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Three social car visions to improve driver behaviour

Andry Rakotonirainy [a], Ronald Schroeter [a], Alessandro Soro [a,b,*]

[a] Centre for Accident Research Road Safety, Queensland, Australia

[b] Computer Human Interaction Group, Queensland University of Technology, Australia

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ABSTRACT

The social cost of road injury and fatalities is still unacceptable. The driver is often mainly responsible for road crashes, therefore changing the driver behaviour is one of the most important and most challenging priority in road transport. This paper presents three innovative visions that articulate the potential of using Vehicle to Vehicle (V2V) communication for supporting the exchange of social information amongst drivers. We argue that there could be tremendous benefits in socialising cars to influence human driving behaviours for the better and that this aspect is still relevant in the age of looming autonomous cars. Our visions provide theoretical grounding how V2V infrastructure and emerging human–machine interfaces (HMI) could persuade drivers to (i) adopt better (e.g. greener) driving practices, (ii) reduce drivers aggressiveness towards pro-social driving behaviours, and (iii) reduce risk-taking behaviour in young, particularly male, adults. The visions present simple but powerful concepts that reveal 'good' aspects of the driver behaviour to other drivers and make them contagious. The use of self-efficacy, social norms, gamification theories and social cues could then increase the likelihood of a widespread adoption of such 'good' driving behaviours.

1. Introduction

Human's craving for social connectedness continues to grow. Social networks have used web technology to fulfil our insatiable need for social connectedness and has unexpectedly changed the way individuals interact with each other. Smartphone devices have brought social networks into our cars, however, due to the vehicle's safety requirements, social networks have never been fully integrated into our driving environment. Furthermore, the physical nature of vehicles such as the metal shield prevents natural social interactions between road users. Cooperative systems such as Vehicle to Vehicle (V2V) communication offer new location aware services which will allow drivers, in the same vicinity, to share and exchange situational information anywhere and anytime. This, however, raises the elementary questions proposed by this special issue, including 'who can communicate what, when, how, and why?'.

The aim of this paper is to present three innovative visions that furthers the debate around those questions, in particular the question 'why'. We argue that social pressure is particularly suitable to influence human driving behaviours for the better and that this aspect is still relevant in the age of looming autonomous cars. Our visions provide theoretical grounding on how V2V infrastructure and emerging human–machine interfaces (HMI) could persuade drivers to (i) adopt 'better' (e.g. greener) driving practices, (ii) reduce drivers aggressiveness towards pro-social driving behaviours, and (iii) reduce risk-taking behaviour in young, particularly male, adults.

* Corresponding author.
E-mail addresses: r.andry@qut.edu.au (A. Rakotonirainy), r.schroeter@qut.edu.au (R. Schroeter), alessandro.soro@qut.edu.au (A. Soro).

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1.1. Why: humans still matter

Improving transportation efficiency through operational innovation is critical as our population grows and ages, budgets tighten and consumer preferences shift. Aside from important issues such as reducing road trauma, fuel consumption and emissions, we also need future technologies to accommodate the road users social needs. The 'Google autonomous car' is claimed to be ready for the public within 5 years whilst Volvo is predicting that within seven years "you won't be able to crash" its cars by using semi-autonomous technologies such as low-speed collision-avoidance or pedestrian detection.

Although these valuable endeavours will make significant contributions to transport and safety by removing the control from the driver; our visions complement the (semi-) autonomous technologies where the driver is still responsible for operating the vehicle at the strategic, tactical and operational levels [1]. It has been shown that driver's decision making is heavily influenced by the social setting. Driving is a socially regulated behaviour [2]. Normative factors have been shown to have influence on speeding behaviour; for example, how driver perceptions of the beliefs, attitudes, and actions of their peers towards speeding can influence driving speeds [3].

The following subsections draw attention to the question as to 'how' social information will be able to be communicated in real-time. They introduce several underlying, emerging technologies that will ultimately enable our visions.

1.2. How: Intelligent Transport Systems and Cooperative systems

Intelligent Transport Systems (ITS) concern the use of information and communication technologies applied to transport infrastructure and vehicles. ITS have the potential to reduce fatalities and injuries by 40% across the OECD [4]. Existing autonomous Advanced Driving Assistance Systems (ADAS), which are a subset of ITS, include examples such as pedestrian detection in bad vision conditions. They generally use various sensors such as radars, cameras, or lasers to gather contextual/situational information about the vehicle's surroundings (e.g., pedestrian approaching) in order to provide appropriate countermeasures (e.g., warning or breaking). However, such systems often have technical limitations. For example, the sensors' perception and awareness are limited to the immediate surrounding area of the vehicle, and this can be obscured.

Cooperative systems, which allow vehicles to communicate with each other to achieve a common goal, are widely recognised as the next big challenge in ITS (http://www.cvisproject.org). Cooperative systems can offer significant improvements in the safety of all road users by increasing drivers' awareness given that 80% of vehicle crashes is due to human errors. Cooperative systems can also improve the quality and reliability of information available to drivers about their immediate and distant environment.

Most of the existing approaches consist of exchanging the current vehicle kinematics and the whereabouts of hazards between two vehicles with the view to anticipate crash avoidance. However, cooperative systems such as V2V could be used to facilitate location aware peer to peer communications between road users.

ITS resembles the infrastructure for ubiquitous computing in the car. It encompasses (a) all kinds of sensing technologies within vehicles as well as road infrastructure, (b) wireless communication protocols for the sensed information to be exchanged between vehicles (V2V) and between vehicles and infrastructure (V2I), and (c) appropriate intelligent algorithms and computational technologies that process these real-time streams of information. As such, ITS can be considered a game changer. It provides the fundamental basis of new, innovative concepts and applications, similar to the Internet itself.

The information sensed or gathered within or around the vehicle has led to a variety of context-aware in-vehicular technologies within the car. A simple example is object detection, which stops the vehicle when sensors (camera or radar) detect an object within the trajectory. We refer to this type of context awareness as vehicle/technology awareness. V2V and V2I communication, often summarised as V2X, enables the exchange and sharing of sensed information amongst cars. As a result, the vehicle/technology awareness horizon of each individual car is expanded beyond its observable surrounding, paving the way to technologically enhance such already advanced systems.

1.2.1. Limitation: Security

Cooperative systems will exacerbate the need for strong security. Driving performance, location and identity (car registration) could easily be tracked with existing technology. Privacy has been hailed as a potential major issue in cooperative systems. The human user is often the weakest link in the security chain of a software system. Changing security profile whilst driving is cognitively more challenging than performing it in a desktop environment. A poor security usability in the V2X context could lead to serious security vulnerabilities that can be exploited for criminal purpose. "The system must be easy to use and must neither require stress of mind nor the knowledge of a long series of rules" [5].

1.2.2. Limitation: Reliability of exchanged information

The Human–Computer Interfaces (HCI) research community has been looking at how drivers could most effectively receive and act upon received information and how information can be delivered with the least amount of unintended consequences, such as distraction [6]. The design of HCI for cooperative applications is still in its infancy. Most in-vehicle HCI research was conducted for Advanced Driving Assistance Systems (ADAS) with the underline hypothesis that the information presented to the driver are highly accurate and reliable. Such assumptions are no longer valid in cooperative systems environments using vehicular ad-hoc networks (VANET). In the previous work we have shown that the 802.11 broadcasts