In-Vehicle Avatars to Elicit Social Response and Change Driving Behaviour

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ABSTRACT

Social and psychological theories have provided a plethora of evidence showing that the physical difficulty to express appropriate social interactions between drivers expresses itself in aggression, selfish driving and anti-social behaviour. Therefore there is a need to improve interactions between drivers and allow clearer collective decision making between them. Personal characteristics and the driving situations play strong roles in driver’s aggression. Our approach is centered around the driving situation as opposed to focusing on personality characteristics. It examines aggression and manipulates contextual variables such as driver’s eye contact exchanges. This paper presents a new unobtrusive in-vehicle system that aims at communicating drivers’ intentions, elicit social responses and increasing mutual awareness. It uses eye gaze as a social cue to affect collective decision making with the view to contribute to safe driving. The authors used a driving simulator to design a case control experiment in which eye gaze movements are conveyed with an avatar. Participants were asked to drive through different types of intersections. An avatar representing the head of the other driver was displayed and driver behaviour was analysed. Significant eye gaze pattern difference where observed when an avatar was displayed. Drivers cautiously refer to the avatar when information is required on the intention of others (e.g. when they do not have the right of way). The majority of participants reported the perception of “being looked at”. The number of glances and time spent gazing at the avatar did not indicate an unsafe distraction by standards of in-vehicle device ergonomic design. Avatars were visually consulted primarily in less demanding driving situations, which underlines their non-distractive nature.

Keywords: Avatars, Intelligent Transport Systems, Road Safety

INTRODUCTION

Family trauma and tragedy associated with road crashes is phenomenal. Road crashes cost $17 Billion per year to Australia. Much of the emphasis in road safety in the last 50 years has been on modifying driver behaviour to reduce road crashes. Unfortunately, the effectiveness of these behavioural interventions in highly motorised countries has plateaued. Thus there
is an urgent need to develop a novel type of intervention to reduce crashes.

The AAMI 2004 Crash index survey of licensed drivers across Australia reported that 93% of respondents (N=1880) had experienced some form of road rage or antisocial behaviour. Furthermore, Australia had the highest percentage of drivers who had experienced attacks in the last 12 months among the Organisation for Economic Co-operation Development (OECD) countries (EOS, 2003). The Victorian Parliamentary Inquiry (Vic, 2005) identified sociological cues such as communication difficulties, anonymity of perpetrators/victims, power of the car, territoriality, physiological arousal, de-individualisation and dehumanisation as car-related factors contributing to driver aggression. Aggression is defined as any behaviour directed at causing physical or mental injury. We refer to non-extreme type of aggression (e.g. faster speed, non-cautious driving) as opposed to criminal and malicious behaviour.

Drivers use what they see in their environment to make appropriate decisions and control their actions. Knowing the intentions of other drivers is among the important environmental cues to be considered in order to avoid crashes. The intentions of the other drivers could be inferred from different cues such as vehicle speed, vehicle position, turning light indicators, gaze directions or simply horns. Crashes or aggression could occur when cues are misinterpreted or absent.

The vehicle’s frame isolates the driver physically from interacting and being seen by other road users. A reduced visibility due to distance, windows and vehicles’ metal frame prevents drivers from exchanging important cues required to share the road safely. The relative difficulty to exchange verbal or visual cues in a driving environment introduces ambiguity when one tries to perceive and infer the intentions of other drivers. A reduced visibility reduces the awareness of the “presence” of other drivers. Such constraints have social and psychological impacts. Presence is here loosely defined as the “degree to which a driver feels the proximity of another driver”. A connotation of reduced social presence is its relation with disrespect of social norms (Derks et al, 2008). Social norms are explicit or unspoken rules about how we ought to behave. Driver’s environment tends to be relatively void of social norms due to the inability to be clearly seen or directly accountable. The vehicle’s frame socially isolates the driver and may provide a feeling of anonymity. The relative anonymity of driving environment manifests in two dimensions: (i) a driver does not know or cannot identify others drivers and (ii) drivers are less aware of the presence of others. Studies have shown that drivers are more likely to drive aggressively when they are anonymous and exposed to aggressive stimuli (Ellison-Potter et al., 2001).

The design of technologies to mediate the subjective perception of presence is an active area of research. It has been widely studied in virtual environments. A virtual environment could change one’s own attitudes to fulfill social norms (conformity theory (Asch, 1951)). It has been shown that the perceived level of presence in a virtual environment can be manipulated with visual, auditory or haptic cues (Nam et al., 2008).

Humans use eye gaze as an implicit rather than explicit, or necessary, communication media. The approach presented in this paper conveys eye gaze patterns as visual cue to change the driving behaviour. The use of eye gaze direction pattern as cues between drivers is not necessary, but an efficient and sufficient cue to assist drivers to make decisions in an ambiguous situation. For example, a cautious driver often seeks eye contact with others on intersections in order to proceed safely. An established eye contact is a tacit recognition of the mutual awareness of the presence and the intention of each driver.

The virtual environment system presented in this paper will make use of existing in-vehicle technology such as ad hoc Vehicle to Vehicle (V2V) network and eye tracker technology to mediate the social power of mutual gazes between road users to reduce road violence, road hostility and selfish driving. This paper focuses on a pilot study examining the impacts
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