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The driver, the road, the rules . . . and the rest? A systems-based approach to young driver road safety

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ABSTRACT

The persistent overrepresentation of young drivers in road crashes is universally recognised. A multitude of factors influencing their behaviour and safety have been identified through methods including crash analyses, simulated and naturalistic driving studies, and self-report measures. Across the globe numerous, diverse, countermeasures have been implemented; the design of the vast majority of these has been informed by a driver-centric approach. An alternative approach gaining popularity in transport safety is the *systems* approach which considers not only the characteristics of the individual, but also the decisions and actions of other actors within the road transport system, along with the interactions amongst them. This paper argues that for substantial improvements to be made in young driver road safety, what has been learnt from driver-centric research needs to be integrated into a systems approach, thus providing a holistic appraisal of the young driver road safety problem. Only then will more effective opportunities and avenues for intervention be realised.

1. Introduction

Young drivers are universally recognised as a major public health and injury prevention problem due to their persistent over-representation in road crashes. Young driver safety continues to be a significant global concern despite an abundance of research and significant investment in crash-prevention and other intervention programs. Current Australian countermeasure examples include: free driving lessons offered to learner drivers by organisations such as the Royal Automobile Club of Queensland; outreach programs provided to secondary students by advocates of the Spinal Injuries Association; and television advertising campaigns featuring young drivers, their passengers and other road users targeting speeding and other risky driving behaviours, to name a few.

The continued overrepresentation of young drivers in road crash statistics, however, suggests that existing approaches are limited in their capacity to fully address the problem of young driver crashes. Notably the interventions described above are all targeted at the young drivers in an attempt to 'fix' them in a way that leads to improved driving performance. This is in direct contradiction with alternative contemporary 'systems thinking' inspired models of accident causation, widely used in other safety critical domains, that argue that attempting to fix individual behaviour or specific components in response to accidents is inappropriate (e.g., Dekker et al., 2011). Rather, the system itself should be the focus of accident countermeasure development.

The systems approach is a long-established philosophy that first emerged in the early 1900s (e.g., Heinrich, 1931) and has since evolved through a number of accident causation models and analysis methods (e.g., Leveson, 2004; Perrow, 1984; Rasmussen, 1997; Reason, 1990). The approach centres on the notion that safety, and indeed accidents, are emergent properties arising from non-linear interactions between multiple components across complex sociotechnical systems (e.g., Leveson, 2004). The adoption of systems thinking is now widely accepted to be an appropriate approach for understanding and preventing accidents in most safety critical, complex, domains including aviation (e.g., Debrincat et al., 2010; Li et al., 2008) and rail (e.g., Read et al., 2013), and is currently the dominant paradigm in accident research (Underwood and Waterson, in press). Although contemporary road safety strategies contain elements of systems thinking (such as advocating a shared responsibility for road safety), and a systems approach to road safety generally was first touted in the early 1990s (e.g., Zaidel, 1992), applications underpinned by systems thinking-based models and methods in road transport remain sparse (e.g., Larsson et al.,

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2010; Salmon et al., 2012a), particularly within the context of young driver road safety.

This paper argues that the prevailing driver-centric approach, although having produced significant reductions in young driver fatalities and injuries, is no longer appropriate for directing young driver safety interventions. Rather, it is argued that a *systems* approach is required in which the role of the overall road transport system in young driver crashes is clarified and system reforms rather than further driver-centric interventions are pursued. The aim of this paper is to demonstrate the utility of using accident causation and analysis frameworks underpinned by systems thinking to initiate such an approach to young driver safety. In doing so, we first contrast the prevailing driver-centric approach with a systems approach to young driver road safety. In order to provide a holistic appraisal of the young driver problem, a description of the actors within the road transport 'system' is then presented and previous research on young driver safety is integrated into a systems framework. Based on these findings, the directions for future research are identified.

