Current Drivers' View of Safety Information Given by C-ITS

Koustanaï Arnaud, Laboratory of Accidentology, Biomechanics, and Driver Behavior, France, *arnaud.koustanai@lab-france.com*, **Barbier Cécile,** CRAFT unit of Geneva University, Switzerland, **Guyonvarch Laurette,** Laboratory of Accidentology, Biomechanics, and Driver Behavior, France, **Buffat Stéphane,** Laboratory of Accidentology, Biomechanics, and Driver Behavior, France

ABSTRACT

Many crashes could be avoided by exchanging necessary safety data between vehicles (V2V), and road operator (I2V). Emerging technologies allow to collect data from vehicle, drivers, and road operator. Such communication would increase road safety if drivers are willing to take into account the messages of the Cooperative Intelligent Transport System (C-ITS). To do so, acceptance of the system including, notably, the perception its utility is necessary. Acceptability and perceived utility of SCOOP@F, a French C-ITS, was thus assessed in a Field Operational Test study. Participants were questioned about its utility before and after one-week use in daily trips. During trips, their comments were recorded with a customized onboard voice recorder. Results showed that drivers perceived the system as a navigation system. After the test week, in-car integration was considered as the most useful innovation. Half of the drivers acknowledged that information provided by the system was useful to improve road safety, one-third recognized that I2V provided more reliable and better up-to-date information thanks to road operator involvement. Signalling immediate and unpredictable obstacles were rated as the most relevant information for road safety. We suggest that, in the current public view, perceived utility of C-ITS shall be grounded on the navigation issue of route optimization. Drivers could also be unaware about relevance for road safety unless they have been already encountered the threat. However, a minimal experience with the system could lead to perceive its usefulness. Several solutions were discussed to improve perceived utility of SCOOP system.

Keywords: C-ITS, perceived utility, road safety, Field Operation Test.

INTRODUCTION

In 2010, Directive C-ITS 2010/40/EU of the European parliament stated that the application of information and communication technologies to the road transport sector will make a significant contribution for improving road safety. Thus, SCOOP project was initiated in order to deploy Intelligent Cooperative Systems based on the exchange of information (C-ITS) between vehicles (V2V) and between vehicles and roads (I2V). One of the objectives of SCOOP is to avoid crashes by exchanging basic safety data between vehicles equipped with sensors to "talk" to each other, and road operator through roadside units. Technologic developments provide many information sources to achieve an effective communication. Information can be given from vehicle thanks to their sensors / embedded technologies (e.g. windscreen wiper status, ABS, ESP, collision sensors). Data can be directly transmitted to other drivers to prevent of an immediate danger (e.g. slippery road, vehicle breakdown, emergency brake), or use to enhance the road operator's knowledge of events, complementing

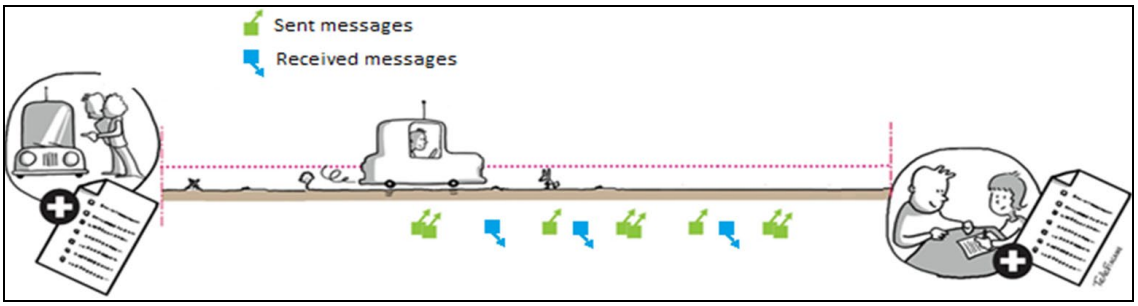
cameras, patrol and other existing sources. The driver himself can be a source of information to detect some events and to warn the road operator (e.g. animal on the road, obstacle on the road, accident). Finally, road operator could provide information about a lane neutralization or a lane closure due to static or mobile roadworks, accident, emergency vehicle approaching, or end of queues. Such communication would provide precise, reliable, and real-time information with accurate localisation of events. Integrating the C-ITS into car navigation system would also prevent drivers from distraction and facilitate interaction with the system. The main expected benefit for safety is driver behaviour adaptation as change in speed, change in lane (if needed), avoidance of dangerous behaviour (e.g. U-turns), and increased vigilance. For road operator, it gives opportunity for faster reach of incident/accidents site to improve road safety of hazardous zones and better protection for road agents.

