Accident Analysis and Prevention 113 (2018) 74–84

Contents lists available at ScienceDirect

Accident Analysis and Prevention

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

Walking the talk: Comparing pedestrian 'activity as imagined' with 'activity as done'

Gemma J.M. Read[a,b,*], Erin L. Stevens[a], Michael G. Lenné[b], Neville A. Stanton[a,c], Guy H. Walker[d], Paul M. Salmon[a]

[a] Centre for Human Factors and Sociotechnical Systems, Faculty of Arts, Business and Law, University of the Sunshine Coast, Maroochydore, Queensland, Australia
[b] Monash University Accident Research Centre, Monash University, Clayton, Victoria, Australia
[c] Transportation Research Group, Civil, Maritime, Environmental Engineering & Science Unit, University of Southampton, Southampton, UK
[d] Centre for Sustainable Road Freight, Heriot-Watt University, Edinburgh, UK

ARTICLE INFO

Keywords:
Performance variability
Pedestrian safety
Intersections
Railway level crossings
Event Analysis of Systemic Teamwork
Systems thinking

ABSTRACT

The safety of vulnerable road users, including pedestrians, is an important issue worldwide. In line with the shift towards systems thinking in transport safety, the aim of this study was to compare the normal performance of pedestrians as they navigate the road system with that imagined by road system managers to gain insights into how safety management can be improved for this vulnerable road user group. The Event Analysis of Systemic Teamwork framework was used to compare pedestrian activity 'as imagined' and 'as done' at signalised road intersections and railway level crossings. Data regarding 'activity as imagined' was derived from documentation review, and data on 'activity as done' was derived from a semi-naturalistic study of ten participants. It is concluded that in both environments pedestrians exhibited more diversity and variability than anticipated by system managers. Insights for improving the design of the road environment for pedestrians are provided. Further, it is argued that wider changes to the processes used in the design and management of road systems are needed.

1. Introduction

The benefits of active transport modes such as walking are well-recognised and there is increasing evidence to support shifts to active transport to improve population health and reduce carbon emissions (e.g. Purcher & Buehler, 2010; Rabl & de Nazelle, 2012). However, there are risks for pedestrians who, as vulnerable road users, are generally more susceptible to injury in crashes than other road user groups (Australian Transport Council, 2011). Between 2004–2008, there were 3,702 pedestrian casualties (fatalities and serious injuries) in the Australian state of Victoria and, across Australia as a whole, pedestrians make up 13% of road fatalities (Burea of Infrastructure, Transport and Regional Economics, 2015). Globally, pedestrian fatalities comprise 22% of all road deaths (World Health Organization, 2015) and worryingly, in the United States, the number of pedestrian fatalities has risen 19% from 2009 to 2014 (Retting et al., 2016).

In Victoria, Australia, the majority of casualty-crashes occur in urban areas and over 40% of fatal accidents involving pedestrians occur at intersections (Senserrick et al., 2014). While collisions with pedestrians at railway level crossings are much less frequent, with 20 collisions in Victoria from 2004 to 2008 (Australian Transport Safety Bureau, 2012a), they are more likely to result in fatal outcomes. These collisions are also more disruptive to the transport system resulting in lengthy train delays with associated economic loss. Statistics indicate that while reductions have occurred in the number of motor vehicle-train collisions at railway level crossings, this has not been reflected in the pedestrian-train collision rate (Australian Transport Safety Bureau, 2012b; Metaxatos & Sriraj, 2013; Stefanova et al., 2015).

Poor pedestrian behaviour has been identified as an important issue for the improvement of pedestrian safety. For example, a study by Freeman and Rakotonirainy (2015) into behaviour at railway level crossings found that 25% of pedestrians reported deliberately violating rules, with the majority doing so because they were rushing or running late. In addition, it is well-known that pedestrians regularly cross against signals at intersections (e.g. Kim et al., 2008; King et al., 2009). It therefore seems apparent that to improve safety we should focus on improving the behaviour of pedestrians, increasing compliance with rules that are developed to keep them safe.

However, is this compliance based approach the most effective way to manage safety? In recent times there has been an increase in the use of so-called systems thinking approaches to understand and enhance road safety behaviours (Newnam & Goode, 2015; Newnam et al., 2017;

* Corresponding author at: University of the Sunshine Coast, Locked Bag 4, Maroochydore QLD 4558, Australia.
E-mail address: gread@usc.edu (G.J.M. Read).

https://doi.org/10.1016/j.aap.2018.01.016
Received 4 September 2017; Received in revised form 19 December 2017; Accepted 13 January 2018

Salmon & Lenné, 2015; Salmon et al., 2013a, 2013b; Salmon et al., 2016). One of the fundamental advances provided by systems thinking centres around the idea that the behaviours underpinning accidents do not necessarily have to be errors, failures or violations (Salmon et al., 2017). As Dekker (2011) points out, systems thinking is about how accidents can happen when no parts are broken. In his drift into failure model, Dekker (2011) argues that the seeds for failure can be found in "normal, day-to-day processes" (pg. 99) that are shaped by goal conflicts and other pressures. These normal behaviours include work-arounds, improvisations, and adaptations (Dekker, 2011). In the pedestrian context, we can view behaviours like jaywalking as an adaptation, undertaken where pedestrians may be frustrated by waiting times and take their own decision to cross when they believe it is safe to do so. Understanding why decisions and behaviours make sense to pedestrians at the time gives us a different perspective on the problem, and facilitates the development of new types of interventions. Studying so-called 'normal performance' and how it plays a role in adverse events is a critical but often overlooked requirement in accident prevention research (Salmon et al., 2017).

