Do motorists really intend to speed in school zones? Road safety issues raised by the Gregory et al. (2014) paper reporting speeding can be attributed to a failure in prospective memory

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Abstract

School speed zones are temporary reductions to speed limits during periods of travel by school children in NSW. Compliance with the lower speed limits has been problematic, but are motorists always consciously responsible for the wrong choice of speed and the resultant likelihood of a driving violation? The present paper takes a road safety perspective on the recently published Gregory et al. (2014) paper. In this paper, two studies were reported. Study 1 showed that an interruption to a journey, caused by stopping at a red traffic light, can result in failure to resume the appropriate, lower legal speed of travel within a school zone. Motorists who had stopped at a red traffic signal and then resumed driving during school travel times sped, on average, 8.27 km/h over the speed limit, compared with only 1.76 km/h over the limit for those who had not been required to stop. Study 2 showed that the addition of a reminder cue to motorists could offset this interruption. We argue that a serious attempt to create a "Safe System" of road use must take this evidence into account. The findings have practical implications for the design of road environments, enforcement of speed limits, and the safety of pedestrians.

Introduction

The Australian National Road Safety Strategy 2011–2020 proposes a variety of actions that are aimed at reducing fatal and serious injury crashes on Australian roads. The strategy has adopted the 'Safe System' approach formally. This approach proposes that the majority of the road users will walk, ride or drive responsibly, but their judgment and their behaviour may falter or fail occasionally. In accepting that people who use the road transport network will, on occasion, make mistakes (errors, slips and lapses), the system therefore needs to be more accommodating and forgiving of those mistakes. There has been a recognition that we are dealing with a road transport system involving safer roads, safer vehicles, safer speeds and safer drivers . . . and that it is the ways in which these elements interact that is crucial for safe traffic movement (i.e., for safe travel, see Faulks, 2013)

In a recent paper, we proposed that motorists who are interrupted by signalized traffic intersections within school zones may forget to resume travelling at the deferred school zone speed limit upon driving resumption due to prospective memory error (see Gregory, Irwin, Faulks, Chekaluk, 2014). Our prediction followed Dodhia and Dismukes's (2009) proposition that "interrupting ongoing tasks intrinsically create prospective memory tasks" (p.74). Prospective memory is defined as memory for intended future actions without an explicit prompt (Einstein & McDaniel, 1990, 1996). Prospective memory errors occur when individuals forget to perform an intended task, usually after an interruption. The Gregory et al. (2014) paper had a primary focus on the interruptions and prospective memory literature, as this was suggested as the primary psychological process underpinning the results. Since

the paper focused on psychological explanations for the speeding behavior, a more substantial discussion around road safety and policy concerns was omitted. As a result, the present paper aims to take a 'road safety' perspective' on the Gregory et al. (2014) paper with the goal to add to current discussion and to shift thinking on intentional vs. unintentional violations in road user speeding practices.

Speed management has been identified as "one of the biggest challenges facing road safety practitioners around the world" (World Health Organization, 2008, p.xiii). A core assumption of many speed management strategies is that the act of speeding is an intentional behaviour (Fleiter, Watson, Lennon, King, & Shi, 2009). Accordingly, many speed management initiatives focus on enforcement, legislation, and education as primary speed deterrent strategies. In Australia, this has led to an increase in the number of speed cameras, police enforcements, and speeding campaigns, as well as a decrease in speed limits in the past twenty years (Walker, Murdoch, Bryant, Barnes, & Johnson, 2009). While these initiatives have contributed to an overall decrease in the road toll, speeding as a factor in fatal road crashes has risen from around one-fifth in 1990 to around one-quarter in 2009 (BITRE, 2011; cited in Ellison, Greaves, & Daniels, 2011). In 2010, crashes which involved speeding were found to represent at least 40% of fatal crashes and 17% of all crashes in NSW (Centre for Road Safety, Transport for NSW, 2012). This increase has prompted researchers to examine factors that may be influencing driver compliance with speed limits.

