Driver Education and Training as evidence-based road safety Interventions

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Abstract

This paper will briefly reflect on the progress of driver education and training as evidence-based road safety interventions and then report and discuss data from an online driver training initiative. In the last decade, new Goals of Driver Education (GDE matrix) have been formulated, which place a greater emphasis on the training of higher-order driving skills, such as visual search, hazard perception, risk management and the ability to self-evaluate. New state-of-the-art technologies have been made available to deliver some of the training safely on computers, via video-based traffic simulations. Our previously conducted studies showed that inexperienced drivers performed significantly poorer than experienced drivers on a laboratory-based hazard perception dual task, but they were able to improve their performance to the level of experienced drivers via road commentary training. We also showed that higher-order driving skills training was more effective than traditional vehicle handling skills training on several safety related measures, including an on-road driving assessment. As a follow up from this research, the present paper will focus on hazard perception performance data collected from 634 drivers, after having received online training via 'eDrive' www.edrive.co.nz, developed by eDrive Solutions Ltd. The training programme improved drivers' hazard perception time by at least 10% and therefore has the potential of delivering effective online training of skills that are directly related to crash risk.

Key words: Driver education and training, higher-order skills, evidence-based road safety intervention

1. Introduction

The recent 100-car naturalistic driving study confirmed that many crashes can be attributed to human factors (Dingus, Neale, Garness, Hanowski, Keisler, Lee, Perez, Robinson, Belz Casali Pace-Schott, Stickgold & Hobson, 2006). One of the most obvious means of addressing this serious safety issue would be via driver education and training. However, driver training is often solely focused on the car handling skills, which can lead to so called 'poor calibration', due to the learner drivers' inflated level of confidence in their driving skills and underestimation of the complexity of the driver task (Kuiken & Twisk, 2001); possibly nullifying any safety benefits of the training (Washington, Cole and Herbel, 2011) and even increasing crash risk (Christie, 2001).

On the other hand, recent research showed that off-road training in higher-order driving skills, such as situation awareness, hazard perception, and risk management, can lead to a statistically significant improvement of visual search behaviour during on-road driving (Isler, Starkey & Sheppard, 2011). This was accompanied by an improvement in hazard perception, safer attitudes to close following and dangerous overtaking and most importantly, a decrease in driving related confidence. In support of these findings, Chapman, Underwood and Roberts

(2002) showed that more effective visual search patterns can be trained off road and there is also evidence that these skills can transfer to real driving behaviour (Mills, Rolls, Hall, & McDonald, 1998; Pradhan, Pollatsek, Knodler, & Fisher, 2009). Hazard perception training can be significantly improved via road commentary and video-based simulations (Isler & Starkey, 2009) and at the same time, such training can reduce risk-taking behaviour in regard to speeding and close following (McKenna, Horswill & Alexander, 2006). Improving hazard perception is a particularly useful goal of any training, as it directly relates to the crash risk of the learner (Horswill & McKenna, 2004). A recent paper by Boufous, Ivers, Senserrick & Stevenson (2011) seems to confirm this. They found that learner drivers who failed the hazard perception test twice, as part of the graduate licencing test in New South Wales, Australia, had an increased risk of involvement in a traffic crash, compared to those who passed the test on the first attempt.

The online interactive driver training program 'eDrive' (www.edrive.co.nz) was developed by eDrive Solutions Ltd., taking the above research findings into account, in order to enable all drivers in New Zealand to improve their higher-level driving skills from the safety of their home computers. The training involves more than 100 video-based traffic simulations and has modules on visual search (situation awareness), hazard perception, risk management, road commentary, and speed choice. The programme also contains a hazard perception test before the training (Pre-eDrive trials, Baseline) and after the training (Post-eDrive trials), in order to evaluate its effectiveness. The aim of this paper is to report on the evaluation data of 634 users who completed the eDrive training modules.

2. Method

2.1. Participants

We used the data of the first 634 users who signed-up for eDrive and completed the entire programme including the pre-eDrive (Baseline) and post-eDrive trials. Because of privacy issues, we gathered very little demographics data, but we can assume that many users have completed the eDrive programme in order to prepare for the driver restricted licence test.

2.2. The eDrive training programme

The online eDrive training programme was described in detail in Isler and Isler (2011). It builds on the success of earlier PC and video-based training programmes developed by the AAA Foundation for Traffic Safety, USA (Blank & McCord, 1998) and Monash University Accident Research Centre, Australia (Regan, Deery, & Triggs, 1999). Recent research has shown that learner drivers who practiced PC-based hazard detection and risk management skills, behaved differently to untrained drivers, in simulated driving conditions and more importantly, in ways that would decrease their exposure to risk (Fisher, Pollatsek & Pradhan, 2006). However, most of these programmes are only available in DVD format and are therefore severely limited in their distribution range and in regard to data collection for evaluation purposes.

