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Title: The experiences and perceptions of heavy vehicle drivers and train drivers of dangers at railway level crossings

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The experiences and perceptions of heavy vehicle drivers and train drivers of dangers at railway level crossings

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Abstract

Heavy vehicle-train collisions have the potential to be catastrophic in terms of fatalities, environmental disaster, delays in the rail network, and extensive damage to property. Heavy vehicles, such as 'Road Trains' and 'B-Doubles', are vulnerable road users due to their size and mass and require specific risk management solutions. The present study aimed to capture the experiences of heavy vehicle drivers and train drivers at road-rail level crossings, with a view to exploring the contributing factors toward such accidents. A series of semi-structured focus groups were conducted, with a total of 17 train drivers and 26 heavy vehicle drivers taking part. Though there were some differences between the groups in perceptions of the causes of heavy vehicle level crossing incidents, discussion in both groups centred on design issues and behavioural issues. With regard to design, the configuration of level crossings was found to affect heavy vehicle driver visibility and effective vehicle clearance. With regard to

behaviour, discussion centred around wilful violation of crossing protocols, often as a time-saving measure, as well as driver complacency due to high levels of familiarity. The implications of these factors for future level crossing safety initiatives are discussed.

Keywords: *level crossings, train drivers, heavy vehicle, human error, qualitative.*

1. Introduction

A recent study by the Australian Transport Safety Bureau (ATSB) (Australian Transport Safety Bureau, 2003) indicates that from 1997 to 2002 there were 74 deaths due to collisions between trains and motor vehicles at railway level crossings. Though these collisions represented less than 1% of the national road toll in the same period, they constitute a significant proportion of the Australian rail toll. Fatalities are typically spread across the railway network, which boasts approximately 9400 level crossings. Of these crossings, only 30% are equipped with active protection systems (boom gates and/or twin flashing lights). With such a large network, the potential for a catastrophic event at level crossings, such as a train derailment resulting from a heavy vehicle/train collision, is of great concern.

Of all road crashes which occur, those that involve a collision between a heavy vehicle and a train are amongst the most severe. Despite the low incidence rate of level crossing collisions, the potential loss in financial terms associated with a heavy vehicle-train collision, and the associated potential for delay in the commercial rail network, is far from trivial. Data collected from 1996 to 2000 in the state of Queensland indicates that, of the seventeen major incidents that occurred at level crossings, eight involved

semi-trailers and three involved other heavy vehicles (Ford and Matthews, 2002). Furthermore, a heavy vehicle/train level crossing incident also represented the highest cost resulting from a road accident in Queensland, a collision between a train and a 'road train' in which the damage bill totalled $AUS3.25 million (Ford and Matthews, 2002). Two other such accidents have also eclipsed the $AUS1 million dollar mark in Queensland alone, with numerous others in the AUS$100 thousand to AUS$1 million range. Similar incidents are also common across the rail network in other states. For example, in the state of New South Wales alone, thirteen train derailments have resulted from heavy vehicle collisions at level crossings since 1992 (Cairney, 2003).

Although there has been some shift of freight to rail in recent years, commercial heavy vehicle traffic on the eastern corridor of Australia is forecast to double in the next 5-10 years. Given the increased traffic, it would therefore seem logical to upgrade protection systems at all level crossings to reduce risk. However, given the sheer size of the rail network in Australia, this has been judged to be neither a cost-effective nor practical solution (Australian Transport Safety Bureau, 2003). As such, recent efforts to improve safety at level crossings are focusing on a human factors approach rather than purely on engineering solutions. With level crossing collisions having such a destructive and costly potential, it is surprising that little research has been directed toward understanding the different perspectives of train and heavy vehicle drivers.

Train drivers are in a position to provide a unique perspective on heavy vehicle-level crossing interactions. Previous research conducted in Australia capturing train drivers experiences of driver behaviour at level crossings found that, on the basis of the number of unreported 'near-crashes' observed by train drivers, the risk involved at crossings are

more serious than the low accident rate suggests (Labour Council of New South Wales, 2001). Furthermore, this research found that train drivers perceive there is a general disregard by motorists for the laws and warning systems at level crossings, with the overhanging of long heavy vehicles being a common issue. Though the impact of these incidents on train drivers receives little recognition, the research available suggests a variety of negative psychological side-effects, often severe enough to preclude a return to work (Labour Council of New South Wales, 2001). Thus, given the opportunity they have to observe heavy vehicles at crossings, and the salience of the experience to the drivers themselves, train driver experience may be seen to be an important link in understanding heavy vehicles at level crossings.

