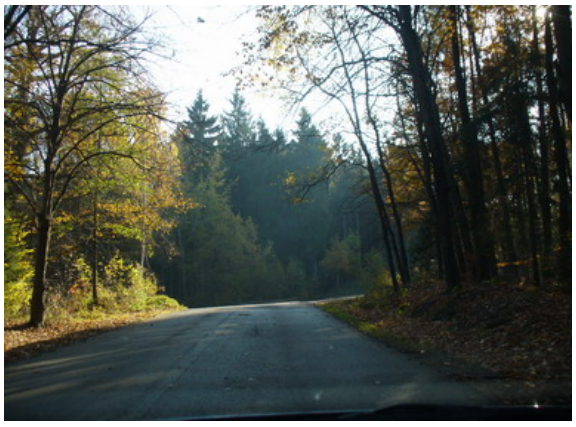

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Fig. 3 – Optical illusion of the road trajectory (left–hand or right–hand bend ?)

Source: Author

Fig. 4 – Detail of the problematic place (intersection of road and forest path)

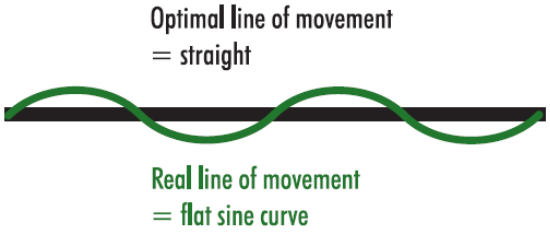
The ability of distinguishing foreground and background information is critical for the detection of road signs and safety devices (Figures 5 – 6). The road engineers should ensure an adequate contrast between the road signs and their background at all times (seasonal variations, sunrise and sunset, night–time, etc.).

Source: Author

Fig. 5 – Insufficient contrast of bend signs

Source: Author

Fig. 6 – Correct contrast of bend signs



Source: (1)

Fig. 7 – Optimal and real line of movement

Optimal line of vehicle movement is in the middle of a traffic lane, not near to its left or right side. However, road users – drivers, cyclists and pedestrians – cannot move in straight lines. The real line of their movement is a flat sine curve (Figure 7). Drivers' ability to maintain an optimal lane tracking is influenced by several factors:

- the relative height of a pavement; The higher is the pavement compared to the roadsides (e.g. bridge, bank), the more difficult it is to keep the optimal lane tracking because drivers tend to move to the middle of the road.
- the quality of orientation lines; Continual and well – contrasted orientation lines (e.g. road marking, crash barriers, tree lines, walls) improve the lane tracking.
- the road features that may require sudden speed changes; Lateral vehicle distance increases when driver have to reduce the speed suddenly (e.g. unexpected sharp bend, potholes, etc.).

The orientation is defined as the perception and understanding of space relations (Where I am? Where I'm going? Who's moving and who stands?). Because of the most of the information received by the driver when driving is visual, the main requirement should be to provide the quality visual information in the road environment. We assume that if the driver receives the visual information on time, he may adapt his behavior to the situation. The road infrastructure and the environment need to be sufficiently clear to road users can easily and quickly foresee situations which can occur (e.g. movement of vehicles and pedestrians, changes of a traffic mode, etc.; Figures 8 – 9).

