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Key challenges in tram/streetcar driving from the tram driver's perspective – A qualitative study

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ABSTRACT

Tram drivers have a difficult task in controlling one of the heaviest vehicles on the road whilst negotiating a complex road environment with multiple road users. Like all public transport drivers, tram drivers need to ensure passenger safety and to run on time. However, very little research has been conducted evaluating tram driving tasks and even less on evaluating tram drivers opinion on how other road users are affecting tram road safety. Therefore, the aim of this study is to investigate the key tram driving challenges, to identify the key road user factors affecting tram road safety as well as to explore the potential safety improvement initiatives on tram routes from the tram drivers' viewpoint. The study incorporated five focus groups involving thirty tram drivers in Melbourne. The key themes emerged inductively from focus groups were identified through a data coding process. Outcomes of the focus groups revealed seven major challenges in tram driving: ensuring safety for all people in and around the tram, pressure for running on-time, maintaining constant concentration on roads, predicting other road users' behavior in advance to avoid any crash incident, preventing passenger falls on board, accepting the operational constraints of trams and managing fatigue workloads. Tram drivers identified that other road users are unaware of safety issues around trams, have a poor understanding of road rules about driving with trams and often violate road rules around trams, and they mentioned this road user behaviors as the key challenges for safe tram driving. Tram drivers proposed rendering greater law enforcement on the tram network to penalize road users who are violating road rules around trams, introducing more safety campaigns and safety education to increase awareness among road users to improve tram road safety. Findings of this research enhance understanding of tram driving challenges, provide an in-depth knowledge of road user factors affecting tram road safety and suggest effective planning strategies for transit agencies to improve road safety.

1. Introduction

Trams/streetcars are light rail transit vehicles which run on fixed rail tracks on roads and mostly share the road space with other traffic and pedestrians. Trams sharing the road with general road traffic is often known as 'mixed traffic tram operation'. Except for mixed traffic, metropolitan trams mostly operate in two other environments: on light rail tracks where

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trams run on their own corridors separated from the road as well as on dedicated tracks where tram lanes are physically separated from other road lanes (Naweed & Rose, 2015b). It is the tram driver who has to control and negotiate trams on these different road environments. In addition to different tram road configurations, tram drivers have to follow traffic signals at road intersections whilst also serving passengers at various types of tram stops often in close proximity to waiting passengers. Moreover, like all public transport drivers, tram drivers need to ensure passenger safety as well as ensuring trams run on time. Despite all these clear challenges, very little research has been conducted evaluating the tram driving task from the tram drivers' point of view.

Tram systems have a number of attractive features including higher passenger capacity, better comfort and lower emission of pollutants compared to other transport systems (Adams & Commissioner, 2008; Anna & Bruce, 2001; American Public Transportation Association, 2016; Cliche & Reid, 2007). Therefore, many countries are introducing new tram networks or extending their existing networks to reduce traffic congestion and to improve the urban environment. However, trams present a range of inherent safety issues regarding their design and operational characteristics, since they are large and heavy vehicles operating in confined, mixed and complex environments with multiple road users (Cheung, Shalaby, Persaud, & Hadayeghi, 2008; Currie & Shalaby, 2007; Grzebieta, Rechnitzer, Daly, Little, & Enever, 1999; Hedelin, Björnstig, & Brismar, 1996; Kruszyna & Rychlewski, 2013; Marti, Kupferschmid, Schwertner, Nash, & Weidmann, 2016; Vuchic, 2007). Mixed traffic tram operation has significant safety challenges, as general road traffic can use all road lanes including the tram lanes, which increases the chance of interactions among road users (Currie & Smith, 2006; Korve et al., 1996; Naznin, Currie, Logan, & Sarvi, 2015a; Richmond et al., 2014; Vandenbulcke, Thomas, & Panis, 2014, Marti et al., 2016). Melbourne, Australia which has the largest tram network in the world and also the largest mixed traffic tram network (Currie & Shalaby, 2007) has a considerable number of tram-involved collisions in past years; 4819 tram-involved collisions were recorded between 2009 and 2013 on the Melbourne tram network by Yarra Trams, the Melbourne tram operator (Yarra Trams, 2014). Tram-involved collisions in Melbourne were mostly identified as collisions between trams and road vehicles, tram-involved pedestrian collisions, collisions between trams, tram hits infrastructure and other obstructions (Transport Safety Victoria, 2013).

Marti et al. (2016) examined tram safety in Switzerland and identified that most of the tram-involved collisions occurred with motorists. Their study also revealed that pedestrians and cyclists are at the most severe crash risk by trams in Switzerland's mixed traffic tram operating environment. Farrán (2000) identified tram-to-car collisions as the most common type of tram-involved collision in the US. Candappa, Corben, and Yuen (2013) identified road safety hazards between trams and motor vehicles at 'cut-through[1]' locations in Melbourne and the study found that motor vehicles making U-turns in front of oncoming trams at these locations are mostly struck by trams from behind and are highly likely to have severe crash outcomes. In Melbourne, trams were identified as the second most common cause of pedestrian trauma after cars by Corben and Diamantopoulou (1996). Mitra, Al Jubair, Cameron, and Gabbe (2010) explored tram-related accident patterns based on hospital data and identified that pedestrians hit by trams are the most common cause of major trauma. A study conducted by Cameron, Harris, and Kehoe (2001) in Sheffield, UK, identified that cyclists were the most vulnerable group for tram-related trauma, followed by pedestrians and motorists, including motorcyclists. A similar finding was obtained by Vandenbulcke et al. (2014) in Brussels, Belgium while evaluating the risk factors for cyclists. Several studies have also identified safety concerns for trams at stops (Currie & Shalaby, 2007; Hedelin et al., 1996; Korve et al., 1996, 2001). Currie and Reynolds (2010) identified that 82% of incidents at tram stops are related to pedestrians in the Melbourne context.

Due to a considerable number of tram-involved crash occurrence in many cities, previous studies have identified various traffic, road, vehicle and environmental factors affecting tram road safety (Cheung et al., 2008; Naznin, Currie, & Logan, 2016a; Shahla, Shalaby, Persaud, & Hadayeghi, 2009; Naznin, Currie, Logan, & Sarvi, 2016b). However, previous tram safety research is almost entirely based on analyses of reported crash data which is known to have a lack of detailed information on the related risk factors, especially road users factors (Alsop & Langley, 2001; Elvik & Mysen, 1999; Giles, 2001; Lopez, Rosman, Jelinek, Wilkes, & Sprivulis, 2000).

A study conducted by Naweed & Rose (2015b) examined the tram driving tasks and evaluated human factors involved in tram-involved collisions in Melbourne. They combined accident reports, on-site observations, focus group discussions and individual driver interviews for their study. The results revealed three basic themes related to tram collisions: tram driver's situation awareness, time pressure, and organizational behavior. Their other study (Naweed & Rose, 2015a) focused on exploring the factors contributing to tram-to-tram collisions at two intersections with high crash risks. They observed tram activities at peak and off-peak periods, followed by 12 individual interviews and a focus group to evaluate the potential conflicting situations at two intersections. Results identified several human factors including high workload across the network and lack of situation awareness which increase the chance of crashes. However, both of the studies focused on particular high crash risk locations on tram routes and did not generalize their findings for the network as a whole. In addition, both studies mostly focused on tram driver factors for collisions, not on other road user factors. Therefore, there is a clear need to investigate the detailed road user factors affecting tram road safety. In addition, no previous studies were found to explore the potential safety measures to improve tram road safety from the tram drivers' point of view.

[1] Cut-through is a median opening for traffic across tram tracks.