Although the perspectives of train drivers is an important element in understanding heavy vehicle-train collisions at level crossings, the input from heavy vehicle drivers is just as critical. A conceptualisation of heavy vehicle drivers which occasionally arises in road safety circles is that of the 'cowboy' mentality; the perception that drivers consciously ignore the risks involved in their occupation, with indifference toward their own safety and that of the public. The implication of such a perspective for level crossing safety is the inference that drivers deliberately ignore crossing protocols, adding to the risk of collision with a train. While there is no doubt an element of risk taking exhibited by some heavy vehicle drivers at level crossings, such explanations are overly simplistic and fail to take into account external circumstances influencing driver behaviour (Arboleda, Morrow, Crum and Shelley, 2002). Furthermore, they do not address the findings of technical research in the field, which has suggested that the design and configuration of level crossings is often inadequate for heavy vehicles (Gou and Bellvigna-Ladoux, 2003). Gaining input from heavy vehicle drivers may serve to

put the contribution of conscious risk taking in perspective, allowing a clearer indication of its contributions to heavy vehicle driver difficulties at level crossings.

This paper presents findings from an exploratory qualitative study focusing on the perspectives of train and heavy vehicle drivers to level crossing safety. The study was undertaken as part of a larger continuing national project investigating driver behaviour at level crossings and the role of educational countermeasures for different road user groups. The output of this exploratory research can be conceptualised as the 'ground-work' required to build specific, targeted road safety educational countermeasures for heavy vehicles, assisting in providing an alternative to engineering solutions for managing risk at level crossings.

2. Method

A series of focus group discussions were undertaken, consulting a sample of train drivers and heavy vehicle drivers who provided informed consent to participate in the research. Each focus group ran for approximately 90 minutes, was moderated by trained researchers audio taped for later transcription. Participants were informed that participation was purely voluntary and that their responses would remain anonymous through de-identification of any collected data. In consideration of the sensitive nature of involvement in collisions (particularly fatal collisions), participants were not asked directly if they had been involved in a level crossing collision but were encouraged to discuss their experiences. An agenda for the focus group discussions was developed in consultation with experts in the field, with topics including the nature, frequency and

reporting of incidents at level crossings; types of vehicles involved in incidents; types of behaviours observed at level crossings; perception of motivation for behaviours; the impact of incidents; and the effectiveness of protection systems. Transcriptions were analysed through a qualitative thematic analysis process.

2.1. Train drivers

The train driver focus groups took place during October 2004, with one focus group being held in a major city (metropolitan passenger services) and the other in a regional area (freight transport). Seventeen train (17) drivers participated in total, with eight (8) from the metropolitan area and nine (9) from the regional area. All participants were male reflecting gender profile of this workforce. The mean years of industry experience for the metropolitan group was 24 years (range 1 to 34 years) and for the regional group, 23 years (range 5 months to 42 years). The majority of participants were train drivers (n=15), while two participants were train guards. All participants had experienced 'near-crashes' with motorists at level crossings, while many regional train drivers had also experienced numerous 'near-crashes' with heavy vehicles. The majority of participants also revealed that they had experienced a fatal level crossing collision during their career.

2.2. Heavy vehicle drivers

Heavy vehicle drivers were recruited through convenience sampling at a large truck stop in Brisbane, with assistance from the Queensland Trucking Association (QTA), the principal Trucking/Road Freight industry association in Queensland. In total, 26 heavy

vehicle drivers participated. Agenda, time and moderation style mirrored the train driver groups. All participants received incentives (a travel mug) for their time. Written information was provided to each potential participant, with verbal agreement being obtained for participation. Verbal consent was deemed the most appropriate type of consent for this industry, as anecdotal evidence suggests that many heavy vehicle drivers are apprehensive of road safety research. Most heavy vehicle drivers were employed drivers of 'B-Doubles', with a few being owner-operators. It is noted that a "B-Double" is a large vehicle combination made up of a prime mover and two semi-trailers, which is also often referred to as "road-train".

