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The role of roadside advertising signs in distracting drivers

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ABSTRACT

Driving is getting more complex by the time due to distraction factors inside and outside the motor vehicle. One of the major external distraction causes is roadside advertising signs. This study aims at assessing the effects of these signs on driving performance on a simulator and drivers' opinion on the distraction caused by such signs using a questionnaire. Twelve volunteers participated in the driving simulator part of this study on two identical paths with one difference. One had roadside advertising signs and one had none. Driving simulator results revealed that two driving performance indicators, drifting from lane and recklessly crossing dangerous intersections, were significantly worse in the path with advertising signs as compared with performance on the other path. The other three performance indicators (number of tailgating times, over-speeding and turning or changing lanes without signaling) were also worse in the presence of advertising signs but the difference was not statistically significant. 160 drivers responded to the questionnaire. Half of the respondents indicated being distracted at least once by roadside advertising signs. Moreover, 22% of them indicated being put in a dangerous situation due to distraction caused by such signs.

Relevance to industry: In light of the results, practical suggestions are made as to the positioning of these advertising signs and the need for more research in this area.

1. Introduction and background

Driving is becoming more and more complex with the advancement of electronic equipment found in the car like mobile phones, radios, CD players and GPS devices. Other voluntary tasks like eating, drinking and talking to passengers while driving also add to this complexity. All of these distraction factors add to the cognitive load exerted on drivers inside the car.

One of the objectives of ergonomics is to ensure that the design of a human-machine system does not exceed the information processing capacity of human beings (Kolich and Wong-Reiger, 1999). Accordingly and optimally, the amount of information presented to drivers, including all distractions, should not exceed their information processing capacity. Driver distraction is not just related to what is happening inside the vehicle. Distraction caused by aspects of the road environment is also a major issue. In a worldwide trend, the amount of visual information presented to drivers is increasing and roadside advertising signs are a major source of that information overflow (Birdsall, 2008).

In this current study, roadside advertising signs refer specifically to electric signs (which are illuminated by internal lights), animated signs (which refer to any sign that moves or gives the effect of a moving display), banners (which are portable signs usually made of fabric), shop fronts, billboards (that consist of a number of standard-sized poster panels) and changing message signs (which are animated signs consisting of messages changing in sequence). These signs can be located within the road boundaries, on private property near the road or mounted on vehicles. Roadside advertising signs do not include road signs aiming to give drivers information or warnings about road status or directions.

Roadside advertising signs can affect drivers by:

- Directly distracting or confusing them while driving.
- Indirectly distracting drivers from the driving task by moving or giving the appearance of motion.
- Taking drivers' eyes off the road, which will give them a slower reaction time to road hazards.
- Obstructing visibility, e.g. at intersections or driveways.
- Presenting a physical obstruction to vehicles moving (Andreassen, 1990; Wallace, 2003).
- Diverting their attention from important roadside warning signs (Lehto, 1992) which might, in turn, put them and other road users at risk.

Distraction caused by these signs have the potential to disturb drivers' eye fixation on the road, lead to deterioration in driving

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performance, affect drivers' reaction time and quality and diminish their ability to make the right decision when faced with driving hazards (Birdsall, 2008; Wallace, 2003).

The optimum positioning of roadside advertisements is recognized by the advertising industry as an important factor in attracting the attention of passing drivers. This industry kept improving its techniques aiming for grapping driver's attention with no care for advertisement signs potential role in distracting drivers (Birdsall, 2008; Crundall et al., 2006; Underwood, 2007).

In a comprehensive study, Stutts et al. (2001) assessed official accident data published in the USA between 1995 and 1999. The authors found a strong correlation between distraction and advertisement signs. Out of drivers who were involved in crashes in these five years, 48.6% indicated that they were paying attention to driving at the time of their crash, 8.3% said they were distracted by foreign objects (including signs), 5.4% said that they "looked but did not see" and 1.8% were identified as sleepy or asleep.

