Title page

Title

Towards a structured understanding of caregivers' safety behaviour in the domestic and driveway setting

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Abstract
Slow speed run-overs represent a major cause of injury and death among Australian children, with higher rates of incidents being reported in Queensland than in the remaining Australian states. Yet, little attention has been given to how caregivers develop their safety behaviour in and around the driveway setting. To address this gap, the current study aimed to develop a conceptual model of driveway child safety behaviours among caregivers of children aged five years or younger. Semi-structured interviews were conducted with 26 caregivers (25 females/1 male, mean age, 33.24 year) from rural and metropolitan Queensland. To enable a comparison and validation of findings from the driveway, the study analysed both driveway and domestic safety behaviours. Domestic safety behaviours were categorised and validated against driveway safety behaviours, uncovering a process of risk appraisal and safety behaviour that was applicable in both settings (the Safety System Model). However, noteworthy differences between the domestic and driveway setting were uncovered. Unlike in the domestic setting, driveway risks were perceived as shifting according the presence of moving vehicles, which resulted in inconsistent safety behaviours. While the findings require further validation, they have implications for the design and implementation of driveway run-over interventions.

Key words

Slow-speed driveway run-over, paediatric injury prevention.

Highlights

- We focused on caregivers' domestic and driveway child safety behaviour
- Semi-structured interviews were conducted with 26 caregivers of young children
- A model of caregiver risk appraisal and safety behaviours was developed
- Differences between the domestic and driveway setting were highlighted, most notably the tendency of caregivers to view the safety of the driveway as shifting

1. Introduction

Pedestrian incidents represent a major cause of injury and death among Queensland children (Queensland Injury Surveillance Unit, 1999). Pedestrian fatalities are most often classified into either traffic or non-traffic categories under the International Classification of Diseases coding ICD-10 (World Health Organisation, 2005). Traffic pedestrian incidents are usually defined as those that occur on a public street or highway, while non-traffic pedestrian incidents are defined as those that occur in driveways, parking lots, and laneways (Brison et al., 1988). It is this latter incident type that remains a considerable risk to young children, as previous research has reported a higher paediatric mortality rate for this form of incident (Partrick et al., 1998). In Australia, one in four child pedestrian hospitalisations result from injuries sustained on home driveways (Pinkney et al., 2006). Of concern is the fact that paediatric pedestrian incident rates have remained relatively stable over the past decade, while road trauma in general has seen a steady decrease (Murphy et al., 2002).

There have been a number of Australian studies that have focused on the prevalence of paediatric non-traffic pedestrian incidents. A nationwide investigation into the incidence of low-speed motor vehicle driveway fatalities revealed that 12 fatalities occurred, on average, per year between 1996 and 1998 (Neeman et al., 2002) and 8.5 fatalities occurred, per year, between 2000/01 and 2005/06 (Parliamentary Travelsafe Committee, 2007). Using several Australian injury and fatality databases, the Bureau of Infrastructure, Transport and Regional Economics (BITRE) (2012) reported 60 fatal slow-speed run-overs incidents involving children aged 0 – 4 year between January 2001 and December 2010. Past research has demonstrated that Queensland records a significantly higher rate of low-speed run-over incidents than the rest of Australia (Parliamentary Travelsafe Committee, 2007; Queensland Council on Obstetric and Paediatric Morbidity and Mortality, 1998). Queensland Health has reported that between July 2000 and June 2006, 376 children under the age of five years were admitted to Queensland hospitals after a low-speed run-over incident. This equates to an average of 75.2 children per annum. A recent study conducted by Griffin et al. (2011) used CCYPCG data to analyse fatal, low-speed vehicle run-overs involving children in Queensland between January 2004 and December 2008. During this period, 15 fatalities were registered (rate: 1.67/100,000), of which the majority (n = 8) were children under the age of two. Although the overall occurrence appears to be low, driveway run-over incidents are one of the leading causes of death and serious injury in young children. As such, this is an important area that deserves the attention of policy makers and injury prevention professionals.