Drivers are a crucial element for the system effectiveness. They are expected to send information to road operators and to take into account the information received by adapting their driving. To do so, they are supposed to accept the system (e.g. Nielsen, 1993). Among all determinants of acceptability, perceived utility is one of the main components (Vlassenroot et al., 2011; Regan et al., 2002; Khoudour et al., 2013). The system has indeed to match with users' needs and expectation to be effective and properly used. Five studies were thus conducted to assess acceptability of SCOOP@F (see Guyonvarch, Barbier & Buffat, submitted). A goal of the studies was to evaluate weather SCOOP met drivers' expectation to improve safety. The present paper focuses on a part of the results gathered in a Field Operation Test (FOT).

METHOD

Data were collected from 30 drivers (15 women: mean age = 39 years, max = 55, min = 23; 15 men: mean age = 46 years, max = 63, min = 27 years). They were selected as they were driving twice a day in an area equipped with roadside units allowing V2V and I2V communication. Before deciding to take part in the study, they received an operating manual explaining the purpose of SCOOP@F, its utility, its advantage regarding reliability, road operator involvement, and example of alerts issued. The study was carried out in three steps (Figure 1).

Figure 1 - Experimental design: (1) Drivers were interviewed before driving, (2) they recorded their experience during driving, (3) they were interviewed at the end of the test week.



Before using the system, drivers were questioned with semi-directive interview and questionnaire about their concern regarding road safety, their understanding and expectations of the system, and their

current use of navigation software. Next, interface and main functions of SCOOP@F were shown in the vehicle. To reflect current reality when handling C-ITS, presentation was voluntary short and not especially focused on road safety. However, a user manual was available in the vehicle. Then, drivers experimented SCOOP@F in their daily trips for a week with one of the two cars equipped with the system (a RENAULT Megane or a CITROËN C4). They were encouraged to record their experience and feelings comments with a customized onboard voice recorder when they received/sent a message.

After the test week, recordings were used in a final session, including self-confrontation interview and questionnaire. Drivers were questioned about their experience with the system, especially the utility of information provided by the system, information they thought relevant or missing. Finally, they filled-in an ultimate questionnaire.

RESULTS

3.1 Current use and expectations

When filling out the questionnaire, most of the participants indicated that they were extremely concerned by road safety. However, they were not using current navigation software to decrease risks. Systems were mainly used for guidance, finding alternative route, and time-trip planning. Information as "accident" was thus considered as an inconvenience for current route rather than a danger area. Drivers showed few needs nor expectations about information that could contribute to safety. Before using SCOOP, they properly expected it was an information system, but V2V and I2V were not considered as salient functions. In particular, the utility of I2V involving road operator to provide reliable, relevant and real-time information was underestimated or unnoticed. In contrast, navigation functions (i.e. giving a route) was well expected.

3.2 Exposure to the system

Between zero and one message per week was automatically sent by the vehicles, mainly to indicate *exceptional weather conditions*. Drivers sent an average of 8 messages, mainly to indicate *stationary vehicle*. However, none of the messages has been received by any other drivers because they were not in a close area. Drivers received an average of 2 to 3 messages from road operator, mainly to indicate *accident area*. Finally, some drivers did not receive any message because no safety related event occurred.