2. Understanding young driver road safety

2.1. The current approach: driver-centric

Traditionally a driver-centric approach has been applied to understanding not only young driver road safety, but road safety in general. That is, a strong focus has been on identifying the specific individual components which contribute to the increased risk experienced by all young drivers', with a particular emphasis on their driving behaviour. For example, much research has focussed on young drivers driving skills, such as hazard perception (e.g., Boufous et al., 2011) and situation awareness (e.g., Whelan et al., 2004); and risky behaviours such as speeding (e.g., Mitchell-Taverner et al., 2003) and driving under the influence of alcohol (e.g., Peck et al., 2008). Frequently the contributing factors are investigated in isolation (e.g., seat belt use, Calisir and Lehto, 2002) or in combination with a handful of other influential variables (e.g., age and gender, Rhodes and Pivik, 2011). The overarching focus then has been the young drivers themselves. Crucially, this research has helped delineate the breadth of driver behaviours and characteristics contributing to young driver crash risks, thus informing countermeasure development. To illustrate this point, the increased risk for all drivers at night simply due to reduced visibility, the greater likelihood of alcohol consumption at night (e.g., Vaez and Laflamme, 2005) and the negative influence of multiple peer passengers (e.g., Doherty et al., 1998) who are likely to be carried by the young driver at night, means that most graduated driver licensing (GDL) programs incorporate a night passenger restriction (e.g., in Queensland, young drivers are allowed to carry one peer passenger only between 11 pm and 5 am), and zero blood alcohol concentration for novice drivers (Queensland Transport, 2007).

Whilst the driver centric approach has had significant success in reducing young driver crash involvement, what appears to be missing is a comprehensive understanding of the system in which young drivers operate. That is, what is the breadth of factors – and most importantly, the relationships between the factors – which are influential in young driver road safety *within* the scope of the young driver road 'system'? How, for example, might other factors such as the behaviour of parents and peers, driver education and training, vehicle and road design, road rules, media coverage, advertising, and high insurance costs interact and influence young driver behaviour?

Moreover, driver-centric research is predominantly atheoretical, and the prevalent theme within the road safety literature focuses upon 'fixing the driver' (Larsson et al., 2010), while largely ignoring the complex interacting system of factors which influence their behaviour. For example, limitations within the public transport system mean that young drivers are likely to be carrying passengers between 11:00 pm and 5:00 am on a Saturday. A systems approach which more fully considers the factors influential in young driver road safety, and the interactions between these factors, is vital if more effective countermeasures are to be developed.

2.2. An alternative systems approach

A systems approach to understanding any complex safety-critical environment, including the road, is characterised by

(1) "top-down systems thinking that recognises safety as an emergent system property rather than a bottom-up summation of reliable components and actions;
(2) focus on the integrated socio-technical system as a whole and the relationships between the technical, organizational, and social aspects; and
(3) focus on providing ways to model, analyse, and design specific organizational safety structures rather than trying to specify general principles that apply to all organisations" (Leveson et al., 2009, p. 241).

As such, road safety is conceptualised as emerging from an interactive and dynamic system influenced by the actions of, and interactions between, a multitude of social, organisational and technical components (Salmon et al., 2012b). This is in contrast to the implicit philosophy inherent within the traditional driver-centric approach that road safety emerges from the driver and their immediate driving environment. An exemplar of what a systems approach can offer to road safety is provided by Salmon et al. (2012c). In this instance, a systems analysis method was applied to the 2007 Kerang rail level crossing incident in Victoria; a crash between a semitrailer and a passenger train which resulted in 11 deaths and 15 people seriously injured. The approach provided a context for understanding how system-wide factors (e.g., road design, trees in close proximity to the crossing, delayed loading of the truck, limited rail level crossing risk assessment process, rail level crossing design financial constraints) created the system in which the incident was allowed to happen.

It is noteworthy at this juncture, however, that a system approach is not synonymous with the road safety 'safe systems' philosophy "which holds that people will continue to make mistakes and that roads, vehicles and speeds should be designed to reduce the risk of crashes and to protect people in the event of a crash" (Australian Transport Council, 2011, p. vii). Whilst there are similarities between the two (such as the notion that safety is the shared responsibility of actors across the system), the safe systems philosophy is still heavily focussed on road user behaviour and the use of infrastructure and vehicle design to *tolerate* the outcomes of these behaviours. In contrast, a systems approach also considers factors outside the immediate environment, and identifies the need to understand the interaction of factors across the system that *influence* the behaviour of humans (i.e., road users) at the 'sharp-end' (i.e., on the road). Rather than strive for a system that is tolerant of adverse behaviours the aim is to address or mitigate the factors and interactions that create the adverse behaviours. For example, one Australian state is considering introducing a scheme whereby parents continue to supervise young novice drivers as much as possible throughout the earliest months of independent driving. Furthermore, the perpetual struggle between mobility and safety in the context of the young driver system also merits consideration within the broader systems approach (e.g., see Bates et al., 2010).

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