1.1 Key characteristics of driveway run-over incidents

Investigations in Australian and other parts of the world point to a common set of driveway run-over characteristics. Most often, driveway run-over incidents involve children aged 5 years and younger (BITRE, 2012; Partrick, Bensard, Moore, Partington, & Karrer, 1998), with most events occurring at or near the child's home, or at the home of relatives or friends (Australian Transport Safety Bureau [ATSB], 2006; Hsiao et al., 2009). In almost all incidents, the environment did not provide a clear delineation or separation between the

driveway and the rest of the yard or children's play area (ATSB, 2006; Hsiao et al., 2009; Shepherd, Austin, & Chambers, 2010; Roberts, Norton, & Jackson, 1995). As the majority of driveway run-over incidents tend to occur at the child's home, it is the parents, relatives, or neighbours who are most likely to be the drivers involved in the incidents (BITRE, 2012; Holland et al., 2000; Hsiao et al., 2009). In Australia, incidents are over-represented in non-metropolitan areas, with the majority of drivers being male (ATSB, 2006; BITRE, 2012). Findings also indicate that large vehicles (cars, trucks, vans and utilities) and in particular family-sized vehicles and 4WD passenger vehicles are frequent or over-represented vehicle types in low-speed driveway run-over incidents (ATSB, 2006; BITRE, 2012). Finally, the physical size or stature of the child is a key risk factor, with smaller children being at greater risk (BITRE, 2012; Nadler et al., 2001).

1.2 Current Project

While previous research has identified the key characteristics of driveway run-over incidents, little attention has, to date, been given to analysing how caregivers develop their safety behaviours in and around the driveway setting. Both parental and child behaviours can be reinforced through environmental changes and management practices. An examination of other child injury prevention strategies, in the domestic setting, provides a foundation for developing interventions to reduce risk through the behaviour change of caregivers. The current study sought to address this gap by investigating and developing a model of driveway safety behaviours among caregivers of young children. As relatively few family interactions take place on the driveway, domestic child safety behaviours were also examined to enable a comparison and a validation of findings pertaining to driveway safety.

2. Method

Given the exploratory nature of the current project, a qualitative approach was used in order to gather the necessary data. A series of individual semi-structured interviews were conducted with caregivers of young children (aged five years or younger), during which participants were asked to describe their safety behaviours in both the domestic and driveway setting. All responses were subjected to thematic analysis.

2.1 Participants

A total of 26 Queensland parents and caregivers were recruited by way of media release, community contacts, and convenience sampling. Measures were taken to ensure rural and remote representation. All but one participant was female, and the mean age of all participants was 33.24 years (range 24 - 44 years). The majority of the participants were a biological parent of the child/ren in their care. The median number of children aged five years and younger in the participants' care was two, with the mean age of these children being 2.8 years. All participants lived in houses with driveways on the property. The number of vehicles regularly being moved on the driveway of the properties varied, with four participants reporting the use of one vehicle, 17 reporting the use of two vehicles, and five

participants reporting the use of three or more vehicles. The majority of participants (73.1%) owned or operated one or more 4WD, truck or other heavy vehicle.

2.2 Materials

The interviews were guided by a pre-developed interview script. Caregivers were asked to freely describe the safety strategies they used in the domestic and driveway setting (e.g., *"Can you tell me about some of the changes you made to your home or your routine after you had children, in order to protect them from being injured?"*) and to elaborate on the reason behind the choice of said strategies. To reduce response bias, the researcher emphasised the importance of honest responses and encouraged participants to describe barriers to effective risk management as well as any 'near miss' incidents or actual incidents that had resulted in a child injury. Interviews averaged 30 minutes in length (range = 16 – 43 minutes).

Overlapping analysis and interviewing allowed for theoretical sampling of the data (Draucker et al., 2007). As theme categories and relationships were initially developed from the data, the interview scripts were modified in order to allow for continuous exploration or confirmation of these themes/relationships. Although the script evolved, the main areas of interest remained included in the script.