The video-based simulations of eDrive are provided with a fully functional 3D-dashboard and near 360 degrees of vision around the virtual car, through the inclusion of side and rear-view mirrors (see Figure 1 left, below). Each of the five training modules is built onto an artistically designed 'progress map', each representing a different region (see Figure 1 right, below) of the country. This encourages user progress, as each region only becomes accessible 'unlocked' when the last module has been successfully completed (80% correct responses).

The eDrive programme contains five training modules:

- The *Visual Search* module consists of 25 video simulations, each about 20 seconds long. The learner is required to carefully scan the traffic environment in front of and around the virtual car (via the mirrors), in order to detect immediate and potential hazards. After the video stops, a multi-choice question relating to a potential hazard is displayed and the user needs to click on the correct answer. If they have got it right, there is positive feedback and the user can move to the next trial. If they have got it wrong, they get a chance to review the video simulation again.

Figure 1. Sample screenshot of an eDrive video-simulation, including the virtual dashboard and the three mirrors (left) and a sample module progress map (right)

- The *Hazard Anticipation* module involves two variations of training. In some trials, the simulation stops after 20 to 40 seconds and the user needs to click on all key hazards they can identify on the static image. In the other trials, the user needs to click on the hazards while the video keeps playing. There is immediate visual and auditory feedback, whether a hazard was correctly identified or not.
- For the *Risk Management* module, the user is required to first identify a risky situation (e.g., following too closely) and then choose to take action before it is too late. That means they have to choose the correct time to act and what to do. For each of the 25 trials, the task for the user is to identify the risky situation as it develops and to take action before it is too late, by clicking the mouse. Options of different possible responses are then given, depending on the situation and the user needs to select the most appropriate response, i.e., when to act and what to do.
- The *Road Commentary* module consists of 4 trials (about 20 seconds each) of driving simulation. There is one demonstration trial with an expert giving a road commentary so that the driver can learn how to perform the commentary correctly. For the remaining three simulations, the users give their own commentaries first, followed by the expert commentaries.
- The *Speed Choice* module addresses the main cause of crashes. For each trial, the learner needs to evaluate the road condition and decide on the appropriate speed.

2.3. Hazard perception evaluation trials

As eDrive was delivered via the internet, performance data were easily gathered from the users and stored in a database for evaluation purposes. The data presented here are based on four pre-eDrive video-simulation trials (Baseline) and four post-eDrive trials, in order to evaluate any improvements of the users in regard to their hazard perception skills after they have completed the five modules of the eDrive programme, with took about 3 hours to complete. These trials required the users to click on 40 immediate hazards as fast as possible, i.e., 20 hazards for the pre-eDrive trials and 20 hazards for the post-eDrive trials. Each of the two evaluation trials took about 4 minutes to complete and they were swapped after each user, in order to balance out the different levels of hazard perception complexity.

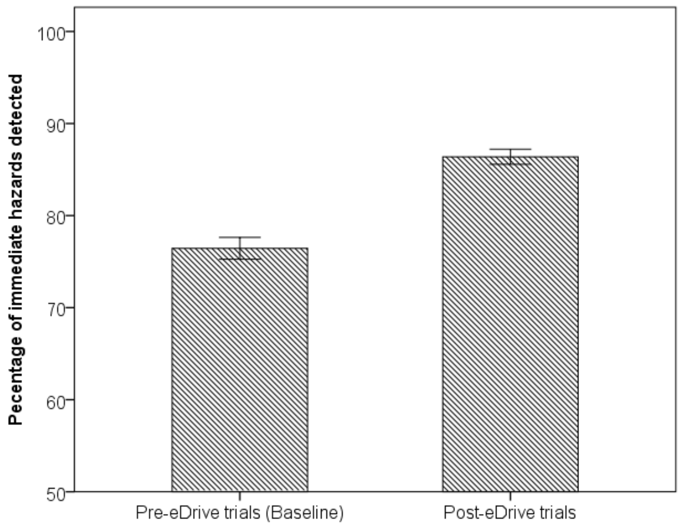
3. Results

We analysed the data of the hazard perception evaluation trials of the first 634 users, who completed the eDrive programme. As mentioned previously, their demographics were not collected because of privacy issues.

3.1. Percentage of hazards detected

Figure 2 shows the mean percentage of identified hazards by the users for the pre-eDrive trials (Baseline) and the post-eDrive trials, after they have completed eDrive. The Figure shows that the users identified considerable more hazards after the eDrive training (86%), indicating a 10% improvement to Baseline. A paired-samples t-test confirmed that the eDrive users significantly increased the percentage of hazard detected, $t(633)=14.886$, $p<0.01$. The standardized effect size index d was .56, a moderate value.

