Transportation Research Part F 28 (2015) 77–85

Contents lists available at ScienceDirect

Transportation Research Part F

journal homepage: www.elsevier.com/locate/trf

Decreasing driver speeding with feedback and a token economy

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ARTICLE INFO

Article history:
Received 12 June 2013
Received in revised form 25 September 2014
Accepted 29 November 2014
Available online 26 December 2014

Keywords:
Driving simulator
Speeding
Incentive
Feedback

ABSTRACT

On-road research suggests that driver feedback combined with a token economy (a system of delayed reinforcement whereby tokens or points are distributed following a desired behaviour and are later exchanged for desired items) can reduce speeding, and that an incentive system without feedback may be sufficient to achieve this reduction. In two studies, we investigated the necessary and sufficient conditions required for this intervention to reduce speeding, and the efficacy of conducting such research using a driving simulator. Study 1 served to validate the simulator procedure. Participants completed a simulated drive while receiving feedback on their speed and a speed-based token economy. The intervention decreased their speeding compared with that of a control group. Study 2 investigated the amount of speed reduction that could be achieved with just one intervention component (i.e., feedback alone or a token economy alone) compared with feedback and a token economy combined or a control condition. Participants completed a 30-min simulated drive. Overall, drivers who received feedback combined with a token economy spent the least amount of time driving above the speed limit, had the slowest mean speed, and had the smallest standard deviation of speed. Drivers exposed to a token economy alone showed similar speed reductions. However, drivers exposed to feedback alone drove at speeds similar to control participants. Replicating these results under more realistic operating conditions could inform policy-makers and car manufacturers. Furthermore, the simulator proved a cost-effective and efficient means for examining the intervention.

1. Introduction

Speeding is a complex phenomenon that is difficult to both construe and control. A model proposed by Berry, Johnson, and Porter (2011) suggests that speeding mediates between a number of multifaceted cause and effect factors; input includes personal, behavioural, cultural, environmental, and vehicular elements, while output includes both negative (e.g., crashes, injuries, deaths, fines) and positive (e.g., increased efficiency, confirmation of self-identify) effects. While it is difficult to delineate the reasons why people choose to speed, it is clear that speeding is a widespread and significant dilemma which entreats intervention.

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http://dx.doi.org/10.1016/j.trf.2014.11.008
1369-8478/

Canadian statistics for 2002–2004 show that speeding was a factor in 25% of fatal vehicle crashes, and in 20% of crashes resulting in serious injuries (Transport Canada, 2008). Young drivers are over-represented in these numbers – 40% of fatally injured speeding drivers were aged 16–24 years. United States statistics are similar, with speed identified as a contributing factor in almost 32% of all fatal motor vehicle crashes in 2010 (National Highway Traffic Safety Administration [NHTSA, 2012). Thirty-nine percent of male drivers and 25% of female drivers aged 15–20 years who were involved in a fatal crash were speeding. Of drivers aged 21–24 years who were involved in a fatal crash, 39% of male and 23% of females were speeding.

These statistics are not surprising given that speeding has been found to be the most common self-reported driving infraction (NHTSA, 2013; Stradling et al., 2003). A 2005 study involving a survey of 2002 Canadian drivers and 12 focus groups found that 71% of drivers reported speeding occasionally or frequently (i.e., scored 4 or greater on a 7-point Likert scale; EKOS Research Associates Inc., 2005). Data from the United States are strikingly similar, with 70% of 6144 drivers who participated in a national survey reporting speeding at least occasionally (NHTSA, 2013). The majority of respondents in both studies reported speeding by travelling slightly (i.e., $\leqslant$10 kmph; EKOS Research Associates Inc., 2005) or moderately (i.e., $\leqslant$15 mph; NHTSA, 2013) above the speed limit.

While many drivers acknowledge that they technically drive above the speed limit, most do not perceive that their speeding endangers themselves or others, despite being able to identify possible negative outcomes of speeding (EKOS Research Associates Inc., 2005; Elvik, 2010; Mannering, 2009). This bias contributes to speeding being so widely tolerated, and thus an issue resistant to change. Because many drivers are conscious speeders, initiatives are needed to encourage drivers to choose to drive within the speed limit.