3. Results

3.1. Train driver perceptions of truck driver behaviour

Throughout the focus groups discussions with train drivers, the risk raised by heavy vehicles at level crossings was a topic that emerged with regularity. It became clear that train drivers consider their interactions with trucks and truck drivers a primary challenge in improving rail safety. Drivers reported that the danger posed by heavy vehicles at level crossings was twofold: risk factors associated with the physical size and mass of the vehicles, and risk associated with the behaviours of the drivers. These factors will be discussed in detail below.

3.1.1. Risk associated with heavy vehicle size. A theme common to regional and metropolitan train drivers was the risk of catastrophic consequence associated with level

crossing collisions. The reasons given for this were the threat of derailment, serious property damage, the high risk of a fatality, personal injury and, most earnestly, the potential for enduring psychological consequences. Drivers uniformly spoke about the continual fear they had of being involved in a collision with a heavy vehicle, and many spoke of the effects that such collisions had on train drivers involved. For this reason, train drivers were said to consider any near-crash incident involving trucks particularly serious. This is in marked contrast to the general view of near-crashes involving cars, which most drivers seem to rationalise and dismiss as a minor danger and acceptable part of their job.

Another emergent theme relating to heavy vehicle size and mass was the fact that heavy vehicles have significantly more difficulty negotiating level crossings successfully. This concern was reflected by the regional and metropolitan drivers in different ways. While regional train drivers were more inclined to discuss the difficulties heavy vehicle drivers face in gauging the time required to cross the crossing safely, their metropolitan counterparts cited concerns related to unintentional overhang of long vehicles. This overhang was said to be especially prevalent in high traffic areas, where a heavy vehicle driver underestimated the space required to clear a crossing, and were thus unable to obtain safe clearance. Both the regional and metropolitan drivers reached consensus that these risks often existed not because of dangerous behaviour on the part of the heavy vehicle drivers, but inadvertently from a general ignorance as to the actual size of their vehicle. Urban train drivers were further inclined to implicate traffic, road design and crossing location as factors increasing this risk.

3.1.2. Risk associated with heavy vehicle driver behaviour. The consensus of train drivers regarding risk caused by unsafe heavy vehicle driver behaviour, was that it occurred frequently and wilfully. A common perception, especially among the regional train driver group, was that heavy vehicle drivers often deliberately increased their speed in order to 'beat the train' across the crossing. Attributions for this behaviour centred on a perceived desire to avoid delay. While some drivers took the view that this behaviour was generated by impatience or recklessness, others cited the intense time pressures that truck drivers are often placed under. To this end, the drivers in the regional sample were able to cite that drivers employed by two specific trucking companies (names omitted) were chief offenders. The wilful unsafe behaviour by the heavy vehicle drivers emerged as a more serious problem for the regional sample, with many examples of repeated violations at crossings suggesting it to be of primary concern. However, train drivers within the metropolitan sample were also able to identify variations of this behaviour, such as the deliberate avoidance of boom gates.

3.2. Heavy vehicle drivers' perceptions of their level crossing behaviour

Drivers accepted some culpability, but perceived the motivations behind their behaviour at level crossings differently to train drivers. Heavy vehicle drivers generally displayed a high level of knowledge regarding crossing laws and safety crossing behaviour. Furthermore, they also demonstrated an understanding of how difficult it was for train drivers to take emergency action to avoid a collision and did, on the whole, acknowledged that their fellow truck drivers do frequently infringe level crossing laws. Their assignment of causation for their unsafe behaviour, however, differed to that

perceived by the train drivers, and they were able to cite several factors influencing their actions at level crossings. These are discussed below.

3.2.1. Crossing design. A unanimous complaint from heavy vehicle drivers was that level crossings are not designed in a manner which is user-friendly to their vehicles. The metropolitan environment was cited as a primary example, where choice of crossing location, traffic and other roadway factors can lead to unintentional short-stacking and overhang e.g., required to stop while part of vehicle remains on crossing. On the other hand, regional crossings were also said to cause difficulties, with design faults and location choice having detrimental effects on sight distances and train visibility. A further comment was inadequate warning of approaching crossings, which drivers perceived greatly reduced their ability to take appropriate action. Heavy vehicle drivers suggested that such shortcomings in design and protection systems were responsible for the majority of unsafe driver behaviour observed at level crossings.