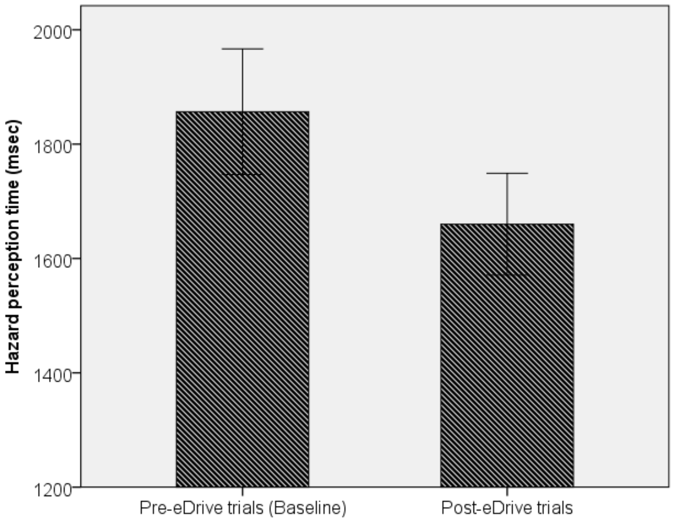
Figure 2. Percentage of hazards detected during baseline (pre-eDrive trials) and after the eDrive training (post-eDrive trials)



3.2. Hazard perception time

Figure 3 indicates that the users shortened their average hazard perception time from 1.8 seconds (Baseline) to 1.6 seconds (after the eDrive training), which is a 11% improvement and very similar to the improvement of the percentage of hazards detected (10%). A second paired-samples t-test confirmed that the eDrive users significantly decreased their hazard perception time, $t(633)=2.687$, $p<0.01$. The standardized effect size index d was .1, a small value, which may reflect the large variability in the data.

Figure 3. Mean hazard perception time of the users during Baseline (Pre-eDrive trials) and after they completed eDrive (Post-eDrive trials)



4. Discussion

The results showed that the online driving programme eDrive was effective in delivering hazard perception training. The analyses of the pre-eDrive and post-eDrive trials revealed that the eDrive training increased significantly the number of hazards the users detected and also shortened their time to detect them. This is an important finding, as hazard perception skills directly relate to crash risk (Horswill & McKenna, 2004). It could be argued that the eDrive programme simply provided a practice effect for the computer programme rather than improved the hazard perception skills. However, previous research showed that similar training led to improved visual scanning in novice drivers and not just enhanced sensitivity for unexpected events (Chapman, Underwood & Roberts, 2002).

It would be interesting to find out which training module of eDrive was most effective in teaching these skills. Module 4 required the users to engage in road commentary in a similar way as in Isler et al. (2009), however, with eDrive, we were not able to verify how much road commentary the users actually did. Isler et al. (2009) found that only 12 trials of road commentary increased the hazard perception skills of the inexperienced drivers to the level of the experienced drivers. Module 3 of eDrive was a hazard perception training module, where drivers had to click on hazards in a similar way as in the pre-eDrive and post-eDrive evaluation trials. For that module, we know that the users had to have at least 80% correct in order to move to the next module and this could have accounted for the hazard perception improvement in the post-eDrive evaluation trials.

As mentioned in the introduction, driving training solely focussed on car handling skills may contribute to increased crash risk. However, a recent change in the driver training philosophy, cited in Washington et al. (2011) validates the training of the higher regions of the GDE matrix, as "the learner shall, after education, achieve increased insight in the advantages of avoiding risks and has the opportunity to realistically assess his/her driving skills"(p.75). Good visual search, situation awareness and hazard perception can be considered to be prerequisites for avoiding risks and the data confirmed that eDrive was able to deliver effective online training in these areas.

There is much potential for extending the eDrive curriculum to further match the new training philosophy, including exercises relating to skills such as ‘having insight’ and the ‘ability to self-evaluate’, whose importance is outlined in the GDE matrix (Hatakka et al. 2002). This could be done by using the Cognitive Behavioural Therapy approach (CBT) to teach a variety of techniques to enhance life-skills, which in turn may lead to changes in thinking and behaviour. It is currently the preferred and scientifically most endorsed intervention for emotional and psychological issues. In future versions of the eDrive programme, underlying lack of self-control, and emotion regulation, low frustration tolerance, low mood, distractibility and impaired cognitive processing will be addressed at the same time as specific skills like visual search, hazard anticipation and risk management are taught.

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