2.3 Procedure

Participant recruitment was undertaken following ethical clearance from the Queensland University of Technology Human Research Ethics Committee. The selection process involved participants being subjected to inclusion criteria (being a Queensland resident as well as a parent or caregiver of one or more child/ren under the age of five) as well as exclusion criteria (personal or vicarious experience of a driveway incident involving young children which had caused distress or trauma). Interviews were mainly conducted via telephone as a geographically wide and disparate cohort of parents and caregivers were sought. All interviews were audio recorded and transcribed verbatim by a professional transcriber. Transcript and audio recordings were subsequently compared by members of the research team to ensure accuracy. Interviewing continued until saturation was reached (Corbin & Strauss, 2008).

2.4 Data analysis

Transcripts were read and analysed in full by the same researcher that facilitated the interviews to maintain continuity with the data. Thematic analysis was undertaken to identify and interpret common themes of child safety that were expressed in the interviews. Thematic analysis entails identifying and analysing patterns or themes across a data set (all instances where a topic of interest is discussed). At the very least, thematic analysis organises and describes identified patterns. The analysis may, however, also be used to interpret the themes and their inter-relationships (Braun and Clarke, 2008), an approach which was adopted in the current project.

To ensure rigour of findings, a constant comparison method (coding, categorising, synthesising, and interpreting data) was followed. The smallest units of text containing relevant information were identified and coded. Based on common elements, these codes were assigned to new or previously formed categories. Depending on category relevance, the same code could be assigned to more than one category. Category properties were derived from the included codes, which subsequently provided the basis for category inclusion criteria. Category property and inclusion criteria were constantly re-evaluated and modified to ensure they adequately represented all included codes. This process included deviant case analysis (Silverman, 2010), which entails analysing and incorporating 'contradictory' statements within the emerging conceptualisation of the data.

Findings were compiled and mapped into a thematic interaction model of perceived risks and safety behaviours. The development and validation of the model progressed through several steps. First, perceived safety risks and behaviours were mapped in the domestic setting. Responses from the initial interviews were reduced to key themes capturing the perception and management of risks. This process continued until interview responses no longer added to or altered the model's key components (i.e., saturation was reached). Following model saturation, a subset of interviews (n = 10) were used to validate the model and its components. Next, the process of modelling child safety behaviours was tested in the driveway setting, indicating that results were transferable between the two settings. In addition, findings from metropolitan caregivers were compared with those from rural and remote areas, showing that the generic structure of the model and conceptual overview did not differ between these two settings.

3. Results

3.1 Domestic Risk Appraisal and Safety Behaviours

Analysis of domestic child safety revealed that caregivers assessed the relative risk to their child in any given situation. Early on during the data collection and analysis phase, it became apparent that caregiver behaviours were preventative in nature. The basis of these preventative behaviours outlined during the interviews was found to be an appraisal of the specific risk factors present in any given context and/or environmental setting. This process was ongoing and dynamic; as contextual risk factors changed, the relative safety of the environment was reassessed. The risk factors that formed the basis for caregiver safety appraisals were categorised and labelled by the researchers into three safety domains: whether or not the child was supervised; the relative safety or dangerousness of the environment; and the safety competency of the child. The interplay between safety domains and their impact on caregivers' safety assessment is exemplified in the following quote;

> *"[...] just keeping an eye on them around areas that I feel around the house are a little bit dangerous. So like if my little one, who's not quite two, is coming down the stairs then I'll try and be near him to do that sort of thing. But they're both getting to*

the age now where they're okay with all that sort of stuff around the house and they know what they're allowed to touch and what they're not, so..." (Participant 12)

