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Effect of tailored on-road driving lessons on driving safety in older adults: A randomised controlled trial

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ABSTRACT

Aim: We evaluated the effectiveness of individually tailored driving lessons compared with a road rules refresher course for improving older driver safety.

Methods: Two arm parallel randomised controlled trial, involving current drivers aged 65 and older (Mean age 72.0, 47.4% male) residing in Canberra, Australia. The intervention group (n = 28) received a two-hour class-based road rules refresher course, and two one-hour driving lessons tailored to improve poor driving skills and habits identified in a baseline on-road assessment. The control group (n = 29) received the road rules refresher course only. Tests of cognitive performance, and on-road driving were conducted at baseline and at 12-weeks. Main outcome measure was the Driver safety rating (DSR) on the on-road driving test. The number of Critical Errors made during the on-road was also recorded.

Results: 55 drivers completed the trial (intervention group: 27, control group: 28). Both groups showed reduction in dangerous/hazardous driver errors that required instructor intervention. From baseline to follow-up there was a greater reduction in the number of critical errors made by the intervention group relative to the control group (IRR = 0.53, SE = 0.1, p = .008). The intervention group improved on the DSR more than the control group (intervention mean change = 1.07 SD = 2.00, control group mean change = 0.32 SD = 1.61). The intervention group had 64% remediation of unsafe driving, where drivers who achieved a score of 'fail' at baseline, 'passed' at follow-up. The control group had 25% remediation.

Conclusion: Tailored driving lessons reduced the critical driving errors made by older adults. Longer term follow-up and larger trials are required.

1. Introduction

Older drivers are the fastest growing sector of the driving population and are overrepresented in crashes per distance travelled, particularly with regard to serious injuries or death as a consequence of crash involvement (Li et al., 2003). Recent statistics show that crash rates among older drivers are increasing and are now equivalent to the fatality rate for drivers aged 17–25 years (8.0 per 100,000) in Australia (Lydon et al., 2015). In the USA an average of 586 older adults are injured in a crash every day (Centres of Disease Control, 2016). Most research into older drivers has focussed on assessing medical fitness to drive and developing screening and assessment tools. This is because our current approach to older drivers is based on regulation and license restriction. However, there are many older drivers who will be deemed 'fit to drive' but still have an increased crash risk. State crash statistics show that older age increases risk of crashes in drivers who meet licensing requirements (Chang, 2008; National Road Safety Strategy, 2016) just as young drivers also have an increased crash risk. Epidemiological research shows that 60% of drivers in older age-groups drive more than 6 times per week and have better health than non-drivers (Anstey et al., 2017b). It is currently this 'fit to drive' group in whom crashes are increasing, with associated injury and medical costs.

The 'fit to drive' but at-risk older driver poses a challenge for injury prevention and healthy and productive ageing. Apart from the limitations in mobility associated with not driving, studies indicate that driving cessation in older adults is associated with increased rates of depression (Donorfio et al., 2009; Ragland et al., 2005; Windsor et al., 2007), social isolation (Marottoli et al., 2000), general health decline (Edwards et al., 2009), mortality (Edwards et al., 2009) and caregiver burden (Taylor and Tripodes, 2001). What we currently lack, however, are methods of improving the safety of those older drivers who pass 'fitness to drive' assessments or who are deemed fit to drive by their general practitioners, neurologists and geriatricians. Effective interventions for this growing sector of the population would improve road safety and reduce injury, mortality and health care costs.

In part as a result of the focus on regulation of older drivers, there

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has been a lack of research on remediation. That is, developing effective methods to increase older driver skill and safety. Education interventions have improved knowledge of road rules but not translated into improved driving skills (Bedard et al., 2004, 2008; Jones et al., 2012; Nasvadi and Vavrik, 2007; Tuokko et al., 2015) For example, the 55-Alive/Mature Driving Program developed by the American Association of Retired Persons (AARP) (Bedard et al., 2004; Bedard et al., 2008; Nasvadi and Vavrik, 2007) and the CarFit program developed by the American Automobile Association led to no benefit for driving performance and safety as assessed in on-road driving tests (Bedard et al., 2004; Porter, 2013), or on crash rates (Nasvadi and Vavrik, 2007).

A review of occupational interventions used in driver rehabilitation by occupational therapists reported no on-road interventions for older drivers meeting criteria, but found evidence for efficacy of off-road driving simulator training for improving on-road performance (Unsworth and Baker, 2014). Only two studies have examined on-road interventions to improve older driver safety (Bedard et al., 2008; Marottoli et al., 2007). Both involved a classroom education session (AAA or 55 Alive program) followed by two 30–60 min on-road lessons to re-inforce the general driving safety concepts learnt in class. One study (Bedard et al., 2008) was multi-site with intervention and no-contact wait-list control groups across three sites in Canada (ns = 39 and 37), with administration and outcome measures comparable in only two sites. Nevertheless, findings indicated that of five driving manoeuvres assessed (starting/stopping, signal violation/right of way, turning, moving in the roadway, passing speed), only 'moving on roadway' was improved at both sites after the intervention ($p < .049$). The other four assessed skills did not improve (Bedard et al., 2008). This study did not report findings for an overall safety rating or report the impact of the intervention on critical errors which are those that cause crashes. The other study (Marottoli et al., 2007), compared an active control group who received one-on-one education on home safety with the on-road intervention group and found a significant decrease in total driving errors in the intervention group. The impact of training on driving safety is unclear in both studies.