3.2.2. Familiarity and complacency. Heavy vehicle drivers nominated their high level of familiarity with their routes, and with the level crossings they encountered while travelling these routes, as a major factor associated with their crossing behaviour. Here, it was discussed that drivers sometimes suffered lapses of concentration, resulting in them failing to follow appropriate safe crossing behaviour at level crossings. Drivers tended to defend their own perceived complacency as a function of high levels of familiarity with the crossings and, furthermore, expressed a degree of confidence in their ability to identify which crossings were most dangerous and required most attention. While a practical approach on the surface, this familiarity was sometimes observed to breed overconfidence in their abilities to control their vehicle, which

resulted in the drivers being generally less inclined to engage in safe crossing behaviours.

3.2.3. Wilful risk taking. Though the truck drivers were generally inclined to identify the above two factors as the predominant causative agents of their unsafe crossing behaviour, a minority raised the spectre of wilful risk taking among drivers. These reports included both confessions of individual involvement, as well as second-hand reports from and observations of other drivers' behaviour. The most prominent motive for unsafe behaviour was a desire to avoid delay in getting to their destination. These drivers frequently cited the delay caused by not only waiting for trains to pass, but also the significant time lost involved in deceleration and re-acceleration. Others were more direct, citing the personal frustration and impatience associated with stopping at crossings for professional drivers. These drivers stated that trains should be slowed down at crossings with large volumes of heavy vehicles.

At the core of each of these behaviours were perceptions of time pressures due to the rigid timetabling imposed by the trucking companies. Many drivers attempted to rationalise their behaviour by stating that, although they knew not obeying level crossing warning systems to be dangerous, they managed their risk level by limiting this behaviour to crossings where they perceived such behaviours to be 'safe'. It is worth noting that drivers were, in general, uncomfortable when discussing wilful risk taking, often attributing it to 'other drivers'. This points to a general awareness that this behaviour is not perceived as responsible, safe or socially acceptable.

4. Discussion

The aim of this study was to provide a formative exploration of the behaviour of heavy vehicle drivers at level crossings. It contributes to the existing literature by capturing the experiences of the primary parties involved. This means that not only were the heavy vehicle drivers themselves consulted, but also the train drivers who, as it was revealed, often have first-hand observational experience of aberrant heavy vehicle driver behaviour at level crossings. Taken together, the experiences of these two groups paint a more detailed picture of the circumstances and behaviours that may contribute to heavy vehicle accidents at level crossings.

In addressing the contributing factors to heavy vehicle accidents at level crossings, both the train and heavy vehicle drivers gave consideration to the size of the trucks involved, and the difficulties that this posed in negotiating the crossings. This was expressed both in terms of factors affecting clearance (impeded acceleration, length of carriage, manoeuvrability) and factors affecting visibility (lines of sight, angles of approach). There was a genuine consensus that such factors introduced a danger at level crossings over and above driver behaviour. Research across the Canadian rail network, comparable to Australia's in terms of its size and layout, supports such findings, having demonstrated that the design of level crossings often do not accommodate for the specific needs of heavy vehicles (Gou and Bellvigna-Ladoux, 2003). It has been suggested that this is due to design considerations being based on an idealistically constructed testing environment, which assumes unrealistic clearance times for larger vehicles (Coghlan, 1997) and fails to adequately account for surrounding environmental factors (such as intersections and traffic patterns) (Caird, Creaser, Edwards and Dewar,

2002). Unfortunately, though such problems represent real dangers to level crossing safety, network-wide engineering-style solutions to these problems are currently regarded as economically and practically unfeasible (Australian Transport Council, 2003). Therefore, rightly or wrongly, this places the practical emphasis for level crossing safety onto the heavy vehicle driver.

Beyond design factors, the responses of both groups demonstrate that heavy vehicle driver behaviour may add to the danger at level crossings. To this end, two tendencies were cited: the effects of familiarity on driver alertness to crossings, and a perception that heavy vehicle drivers take excessive risks.

The effect of high levels of driver familiarity with routes was discussed among the heavy vehicle driver sample, with a degree of acceptance from the participants that it can lead to complacency at level crossings. Given that the drivers in the sample reported a high level of knowledge of crossing protocols, as well as an understanding of the potential consequences of a collision, it may be surprising to see them nominate complacency as an explanation for dangerous behaviour at level crossings. However, this may be more an artefact of their job than an admission of negligence. Heavy vehicle drivers in Australia often drive a limited number of routes at a high frequency, meaning that they can become highly familiar with conditions and, by extension, the level crossings they encounter. This constant exposure, coupled with the low frequency of level crossing accidents, may breed a learning effect that encourages complacency. For example, if a truck driver repeatedly encounters a certain crossing without seeing a train, this may lead to a low expectation of encountering trains here in this future and a learning that heightened attention is not required at this crossing (Witte and Donahue,

2000). Given drivers constant exposure to the same level crossings, this learned complacency may hold a level of reinforcement difficult to break.