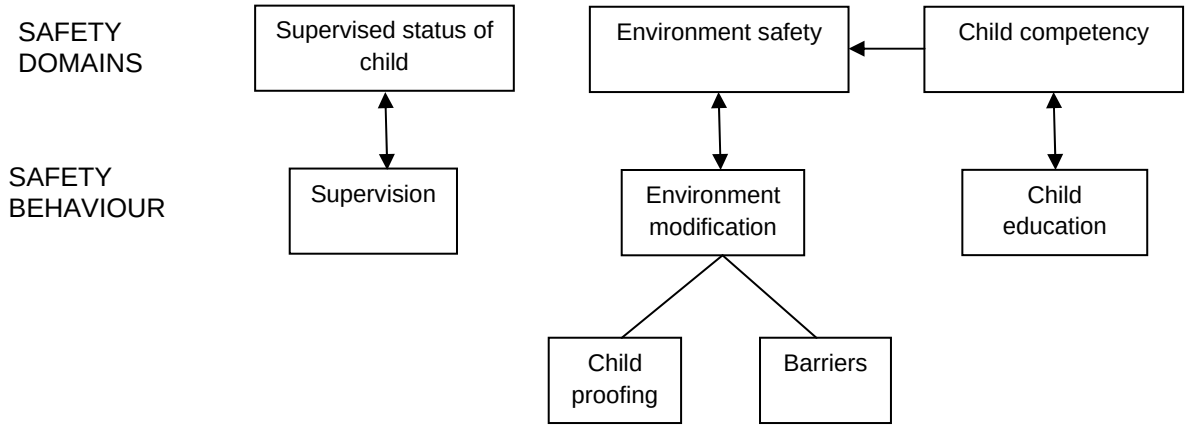

Figure 1. The Safety System Model (SSM); illustration of the safety domains and corresponding safety behaviours.

This risk appraisal, in turn, informed and influenced the subsequent *safety behaviours* implemented by the caregiver. Analysis of extracts pertaining to safety strategies employed by caregivers showed that these strategies fell into three behavioural categories. As illustrated in Figure 1, safety behaviours centre on improving the three safety domains in order to maintain appropriate risk management. The first identified cluster of behaviour pertained to child supervision, where the location and/or the behaviour of the child were generally visually or auditory monitored. One example;

"Like if I'm going to go to the bathroom or something, I'll say to him I'm going to the bathroom. Which is...he still thinks it's a bit silly announcing it, but in my mind, I need to know if they're being supervised or not." (Participant 11)

Analysis of behaviours addressing environment safety (environmental modification) revealed that these could be further sub-divided in two categories; child-proofing and barriers. Child-proofing behaviours included removing dangerous objects or preventing access to them by using child safety latches or by locking cupboards;

"I just reorganised everything from the waist down in the house and that's been the most effective thing because then he can have a lot of freedom because I know that the environment is a safe one." (Participant 7)

The second sub-group, barriers, included behaviours aimed at physically preventing the child from accessing a dangerous area. This was done either though the use of child-gates or

through ensuring that pertinent doors were closed. All participants reported having used both child proofing and barriers as a safety precaution that targets environmental modification. Finally, caregivers engaged in child competency augmentation by way of child education. Behaviours in this category included the use of rules that prevented children from entering dangerous situations or areas, or using dangerous objects. Education also included explaining and/or showing dangers that were present in the environment to the child. Context based learning or learning through vignettes or real stories were examples of the latter educational approach.

It is of interest to note that although all three aspects of child safety are targeted by caregivers' safety behaviours, the long-term objective was to increase child competency. As competency increases with age the child starts to internalise the safety behaviours demonstrated by the caregivers which, with time, render caregiver safety efforts superfluous. For example:

> *"I mean eventually you want them to be able to self regulate, they've got to cross roads and that to go to school or whatever, but yeah, you know, until they get to a certain age I just don't think you can trust them." (Participant 18)*

This comment also demonstrates that although child competency is an important long-term goal. However, caregivers place a relatively low premium on this safety aspect during the early childhood years, as the success of educational efforts largely depends on the developmental age of the child. While child competency is a long-term goal contingent on the developmental age of the child, the domestic environment more readily lends itself to manipulation. Supervision was found to be the most volatile of the safety behaviours and, therefore, the behaviour most often altered to maintain the balance between safety aspects and behaviours which are needed for safety to be maintained.

