Transportation Research Part C xxx (2015) xxx–xxx

Contents lists available at ScienceDirect

Transportation Research Part C

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

Eco-driving training of professional bus drivers – Does it work?

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ARTICLE INFO

Article history:
Received 29 May 2014
Received in revised form 31 March 2015
Accepted 8 April 2015
Available online xxxx

Keywords:
Bus drivers
Eco-driving
Training evaluation
Economical driving
Fuel economy
Simulator training

ABSTRACT

The drive to reduce fuel consumption and greenhouse gas emissions is one shared by both businesses and governments. Although many businesses in the European Union undertake interventions, such as driver training, there is relatively little research which has tested the efficacy of this approach and that which does exist has methodological limitations. One emerging technology employed to deliver eco-driving training is driver training using a simulator. The present study investigated whether bus drivers trained in eco-driving techniques were able to implement this learning in a simulator and whether this training would also transfer into the workplace. A total of 29 bus drivers attended an all-day eco-driving course and their driving was tested using a simulator both before and after the course. A further 18 bus drivers comprised the control group, and they attended first aid courses as well as completing the same simulator drives (before-after training). The bus drivers who were given the eco-driving training significantly improved fuel economy figures in the simulator, while there was no change in fuel economy for the control group. Actual fuel economy figures were also provided by the bus companies immediately before the training, immediately after the training and six months after the training. As expected there were no significant changes in fuel economy for the control group. However, fuel economy for the treatment group improved significantly immediately after the eco-driving training (11.6%) and this improvement was even larger six months after the training (16.9%). This study shows that simulator-based training in eco-driving techniques has the potential to significantly reduce fuel consumption and greenhouse gas emissions in the road transport sector.

1. Introduction

Around 11% of the greenhouse gases emitted each year come from within the European Union. In an attempt to reduce the EU's environmental impact the EU has committed to a 20% reduction in greenhouse gas emissions by 2020 (as compared with 1990). Although the EU and most of the member states appear on track to meet this commitment, transport is one area where reductions have not materialised. Overall, the transport sector account's for 20% of the greenhouse gas emissions produced by the 28 EU member states and data from 2011 shows that emissions from this sector have grown by 19% since 1990. In order to try and reduce greenhouse gas emissions from transport the EU has discussed and made several proposals regarding improving support for the use of alternative fuels, which will require substantial investment in infrastructure and the

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http://dx.doi.org/10.1016/j.trc.2015.04.010
0968-090X/

vehicle fleet. However, another more immediate, less costly and perhaps easier approach to reducing greenhouse gas emissions would be to train and motivate everybody to drive in a more fuel efficient manner.

Training individuals to drive in a more economical manner would be particularly important for professional drivers, who in general drive longer distances than the general public. A number of organisations have implemented driver training to improve fleet safety and fuel efficiency, but several researcher have questioned whether driver training is effective (e.g. Christie, 2001). However, a randomised controlled trial of four fleet safety interventions showed that there is at least the possibility that driver training could be effective if the right interventions are put in place, with the driver training group showing a significant reduction in crash costs (Gregersen et al., 1996).

There have also been a number of peer-reviewed studies investigating whether eco-driving training results in more economical driving amongst small and medium sized vehicle drivers (Andrieu and St Pierre, 2012; Beusen et al., 2009; Rutty et al., 2013), as well as buses (Carrese et al., 2013; Strömberg and Karlsson, 2013; Wahlberg, 2007; Zarkadoula et al., 2007) and trucks (e.g., Reed et al., 2012; Strayer and Drews, 2003), but all of these have methodological short comings which call into question their conclusions. The main methodological issues include: very small numbers, short monitoring periods, missing details, artificial driving conditions, self-selected participants and the absence of control groups.