Emerging evidence suggests that the road environment may be one factor that influences whether drivers speed or not (Ellison et al., 2011). Within school zones, mean speeds have been found to vary depending on the presence of signage, markings, warning lights, and the type of road classification (Kelly & Saito, 2006; Lazic, 2003; Lee, Lee, Choi, & Oh, 2006). Tay (2009) found that vehicle speeds were slower in two-lane roads compared to four-lane roads. He also reported that schools that were fenced and were longer in length tended to be associated with reduced vehicle speeds; a finding replicated by Kattan, Tay, and Acharjee, (2011). These findings suggest that latent factors within the road environment may be inadvertently contributing to speeding behaviour. From this perspective, speeding may not always be an intentional behaviour. Instead, it may be an error brought about by the complex traffic environment (Salmon, McClure, & Stanton, 2012; Reason, 1990).

This suggestion is consistent with the systems approach to human error (Reason, 2000). The systems approach, from a road safety perspective, acknowledges that human fallibility exists, but rather than view it as a cause, the systems approach purports that road accidents result from an interaction between human behaviours and ensuing latent conditions within the road environment (Larsson, Dekker, & Tingvall, 2010). These latent conditions can include inadequate training, manufacturing deficits, poor road infrastructure, and confusing road environments. Consequently, the systems approach removes the apportioning of blame from individuals to include operators within the system. It also recognises the fallibility of humans and encourages error tolerance within system designs.

In recognition that not all speeding behaviour is a direct result of intentional non-compliance on the part of the driver, in a recent paper we proposed that motorists who are interrupted by signalised traffic intersections within school zones may forget to resume travelling at the deferred school zone speed limit upon driving resumption due to prospective memory error (see Gregory et al., 2014). To do so we compared the speed of motorists who were interrupted and required to stop at signalised traffic intersections within school zones to those

of motorists who had an unimpeded passage through them. In this way, interrupted motorists were faced with an open road upfront while waiting at the traffic light and noninterrupted motorists were free-flowing. A secondary objective was to assess whether introducing a flashing "check speed" reminder sign, positioned 70 m after the traffic light intersections, could mitigate any interruptive effect found between interrupted and noninterrupted motorists. The following sections will present only the method and results of our earlier paper that is relevant for the present discussion. For a more detailed elaboration see Gregory et al. (2014).

Method

In total, the speeds of 2496 school time motorists who were not interrupted by signalised traffic intersections and the speeds of 647 school time motorists who were interrupted by signalised traffic intersections was recorded. When a flashing "check speed" sign was introduced, the vehicle speeds of 2496 noninterrupted motorists and the vehicle speeds of 647 interrupted motorists were recorded. These warning cue conditions were compared to 256 noninterrupted motorists who had the sign configuration but the flashing lights were turned off (demonstrated to produce equivalent speeds to when no sign was present) and 64 interrupted motorists who also had the sign configuration but the flashing lights were turned off. A criterion value of three seconds was used to differentiate whether individual vehicles were to be included in noninterrupted conditions. Only the first row of stationary vehicles waiting at the intersections were considered for analysis as interrupted vehicles.

Data were collected in four designated school zone areas across metropolitan Sydney, New South Wales (NSW), Australia. A Bushnell's Velocity Speed Gun (Model 101911) was used to measure vehicle speed. Data collection occurred from Monday to Friday during school zone times (8:00am till 9:30am and 2:30pm till 4:00pm) when weather conditions permitted dry roads. At each site location, observers would stand 100 m from the traffic light intersection behind a tree or in a bus shelter while collecting data. Observer one looked in the direction of approaching traffic and would place a scarf over the speed gun to conceal it from passing motorists while taking vehicle speeds. Observer two faced observer one and looked away from the approaching traffic, recording the speeds of the vehicles read out by observer one on the data collection form a well as vehicle sype and whether the vehicle displayed L, P1 or P2 licensing plates. When the flashing "check speed" sign was introduced, it was placed 70m from the signalised traffic intersections.