As previously discussed, the classification of risks and safety behaviours into the categories included in the SSM was validated using a subsection of the interviews. Caregivers in these interviews were presented with the model and asked to discuss how it related to their own safety behaviour and whether they believed that additional categories were needed. No additions to the model were raised in this sample, for instance; *"Yes that definitely applies to us, yes" (Participant 26)* and *"No that sounds just about right" (Participant 22).*

3.2 Driveway Risk Appraisal and Safety Behaviours

After uncovering the behaviour system by which safety was ensured in the domestic setting, the next step was to compare this system to behaviours displayed in and around the driveway. The domestic child safety model was used as the basis for mapping the driveway behaviours in order to assess for 'fit' between the two settings.

The analysis of driveway behaviours revealed a similar safety domain and safety behaviour constellation as was present in the domestic setting (see Figure 1). For example, in the supervision status domain, the safety appraisal process was found to be similar in both domestic and driveway settings; in fact, it was deemed especially important in this setting. Monitoring children while in the driveway (particularly during vehicle movement) was the most frequently cited safety behaviour. The objective of driveway supervision was, however, slightly different from the domestic behavioural equivalent; while domestic supervision mainly focused on monitoring the behaviours and general whereabouts of the child, driveway supervision solely focused on identifying the exact location of the child in relation to the moving vehicle. For instance:

> *"We've got a designated spot for children under the age of five basically where they must stand. They're visible at all times then so that while we're busy organising seating arrangements for other children or there might be another vehicle moving, we know that those children are in that designated spot." (Participant 4)*

While still fitting the model, analysis of the environment safety domain revealed that for some caregivers there was a discrepancy between the perceived safety of the driveway and domestic environments. For instance, while the safety of the areas inside the house tended to be unchanging, the safety of the driveway was considered to be shifting. In such a way, the same driveway area could be considered both a dangerous zone as well as a play area for children. For instance:

> *"Mmm yeah, well we don't, they can play on the driveway at all times, it's not fenced off from the rest of the yard, so they can play on it at all times unless we're reversing or driving in." (Participant 17)*

As the driveway is not consistently considered as a dangerous zone, safety behaviours were consequently inconsistently implemented. Awareness of the hazards introduced by the shifting safety status of their own driveway was only reflected on by two participants. One example:

> *"I mean, I know yes we're naughty and do it a little bit, but I guess it probably shouldn't really be used as a play area. But I mean I know that's difficult for some people because that's the only area that they've got. Because I think that could cause a couple of problems, you can see that yeah it could cause a few safety issues there." (Participant 19)*

In the domestic setting, it was found that environmental safety behaviours were sub-divided into *child-proofing* and *barriers*. However, behaviours aimed at improving the safety of the driveway fell exclusively into the barrier subcategory. The lack of child-proofing behaviours could be taken to reflect that, perhaps not surprisingly, removing the vehicle from the driveway was not an alternative for the caregivers. One caregiver stated the following:

> *"Yeah that's right, that's what I'm saying, you can't remove the car from the environment so I do think that in that case they have to be better supervised. Or they [caregivers] have to install safety features. Maybe if they put a child-proof gate on a door and left the children in the house until they reversed out or something like that maybe." (Participant 18)*

A large proportion of the barriers used to increase the driveway environmental safety were not directly adjacent to the driveway but, instead, often a distance away. Two examples reflect this:

> *"The garage door was something, I mean we've never actually had any incident of our child going out there but she was starting to try and turn door handles and that was something that I could see was clearly a danger in our house and could potentially be an issue. Which is why I put my foot down finally and said that's it, we're getting a lock on that one." (Participant 11)*

> *"Um, at the moment we're in a rental property but we're building a house at the moment and that house has been, like the entire backyard is fenced off away from the driveway so you can never go near the driveway." (Participant 21)*

Barriers as a means of environment safety were exclusively used to ensure that the child is kept away from the driveway during vehicle travel and, as such, were used as a means to gain control of the child's location in relation to the vehicle. Physical containment (e.g., holding the child's hand) was also mentioned as a form of child barrier, and was particularly used with younger children.