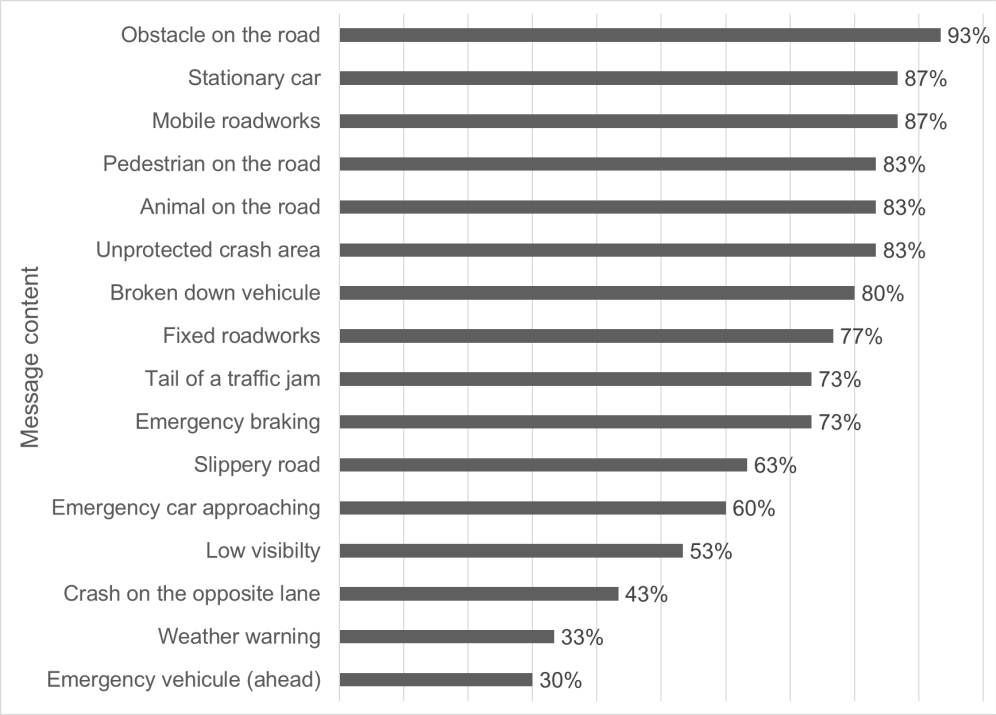
3.3 Perceived utility after the test week

At the end of the test week, only half of the drivers were convinced that SCOOP@F could be more relevant than current navigation software to improve road safety. Most of drivers thought that the main advantage of the system was in-car integration (44%). The reasons were various: some of the drivers thought that gathering all relevant information on the same display would prevent from distraction whereas others saw practical implication with the avoidance of software installation and battery charging concerns. Some of the drivers (30%) recognized that I2V should provide more reliable and better up-to-date information thanks to road operator. Few drivers (6%) considered that V2V was an

advantage. This function was already provided by current navigation software and there were not enough vehicles equipped with SCOOP@F to make this type of communication effective. Finally, 30% of drivers founded no benefit from the system.

Concerning the content of information given by the system, drivers showed preference for immediate and unpredictable obstacles on the road (Figure 2). Drivers rated that moving obstacles (mobile roadworks, animal, and people on the road) and stationary obstacles (unsecured accident area, stationary vehicle and vehicule breakdown) were the most relevant. Events considered predicable or not directly related to the current route (related to weather condition, accident into apposite lane, emergency vehicle approaching) were the less relevant. Since no V2V messages were exchanged, drivers evaluated information automatically emitted by the vehicle (Tail of traffic jam, emergency braking, slippery road, weather warning, low visibility) without ever having experienced them.