Though learned complacency no doubt plays a role in dangerous heavy vehicle driver behaviour, both the train drivers and the heavy vehicle drivers cite deliberate risk taking as a primary cause. Train drivers reported heavy vehicle drivers routinely exhibit dangerous behaviour they attribute to attempts to 'beat the train' and avoid stopping at crossings. Heavy vehicle drivers confirmed this to be the case, though often attributed the behaviour to 'other drivers'. These behaviours can be categorised as violations on the part of the drivers, acts that imply a wilful disregard of safe crossing protocols, as well as indifference toward the risks involved in their behaviours (Lawton, Parker, Stradling and Manstead, 1997). In the case of heavy vehicle drivers, however, this explanation tells only part of the story; more interesting are the influences that may facilitate the behaviour. To this end, heavy vehicle drivers cited unrealistically rigid scheduling and punitive measures for non-compliance as a primary motivator for risk taking. This is not an uncommon explanation, with previous work observing such heavy vehicle industry management practises as instrumental in driver violations (Arboleda et al, 2002). Here the finding is given extra credence, however, by the train driver observations that wilful violations are more common among drivers of some companies than others. This may suggest a move beyond the simplistic 'cowboy' characterisation of individual drivers, and a recognition that level crossing behaviour may be partly an issue of industry culture.

Countermeasures

While the authors recognise that making wide spread changes to current operational level crossings may be considered unfeasible, future level crossing design (or scheduled maintenance and renovations) should accommodate for the specific size and layout needs of large trucking vehicles. More specifically, the results of this research indicate that the level crossing design process should include consideration of the requirements and limitations of driving large vehicles, including: (a) length of vehicle, (b) manoeuvrability, and (c) visibility. Furthermore, the implementation of advanced warning systems such as increasing the existence of early road signage may prove fruitful in improving safety. In addition to design factors, after considering the study's emerging themes regarding wilful violations and complacency, there may appear some merit in implementing educational awareness campaigns that highlight to large vehicle drivers the increased risks associated with operating trucks on and around level crossing. Such an initiative could be conducted at a company-level through the supervision or induction process and possibly reinforced through corresponding regulatory governing bodies. From an enforcement perspective, the likelihood of creating attitudinal and behavioural change would also be increased if risky level crossing manoeuvres were detected and penalised, or alternatively, if perceptions of such detection was increased. Taken together, an appropriate amount of attention should be directed towards improving level crossing safety at both the environmental and driver level, as the complex conditions encountered at such locations remains one of the most difficult driving tasks associated with operating large vehicles.

5. Conclusion

Though the number of incidents involving heavy vehicles at level crossings may pale in comparison to other road accidents, it is the sheer scope for catastrophe in terms of dollar value and loss of human life that marks it as an area worthy of study. In capturing the experiences of both train drivers and heavy vehicle drivers, the two groups most likely to have first-hand experience with the behaviours, incidents and consequences involved, this study has aimed to articulate the understanding of heavy vehicle level crossing safety. The results show that, while crossing design is regarded as a legitimate contributing risk factor, the behaviour of heavy vehicle drivers at level crossings still poses a considerable danger. With increasing rail and road freight traffic across Australia, coupled with the prohibitive cost of design-based safety solutions, the need for interventions targeted at changing heavy vehicle drivers' behaviours and attitudes to level crossing safety becomes clear.

The specific development of level crossing countermeasures and protocols aimed at improving safety would also benefit from further research into this sub-culture of truck drivers who have traditionally been reluctant to participate in programs of research. However, the findings of this study need to be replicated with larger sample sizes to determine the generalisability of the main themes, as well as identify additional contemporary factors that influence level crossing behaviours among both train and truck drivers. Additionally, it may prove of assistance to examine other areas of health promotion research that have been successful in targeting specific behaviours among certain subgroups rather than relying on generalist education campaigns. While likely to remain difficult, research endeavours to improve level crossing behaviour among such groups can only assist in the identification of effective and practical methods to

reduce the risk and consequences of serious crashes at meeting locations of rail and road transport services.

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