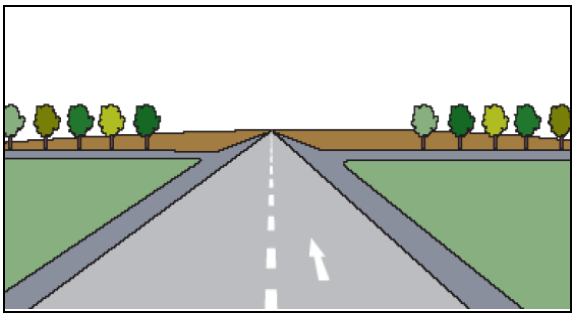


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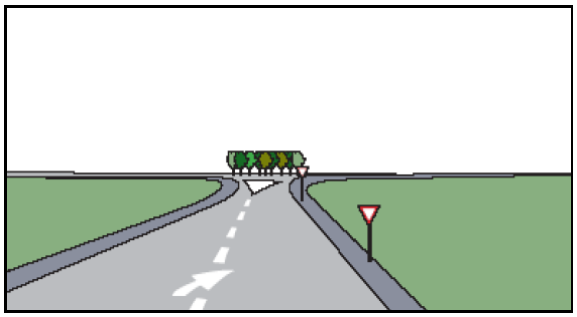
Fig. 8 – Self-Explaining road (overstricking of the minor road)



Source: (1)

Fig. 9 – Self-Explaining road (overstricking of the road end)

The road should be able „to forgive“, that means it permits evasive maneuvers in critical situations with minimal consequences. Obstacles on the roadside have to be in an adequate distance to the pavement to they not aggravate road accidents consequences. If this requirement is not met, fixed obstacles on roadsides need to be secured by security devices (e.g. crash barriers).

2. ROAD SAFETY INSPECTION

The road safety strategy should include a problem localities improvement plan. By searching these localities a question appears how to identify a dangerous place. Requirements for the improvement of a locality can be divided by a risk type:

- provable risk – objective safety (traffic accident statistics);
- potential risk – objective safety (measurement at the locality);
- experiential risk – subjective safety (road users opinions);
- intolerable risk – subjective safety (social unacceptable risk – e.g. accidents of children).

In a foreign practice for a longer time road safety inspection for searching of dangerous places which search all 4 types of the risk is used. The product of the road safety inspection is except a list of problem places and proposals of remedial measures as well.

The road safety inspection technique is based on the manual „Road Safety Inspection Methodology“ and on self experiences of trained producers. For the inspection a personal vehicle is used in which a digital camcorder is placed on the dash board. The monitored road is traveled in both directions that means forward and backward. The driver perceives the road environment for each direction different consequently what is safe for one direction can be dangerous for the opposite direction. By monitoring the road to identify weaknesses and risks the using of the GPS navigation is prohibited and the driver must depend only on road sings. During a ride the driver and front passenger record their impressions which are later by the evaluation compared with the video record of the drive. The driver and the front passenger shouldn’t know the monitored road to not influence their natural reflexes.

Each problem is recorded into the form (Figure 10). In the form basic information (locality name, road number, map of surroundings, photos), a sententious description and a simple sketch and description of proposed modifications to remove the problem are written.

The difficulty of the proposed solution is marked by color scale:

- green – simple solution (e.g. regulation of abundant vegetation, renewal of road sings, installation of delineators);
- yellow – medium difficult solution (e.g. new road signs, small reconstructions);
- red – difficult solution (e.g. reconstructions).

Pilot project of road safety inspection of road II/330 was conducted in 2009.

This method of road safety monitoring can be used not only for road sections but also for problematic points. Road safety inspections of 30 railway crossings with high accident rate in Central Bohemia region was created by CTU FTS in 2010. Inspections were created by students of CTU FTS in subject K612Y1PD (Transportation Constructions Assessment). Students have been trained at first and after that they created inspections of single locations under the supervision of experts. The results of inspections were devolved on RIA (Rail Infrastructure Administration).

Source: Author

Fig. 10 – Road safety inspection – form of the problematic place (example)

3. CONCLUSION

Human errors can never be totally eliminated and these will surely occur in minor even after the road system will be better adapted. It is therefore necessary to integrate the design elements for minimizing of human errors and their consequences into technical standards and regulations for road design, which will increase the road safety.

The method of monitoring human (driver) errors is used in some studies of user–friendly roads where the risk of human error by driving is minimalized.

Currently the engineers of CTU FTS use this method by creating the road safety inspection of the roads of the class II in the Central Bohemia region.

ACKNOWLEDGEMENT

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