Figure 2 - Perceived utility of message content (percentage of responses)



The semi-directive interview and questionnaire were also used to determine any additional information that drivers considered to be useful. Most of the drivers (60%) thought that information about speed camera, traffic jam, and real-time traffic were lacking. Few drivers (13%) believed that the system already presented all the relevant information and coherently did not have idea about additional information they could miss (10%). Other drivers thought that extensions of use in association with road operator would be useful; the location of public events would help to avoid traffic complications. The opportunity to send an emergency signal (like e-call) would provide rapid assistance in case of a breakdown or accident (7%). Indications on local traffic regulation would be helpful to speed adaptation in the case of a traffic light breakdown or lack of signs in the infrastructure, for example (3%). Finally, some drivers feel that the information should be more detailed or given real-time to be useful (3%).

Discussion

The FOT was a unique occasion to present a C-ITS in real conditions to users, with all the limitations of such an operation. Results were limited by the short exposure with the system, preventing drivers from extensive experience of I2V communication. The number of equipped cars used in the study (two) did not allowed effective V2V communication. As a result, drivers had little exposure to SCOOP@F and were not able to experience its full potential. In addition, data collected before using the system suggested that drivers had little expectation about SCOOP@F to improve road safety. Despite information given about the C-ITS purpose, they were expecting that the system was dedicated to navigation and optimization of travel time. We suggest that this result account for the current public view that utility of C-ITS is at first stance related to route optimization. It may explain in part why the role of filtering, authentication and real-time management of information by road operator was not perceived as being useful. Moreover, while drivers considered they were concerned about road safety issues, their evaluation of the utility of safety information indicated that, in practice, they were not perceiving the risk. They were rather concerned about journey times and, in general, the objective of reaching their destination. Everything apart from this objective was thus out of the picture. Interviews confirmed that the information perceived to be most useful was that for which drivers had previously experienced a risk; for example, drivers perceived *weather warning* as useful information when they had previously encountered danger in this situation. Otherwise, implications of this information were either irrelevant or difficult to picture. Similarly, most of the drivers were likely to have experienced the risks associated with immediate and unpredictable events.

We propose that this phenomenon accounted for the drivers shifted in focus from utility for safety to Human Machine Interface (HMI). In-car integration made the utility of the system much more tangible. Drivers were able to experience the ease of use of SCOOP@F thanks to the ergonomics suited to driving. Efforts to interact with the system could be even more improved. Limiting sources of information could reduce distraction. The system integration could also avoid to setup a remote device (like smartphone), which installation and legal requirements can be an issue.

In summary, the acceptability of SCOOP@F was not positively assessed in this study. Drivers had little opportunity to experience information, they were relatively unaware of its usefulness for road safety, and they expected the C-ITS was an improved navigation system. Nevertheless, an optimistic aspect was that some drivers became aware of the benefits of the system after a short period of use. This outcome was congruent with Vlassenroot et al (2011), who observed that acceptability increases rapidly while experiencing the system. However, the perceived usefulness remains inseparable from navigation concerns; even after use, drivers still wanted these functions. We assume that focusing only on the safety aspects will always make it difficult to observe high levels of acceptability for a C-ITS. It should be considered as a complete package, including information useful for trip optimization.

Conclusion

Currently, the use of information to increase safety does not seem to be well known by drivers. Based

on our results, there are several possible solutions to increase the perceived utility of C-ITS for safety purpose. A first solution would be to communicate about the actual safety contribution of road operator and how systems such as SCOOP@F could help them. For example, drivers could be made aware of the better location and rapidity of emergency assistance and securing in an accident area. Another solution would be to merge safety information with navigation system and other on-board services. Drivers might find the system as a complete valuable package and might be more willing to follow its instructions. Prioritizing and salience of safety-related information would thus have the potential to increase safety. In the study, drivers who did not receive any messages had the impression that the system was not working. A multi-function design would compensate for the low occurrence of safety related messages and promote the perception of a system that is working properly. Another solution would be to display safety information on the dashboard. Currently, information on weather conditions or the potential for slippery road is already displayed on this location in some vehicles. This would allow drivers to better distinguish between safety-oriented and navigational information. Finally, the information could be limited to the events perceived as most relevant, i.e. the most immediate and least predictable. However, it is not certain that all drivers will have the same perception of these events. Nor is it certain that inform on these events only is sufficient to increase safety.

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