Efforts to incite change have been developed and initiated over the years. Speeding countermeasures include those enacted by the community (e.g., electronic signs that warn drivers when they are speeding, awareness campaigns, speed cameras, and police enforcement) and those regulated by the vehicle or driver (e.g., electronic notification devices, governors, and recording devices linked to insurance companies; NHTSA, 2013). Generally, measures that do not entail penalties are deemed the most acceptable by drivers (EKOS Research Associates Inc., 2005; NHTSA, 2013).

Recent research has examined the effectiveness of rewarding (or, more accurately, reinforcing) safe driving behaviour (Battista, Burns, & Taylor, 2010; Mazureck & van Hattem, 2006; Reagan, Bliss, Van Houten, & Hilton, 2013). Behavioural techniques such as reinforcement, feedback, and prompts have previously been used to decrease speeding (Ragnarsson & Bjorgvinsson, 1991; Van Houten & Nau, 1983), as well as encourage other safe driving behaviour such as increasing seat-belt use (Cox, Cox, & Cox, 2000; Ludwig & Geller, 1991; Van Houten, Malenfant, Austin, & Lebbon, 2005), increasing motorist compliance at stop signs (Van Houten & Retting, 2001) and pedestrian crosswalks (Van Houten & Malenfant, 2004), and decreasing cell phone use while driving (Clayton, Helms, & Simpson, 2006).

A Netherlands on-road trial investigated whether an intervention consisting of feedback and a token economy (i.e., distributing tokens or points following a desired behaviour, which could later be exchanged for desired items) could decrease speeding and tailgating (Mazureck & van Hattem, 2006). An in-vehicle device attached to the vehicle dashboard provided visual feedback (in the form of two green and two amber symbols that illuminated) regarding the driver's speed and following distance. Drivers accumulated points for every 15 s that they maintained a safe driving speed and following distance (i.e., when both green symbols were illuminated), and these points could later be exchanged for items selected from a catalogue (indoor or outdoor experiences such as sporting or cultural events). Participants also competed for monthly monetary reinforcers (500 euros), which were awarded to the driver who earned the most points each month.

The trial found that the intervention increased the percentage of kilometres travelled within the speed limit (from 68% during baseline to 86% with the intervention) and the percentage of kilometres driven with a safe following distance (from 58% to 77%) (Mazureck & van Hattem, 2006). A further benefit was a mean reduction in fuel consumption of 5.5%. A Canadian on-road trial using a similar intervention of feedback and a token economy found comparable results, with speed compliance increasing from 74% during baseline to 94% with the intervention in place, and headway compliance increasing from 84% to 92% (Battista et al., 2010).

Although reinforcing safe behaviour appears promising, these studies failed to inform whether both feedback and a token economy were required to increase safe driving, or whether similar results could be achieved with just one of these components. Given that drivers are often aware of when they are speeding (EKOS Research Associates Inc., 2005; NHTSA, 2013), a token economy without feedback may be sufficient to increase safe driving. Alternatively, the intervention's cost-effectiveness would increase substantially if feedback alone was effective for increasing safe driving. A United States on-road trial attempted to tease out the effectiveness of these intervention components (feedback and a monetary incentive system) for reducing speeding (Reagan et al., 2013). Results showed that feedback produced a moderate decrease in speeding, while the monetary incentive system led to a substantial decrease. However, the effect of each intervention component compared with the two components combined could not be determined due to a floor effect (i.e., the monetary incentive system decreased speeding to such an extent that there was no room for further reduction when feedback was also introduced).

The present research was designed with several goals in mind: (a) to replicate the pattern of results Reagan et al. (2013) obtained, (b) to further examine which components were necessary to achieve a reduction in speeding, and (c) to determine the efficacy of conducting such research using a driving simulator. Simulators offer a fast and more economical means of testing intervention components than on-road research, while offering a high level of standardization and increased safety (Carsten & Jamson, 2011). There is a high degree of agreement between simulator and on-road measures of driving performance (Blaauw, 1982; Blana, 1996; Kaptein, Theeuwes, & Van Der Horst, 1996; Törnros, 1998). However, simulators lack a