Results and Discussion

We found that during school time, motorists who were interrupted by signalised intersections (M = 48.27, SD = 6.32) recorded faster vehicle speeds than noninterrupted motorists (M = 41.76, SD = 5.93), $t(3141) = 11.35$, $p < .001$, 95% CI [5.98, 7.02], d = 1.08, 95% CI [0.87, 1.29], suggesting that stopping at signalised traffic intersections within school zones can increase the speed at which motorists resume their journey when measured 100m from these intersections.

Examining the effect of the flashing "check speed" sign on motorists' speed, we found that motorists who were interrupted by signalised traffic intersection with no flashing reminder sign (M = 47.76, SD = 7.63) recorded faster vehicle speeds than motorists who were interrupted but had the flashing sign (M = 40.15, SD = 5.33), $t(1134) = 22.92$, $p < .001$, 95%

CI [7.42, 8.81], *d* = 1.37, 95% CI [0.96, 1.78]. Thus, the provision of the flashing reminder sign offset the effect of the interruption on driving speed. We also found that motorists who were not interrupted by the signalised traffic intersection with no flashing sign (*M* = 40.95, *SD* = 6.35) recorded significantly faster vehicular speeds than motorists who were not interrupted but had the flashing sign (M = 38.54, SD = 4.92), *t*(1524, *t*(2312) = 15.40, *p* < .001, 95% CI [2.84, 3.60], *d* = 0.57, 95% CI [0.29, 0.66]. The provision of the flashing "check speed" sign therefore also reduced the speeds of motorists who were not required to stop at the signalised traffic intersections. These findings are in line with research suggesting that speeding is not always an intentional behaviour on the part of the driver.

In Australia, the aim of the safe system approach to road safety is to view the road transport system holistically to manage the interaction between road users, roads and roadsides, travel speeds and vehicles. The approach recognises that human error within the system is inevitable no matter how educated and/or compliant the road user is to obeying traffic laws, and therefore suggests that all road users need to be protected through safer roads, safer speeds, safer vehicles, and safer road users (Langford, 2009). Despite this more holistic approach, however, there remains a disproportionate weighting assigned to the investigation of how the road environment may contribute to speeding behaviour. Indeed, while the safe system has speeding as a central factor in the model, and suggests that road infrastructure can influence traffic behaviour, there remains a somewhat limited view of speeding behaviour by road safety policy makers. That is, speeding is still assumed to be an intentional, and therefore volitional, act. As a result there remains a greater emphasis on incorporating speed management and policy initiatives that focus on enforcement, legislation, education, leading to greater reductions in speed limits and an increased focus on speeding campaigns and police enforcement. Given our findings, we propose that more: (1) attention is needed in adopting a more user-centred approach in the design of road infrastructure (as suggested by the safe system approach), and (2) recognition that the implementation of road infrastructure may lead drivers to speed as a result of a cognitive oversight rather than a wilful act.

It should be noted that we are not arguing that it is invalid to treat speeding behaviour as an intentional act. Indeed, drivers do deliberately and consciously intend to speed on the roads. What we are arguing is that in some circumstances it is the way the road infrastructure is designed that may encourage and prompt motorists to engage in otherwise avoidable illegal speeding behaviour. Specifically, what our studies show is that speed behaviour, within what are regarded as locations meriting specific protections to protect vulnerable road users (lower speed limits around schools), can: (1) be subject to fundamental psychological processes that result in inadvertent breaches of speed choice; and, (2) when appropriately alerted to this drivers will readily correct their driving to reflect an appropriate speed. In summary, it seems that not all speeding offending behaviour is intentional or contumacious, and that when speeding offending drivers are made aware of their error they can readily correct their driving speed to comply with the posted speed limit.

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