Given the current paradigm shift in transport safety from an individual approach to systems thinking approaches (Larsson et al., 2010; Newnam & Goode, 2015; Salmon & Lenné, 2015), this paper argues that comparing the normal performance of pedestrians as they navigate the road system with that imagined by road system managers can provide insights into how safety management can be improved for this vulnerable road user group.

1.1. A systems framework

A popular systems-based model of safety management is Rasmussen's (1997) risk management framework. It describes how the transport system comprises hierarchical levels from government at the top, down to the operating process at the bottom. At each level, decisions and actions are made by actors such as government officials, regulators and transport managers that constrain the decisions and actions of those in the level below. In turn, information is provided back up the hierarchy to inform those above of the effectiveness of the safety constraints. This process of constraints flowing down and information flowing up the hierarchy is known as vertical integration. According to Rasmussen, failures of vertical integration lead to accidents and incidents. Fig. 1 shows Rasmussen's framework adapted for pedestrian activities.

Applying the idea of vertical integration to pedestrian safety, it is important to understand the extent to which the assumptions and expectations of those at the higher levels of the system who own and manage the system flow down through the system and match the behaviour of system users (e.g. pedestrians themselves). The distinction between 'work as imagined' and 'work as done' is an important notion in the understanding of safety-critical systems (Hollnagel, 2014; Norman, 1988). How management anticipate and expect the system to be used is often very different to how it is actually used, particularly over time as practices shift and adapt to perturbations and external disturbances. In the road transport system, the managers (e.g. road authorities, government) tend to promote a normative view of road user activity. That is, they focus on how users should interact with technology and the built environment as designed, regardless of context or competing goals. For example, fences and barriers may be implemented to stop pedestrians from crossing a road in a particular place, with no regard for why pedestrians want to cross there, such as desire lines between points of interest. Deviations from these expectations, such as pedestrians jumping or otherwise circumventing barriers, are addressed through changes to laws in an attempt to reduce variety and variability. However, to improve safety in practice there is a need to understand actual user activity. This provides leverage to design to meet the needs both of the users and the system managers.

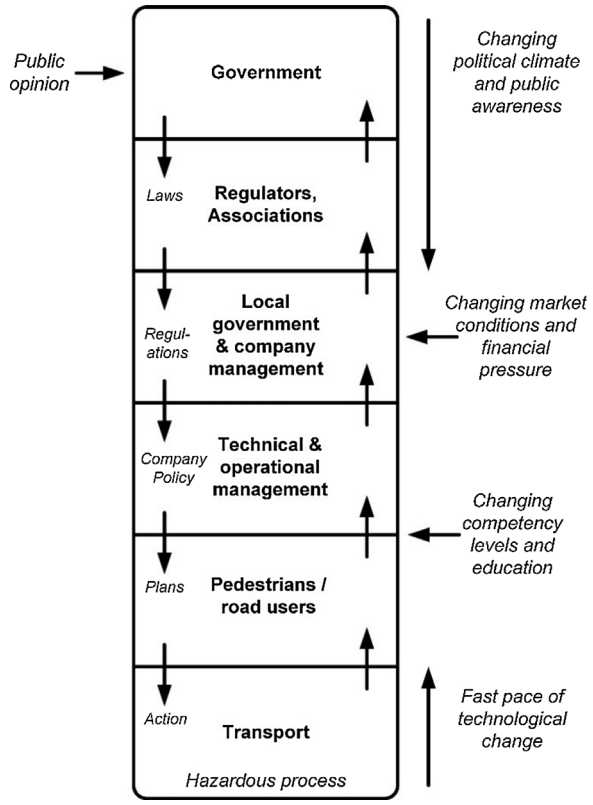

Fig. 1. Rasmussen (1997) risk management framework, adapted for pedestrian activities.

1.2. Performance variability

As noted previously, accident causation theory has moved away from discussions of human error or deviations from normative behaviour; instead focussing on the notion of 'human performance variability' (e.g. Dekker, 2014). This acknowledges that in complex systems, including road transport systems (Salmon et al., 2016), human performance must be variable and adaptive to cope with system perbutations and disturbances. This view of safety emphasises that a broad spectrum of behaviour exists in any system, not only as a dichotomy of compliant and non-compliant behaviour (Dekker, 2006). Unless this is acknowledged by those responsible for designing and managing safety critical systems, opportunities will be missed to create resilient systems. For example, if we know that pedestrians have a general propensity for choosing the quickest or shortest route (Agrawal et al., 2008) then rather than force compliance (which can be expensive), we can use this understanding to design environments in which the quickest, shortest route (or one that appears that way) is also the safest. This could be achieved, for example, by providing signalised crossings where pedestrians prefer to cross.

Research in the area of pedestrian behaviour and safety is beginning to move towards systems-based approaches (e.g. Salmon et al., 2014b; Stefanova et al., 2015; Vizzari et al., 2013) and understanding variability in how pedestrians and other road users perceive and negotiate road environments (e.g. Beanland et al., 2015; Cornelissen et al., 2013; Mulvihill et al., 2014; Salmon et al., 2014b). These applications have provided important insights into how the design of road environments influences pedestrian behaviour and safety; however, no previous research has focussed specifically on the concept of 'work as imagined' versus 'work as done' in the area of road safety. Given that most pedestrians cannot be considered to be undertaking work when interacting with the road system, we can instead conceptualise the comparison as being between 'activity as imagined' and 'activity as done'.

The aim of this study was to contrast the activities of pedestrians 'as