There is some evidence that skills training using a driving simulator can improve on-road performance in healthy older adults (Casutt et al., 2014; Levallière et al., 2012; Romoser and Fisher, 2009). One study reported that compared to simulator-based training of simple reaction times and visual attention, simulator-based driver training on specific traffic scenarios led to significant improvement on a composite measure of on-road driving (Casutt et al., 2014). However, the training was not personalised to the drivers' difficulties, the safety implication of the improvement is unclear, and some sub-measures of on-road behaviour did not improve (e.g., traffic observation, lane behaviour). Other studies have combined simulator-based driver training with personalised feedback (Levallière et al., 2012; Romoser and Fisher, 2009) and found that compared to general education, drivers receiving video feedback of their own risky visual inspection behaviour along with simulator-based practice of correct behaviour, showed a significant increase in the frequency of blind-spot checks (Levallière et al., 2012), and secondary looks when crossing an intersection (Romoser and Fisher, 2009). However, the translatability of the findings are difficult to assess given lack of random allocation (Romoser and Fisher, 2009), either unreported (Levallière et al., 2012) or high impact of simulator sickness (38% of study participants) (Romoser and Fisher, 2009), lack of improvement on other measures of visual inspection (rear-view mirror, speedometer, front field, external mirrors) (Levallière et al., 2012), and lack of information on the safety impact of the observed training gains.

Personalised feedback alone, in the absence of any active training, may be effective at improving older drivers' on-road skills (Porter, 2013). This study allocated one group to receive no-contact, one group to classroom based education (55 Alive course), and the other group to receiving personalised feedback in the form of a one-on-one session with a qualified instructor to view and discuss video footage of the driver's baseline on-road assessment. Results indicated significantly fewer total driving errors following video feedback, compared to either classroom education or no intervention. Although the global safety rating was based on errors that would place the driver at risk of a crash, sample sizes were too small to analyse whether the intervention effect significantly improved safety. Nevertheless, these off-road training studies suggest that driving improvements may be quite specific to the trained skills, and that a tailored approach is more beneficial than general education and training.

In summary, only two studies have evaluated on-road driver training for improving older drivers' skills. These previous on-road interventions have not been tailored to address specific weaknesses or deficits on an individual basis. Data from studies of off-road training suggest that a tailored approach with personalised feedback on driving errors may be effective. Across the literature, research designs had many limitations such as use of only global measures or measures with no clear relationship to crash risk, a lack of information on masking of assessments, no contact control groups, small sample sizes, cross-site effects, baseline differences in performance, poor characterization of the intervention and/or baseline assessments, and variation in follow-up time-period. There has also been a lack in translation of research findings into naturalistic settings or safety ratings.

There are few theoretical models of driver training and none focussed on older drivers. The current study draws on three sources of literature to inform a design for an intervention to improve older driver safety. First, our own multifactorial model of driving safety identifies the key domains where sufficient capacity is required to drive safely, including cognitive, visual and motor factors as well as sound decision-making (Anstey et al., 2005). Second, we utilise the Goals for Driver Education (GDE) (Hatakka et al., 2002) to inform development of the components of a driver-training intervention for use with older adults. This framework includes four levels of goals (broad goals for living, goals related to a driving trip, mastery of traffic situations, and vehicle manoeuvring) and three essential contents (knowledge and skills, risk increasing factors and self-evaluation). Third we drawn on the 'adaptive intervention' literature (Collins et al., 2004) which provides the framework for developing tailored interventions appropriate to the individual. For our study of the effectiveness of driver training for older adults, we developed a method of assessment, a group of tailoring variables and a tailored intervention protocol. Our objective was to conduct a study of the feasibility and effectiveness of an intervention (assessment, tailoring and intervention) as a means of improving older driver safety.

Our hypothesis was that tailored driving lessons prescribed on an individual basis to older drivers, after a rigorous assessment of their driving weaknesses, would improve their safety, by improving their driver safety rating (DSR) and reducing "critical errors" (errors likely to lead to a crash in the absence of Driving Instructor intervention). The program we developed involves a detailed quantitative driving assessment and analysis by a driver-trained occupational therapist (OT) and driving instructor (DI) based on the on-road assessment as well as in-car video recording of the on-road assessment. From this, a prescription is developed using a standardized methodology. We evaluated this program in a randomized controlled trial and report this following CONSORT criteria.

2. Materials and method

2.1. Design

The study used a two arm stratified (gender: male/female, age: 65–75 years, 76 + years) parallel-groups, with balanced randomisation allocation ratio of 1:1 into the intervention and control groups. The stratification variables were selected on the basis of knowledge that age is correlated with driving safety (e.g., Anstey et al., 2005), that driving patterns differ across genders (e.g., Anstey et al., 2005; D'Ambrosio et al., 2008), and that females are generally underrepresented in driving