Rutty et al. (2013), for instance, tested the effect of eco-driving training on 15 medium sized vehicles using in-vehicle data monitoring. They monitored vehicle performance on a number of variables (e.g., hard acceleration, idle time, CO_2 produced and fuel cost from idling) one month before and one month after the eco-driving training. They found that the training resulted in a daily reduction in idling time of between 4% and 10% and that average emissions of CO_2 were reduced by 1.7 kg per vehicle per day. However, there was no control group employed in this study so it is possible that something other than the training may have been responsible for the changes observed. It is also not clear whether any of these changes were statistically significant and the drivers were only monitored for one month, meaning that this study does not provide any information on long term behavioural changes. Furthermore, the drivers self-selected and were therefore most likely already interested in eco-driving; although it is not mentioned precisely what the participants were told before commencing the study.

Similar problems were also evident in another study testing the impact of eco-driving knowledge on car driving (Andrieu and St Pierre, 2012). Andrieu and St Pierre investigated whether simply providing advice on eco-driving was as effective for encouraging economical driving as attending an eco-driving course. They had two groups; the first group consisted of twenty drivers who drove a 14 km route "normally" in a manual Renault Clio before being given advice on the golden rules of eco-driving and then driving the same route again "economically". The authors state that these two conditions were counterbalanced, although it is difficult to understand how half drove economically before being given advice on the golden rules of eco-driving. The second group ($n = 19$) used an automatic Renault Megane and drove a 70 km journey twice, once normally and the second after the eco-driver training course. They found that fuel consumption was improved by 12.5% using simple advice on eco-driving and by 11.3% for the eco-driving training.

However, there are a number of issues with the comparisons made by Andrieu and St Pierre (2012). Firstly, there was no control group data reported and thus any changes could be due to something other than the training or advice. Moreover, the two vehicles were different as was the length of the route thus making any comparisons difficult. In addition, four members of the first group were also eco-driving instructors, who were presumably very skilled and knowledgeable about eco-driving and were probably also strongly motivated to demonstrate a substantial difference between normal and eco-driving. Furthermore, these cars were not their normal vehicles and were only used for the length of the trials. They also knew they were being monitored and were only monitored for a very short period of time over a test route. Unfortunately this study does not tell us whether those trained will use this advice and training when driving their own or company vehicles in normal everyday conditions and if so how long this behaviour will be maintained. Therefore, this research largely only demonstrates that, when monitored drivers appear able to put the training and advice into practice. A number of these problems were also evident in a study of Belgian car drivers (Beusen et al., 2009).

Beusen et al. (2009) investigated whether eco-driving training would lead to an improvement in car drivers' fuel economy. On-board logging devices were used to monitor 10 participants driving their normal car under every day conditions. Fuel economy data were collected during the period four months before and four months after the course. After the course their fuel economy was on average 5.8% better than before the course. These were individuals driving in real conditions in their own car, over an extended period of time, meaning this was a less artificial measure of the impact of eco-driving training. The improvement in fuel economy occurred immediately following the course and was maintained after four months. However, this was a within subject design without a control group, meaning that again some other external factor may have contributed or caused the observed change in fuel economy. Moreover, this was a self-selected sample, in that the participants were recruited using an advertisement for participants, so presumably they already had an interest in eco-driving (although it is not mentioned what the participants were told about the study). Further to this point, the authors state that some of the drivers were already clearly improving fuel economy figures before they had attended the course, indicating that at least some of the improvements in fuel economy were not due to the eco-driving training.

The research on truck driver training has similar problems. In one of the first studies to investigate the benefit of simulator-based training for reducing fuel consumption Strayer and Drews (2003) found an average improvement of 2.8% in fuel efficiency for the six months following simulator-based training. However, this research did not include a control group and it is not mentioned how the participants were selected. Also in 2003, a full mission truck driver training simulator (TruckSim) became operational at the Transport Research Laboratory in the UK. From 2003 to 2004 over 600 drivers took part in training and validation trials, but no transfer to real-road conditions was undertaken at this stage. Some years later,

Please cite this article in press as: Sullman, M.J.M., et al. Eco-driving training of professional bus drivers – Does it work? Transport. Res. Part C (2015), http://dx.doi.org/10.1016/j.trc.2015.04.010