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Driver feedback during naturalistic driving experiments: A review of types, methods and future challenges

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Abstract

Providing targeted feedback to drivers can significantly contribute to the improvement of their driving behaviour and overall safety. However, the effectiveness of the driver feedback provided depends on various parameters. This paper constitutes a systematic effort to review the current state-of-the-art in driver feedback research. The most important parameters that should be taken into consideration when designing such feedback experiments are also reviewed and analyzed herein. The focus is on the demographics, the types, the means and the time of feedback of the experiments. Novel ways of providing feedback in a naturalistic experimental setting can be designed based on the review at hand.

Driver sample demographics

There are various demographics present in driving behaviour experiments. In order to consider user feedback methods and impacts, it is meaningful to initially consider the target group of such information. This is achieved via an examination of past demographic compositions of the various samples of studies published from the relevant literature. For instance, some studies focus on young drivers that may have better response to feedback.

Experiment types

There are two major ways to conduct an experiment, by using (a) real conditions in a naturalistic experiment or (b) a simulation in a more secure contained experiment.

Naturally, the type of experiment affects the way drivers are recorded, and feedback is produced and provided to participant drivers.

Types and means of providing feedback

Regarding the different types of feedback provided to drivers, the most common feedback categories identified in literature mainly concern overall safety, speed, distraction, drowsiness, headway, fuel economy as well as combinations of the above-mentioned factors such as safety and fuel economy, speed and headways and mirror-checking, headway and speed. Feedback is usually provided through in-vehicle devices (tablet, smartphones etc.), videos, verbally and/or auditorily.

Time of providing feedback

Most studies conclude that feedback is improving drivers' behaviour, but the question remains: When is feedback more effective? In most experiments, feedback is provided either at real time or after the 1st drive in order to assess the impact of feedback on driving performance.

Table 1. Driver feedback literature summary

Reference	Sample size	Drivers	Experiment type	Feedback regarding	Feedback through	Time of feedback
Molloy et al., 2018	100 (61 males)	Young	Driving simulator	Speed	Verbally	After the 1st drive
Stillwater et al., 2017	42	All	Naturalistic experiment	Fuel economy	In-vehicle device	At real time
Brouwer et al., 2015	26	Professional truck drivers	Driving simulator	Fuel economy	In-vehicle device (Tablet)	At real time
Toledo & Shiftan, 2016	350+	All	Naturalistic experiment	Safety and fuel economy	Verbally and written report	After the 1st drive
Mullen et al., 2015	15 and 28	Young	Driving simulator	Speed	In-vehicle device	At real time
Dijksterhuis et al., 2015	60	Young	Driving simulator	Safety	In-vehicle device and web	At real time and after the 1st drive
Horswill et al., 2017	175	All	Video	Safety	Video and/or Graph	After the 1st drive
Aidman et al., 2015	15	All	Naturalistic experiment	Drowsiness	Optalert Alertness Monitoring System (OAMS)	At real time
Shimshoni et al., 2015	217	All	Naturalistic experiment	Safety	In-vehicle device and web	At real time and after each drive
Dahlinger et al., 2018	62	All	Naturalistic experiment	Fuel economy	Smartphone	At real time
Soriguera & Miralles, 2016	7	All	Naturalistic experiment	Safety	Smartphone	After each drive
Risto & Martens, 2014	20	All	Driving simulator	Headway	Sound	At real time
Merrikhpour & Donmez, 2017	40	Young	Driving simulator	Distraction	Auditory alert and report	At real time and after each drive
Rolim et al., 2014	216	All	Naturalistic experiment	Safety	Sound	At real time
Donmez et al., 2008	48	Young	Driving simulator	Distraction	In-vehicle device	At real time and after each drive
Hutton et al., 2001	2	All	Naturalistic experiment	Mirror-checking, headway and speed	Verbally	At real time
Dogan et al., 2012	36	Young	Video	Safety	Report	After each drive
Zhao & Wu, 2012	30	All	Driving simulator	Safety	Visual and auditory	At real time
Farah et al., 2014	217	All	Naturalistic experiment	Safety	Verbally	After each drive
Donmez et al., 2007	29	All	Driving simulator	Distraction	In-vehicle device	At real time
Merrikhpour et al., 2014	37	All	Naturalistic experiment	Speed and headways	In-vehicle device	At real time
Stillwater & Kurani, 2013	46	All	Interviews	Fuel economy	-	-

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