Smiley et al. (2005) assessed traffic safety impact of video advertising signs in a series of studies involving three Toronto downtown intersections and an urban expressway site. An on-road eye fixation study was conducted to determine if drivers look at video advertising signs and a conflict study was conducted to determine if there were more conflicts on intersection approaches with visible video advertising signs than on those without such signs. Also, a before-and-after sign installation study of headways and speeds on an urban expressway was carried out and accidents before and after sign installation at the expressway and the three intersection sites were compared. Finally, a survey was conducted to assess drivers' perception of any effect of roadside video advertising on traffic safety. The eye fixation study and the public survey data showed that video advertising signs can distract drivers and lead to traffic accidents. However, evidence from other studies was inconsistent and indicated that for the particular signs studied, overall impact on traffic safety were small. Finally, the authors suggested that further studies are required to determine factors that minimise driver distraction.

Crundall et al. (2006) compared two different advertisement types in different conditions and measured eye movement and eye fixation of drivers through driving videos. This was done by measuring how long the eye was fixed on a certain advertisement sign which participate in distracting them from hazards. The two types of advertisement were SLA (short level advertisement) and RLA (raised level advertisement). There was also one test with no signs. An eye movement was recorded at 250 Hz using SMI eyelink system which counts the eye fixation spot and time. The authors found out that SLAs received most fixations when participants were solely looking for hazards, and the fewest fixations when primed to look for advertisements. SLAs also had longer fixations than the RLAs.

In a similar study, Beijer et al. (2004) assessed the difference in glance behaviour of drivers between active (i.e. with movable displays) and passive signs. The authors found that active signs attracted significantly more glances from drivers and for significantly longer durations.

Results of studies mentioned earlier strengthen the argument that advertising signs have the potential in distracting drivers and affecting their driving performance. A great amount of information presented to drivers is anticipated to lead to slower comprehension of important road signs and warning. This in turn may jeopardise driving safety (Liu, 2005). However, not enough research has been done up to date that assessed specifically the possible effects of all roadside advertising signs on drivers' attention (Birdsall, 2008; Wallace, 2003). This study aims to determine if the existence of roadside advertising signs constitute a road hazard by assessing any possible effects of such signs on driving performance on two simulated paths, one with advertising signs and one without. It also aims at exploring drivers' opinion on this issue using a questionnaire. It is anticipated that findings of this study will help in determining ways to minimise the risk of sings in distracting drivers.

2. Methodology

Distraction issues are blurry and cannot be directly measured. What is apparent in distraction is the effect of distraction on driving performance. One of the ways to measure this performance is by simulating driving and assessing drivers' performance on a driving simulator (Horberry et al., 2006; Ting et al., 2008) which constitutes the first part of this study. Another way is to explore drivers' opinion on this issue through a questionnaire which constitutes the second part of the study.

2.1. Driving simulator

2.1.1. Technical information

The driving simulator used in this study is a new SSI S-2300 Interactive Modular Driving Simulator. It consists of three large 1024 × 768 pixels screens that give a 175° virtual driving environment, a real-life steering wheel and real-time brake and gas pedals. The simulator has both manual and automatic transmission options. The latter one was used in this study.

The driving environment and driving conditions are predetermined by the researcher with many driving scenarios and hazards (including advertisement signs) to choose from. After the setup is done, the screen is programmed to follow the driver's orders. The simulator follows real-life traffic laws and allows choosing among the following environmental and traffic conditions:

1. Rain: no rain, rain, heavy rain
2. Fog: no fog, medium fog, heavy fog
3. Time: day, night
4. Traffic volume: no, low, medium, heavy traffic
5. Road type: lighted road, highway (without traffic lights)

After the driving session finishes, the simulator gives information on the session like session duration, occurrence of accidents (if the driver crashes into any surrounding object) and the following driving performance indicators:

1. Number of tailgating times
2. Number of overspeeding occurrences
3. Number of times the car drifted from lane
4. Number of times of not signaling when passing other cars or turning
5. Number of times of crossing recklessly dangerous intersections

2.1.2. Participants

Twelve male volunteers between the age of 23 and 28 years participated in this study. As participation rate of male drivers in accidents is significantly more than female drivers (Salminen, 2000), it was thought that choosing only male participants would reflect real-life scenarios in a better way.

All of the participants indicated having more than five years of driving experience and that they drive their cars on a daily basis. These conditions for inclusion in this study were put in order to minimise differences between subjects. All of them were either university graduates or finishing a university degree soon. As was the case in other laboratory-based experiments (see, for example, Lai and Huang (2008)) and to prevent the results from being