Finally, as seen in the domestic setting, environment safety was found to be related to child development. Of particular interest within the child competency domain were young children who were mobile and able to engage with the environment; but not yet cognitively mature enough to comprehend dangers. The analysis of driveway behaviours revealed a similar safety domain and safety behaviour constellation as was present in the domestic setting. It was found that child driveway competency was a *long-term goal*, akin to the continuing educational efforts that were evident in the domestic setting. One such example was the rule enforcement and child education that many caregivers engaged in while their children were still young. The intended goal of this action was long-term oriented, as caregivers were aware that young children could not be trusted to independently adhere to rules. The compensatory relationship between safety domains was also evident in the driveway setting. To give an example, as child competency grew, barriers were used increasingly less as children were trusted to obey rules and be able to make correct safety judgements regarding environment safety.

"Yeah and I guess his development as well like with telling him or reminding him of the rules and he's learning what that rule is about you know you don't run into daddy's garage when he comes in or, we try not to let him go in there at all actually. For that reason...Um... yeah I think just teaching him and reminding him of that rule and the supervision when he's down there." (Participant 20)

4. Discussion

Analysis of caregivers' risk awareness and safety behaviours uncovered an underlying process of risk appraisal and safety behaviour applicable to both the domestic and the driveway setting. Risk appraisal was based on three safety domains; the supervised status of the child, the environment safety and child competency. Safety behaviours, falling into three corresponding categories, supervision, environmental modification (childproofing or use of barriers to prevent access to dangerous areas) and child education, were used to improve each of the safety domains in order to maintain adequate child safety levels.

The developed model was utilised to examine differences in safety behaviours between the two settings. In the driveway, caregivers reported being unable to childproof the environment, and therefore used barriers only (e.g., securing front or garage doors) to decrease environmental risks. Notably, it was also found that the driveway as an environmental zone was given a non-fixed safety assessment, which resulted in inconsistently applied safety behaviours in this area. Although the current study did not directly investigate driveway incidents, the fact that the model was applicable to both the domestic and driveway setting, suggests that caregivers' perception of risk and subsequent safety behaviours were similar in both settings.

4.1. Limitations and future research

Important limitations in relation to the sample and the generalisability of the findings in the current study are noted. First, it is plausible that those caregivers that volunteered their participation in this research were highly motivated and knowledgeable regarding child safety and potentially not entirely representative of the wider population of caregivers. Moreover, the current study obtained sample of primary female caregivers. In Australia, women still devote a greater portion of their time to child care than men (Folbre & Yoon, 2007), and are thus an important demographic to target in studies on driveway child safety. However, previous research (ATSB, 2006; BITRE, 2012) suggests that a majority of driveway incidents involve a male driver, highlighting the need for studies to include male caregivers. Thus, while initial support for the accuracy of the SSM was obtained in the current study further support for the validity of the model must be sought through replication in larger representative samples with equal gender distribution.

4.2 Conclusions

The findings of this study represent an important first step towards the development of driveway run-over interventions. While further validation of the SSM is needed, the initial findings suggests that risks to child safety falls within three discrete domains and that safety behaviours centre on the improvement of safety within each domain. As such, interventions could focus on raising awareness of risks associated with each safety domains. In terms of environment safety specifically, the tendency of caregivers to regard the driveway as a zone of shifting danger/safety could be targeted. Safety strategies could further be suggested within the three identified safety behaviour categories. However, as caregivers did not engage in child-proofing behaviours in the driveway, suggested behaviour strategies should focus on supervision, the use of barriers and child education. In addition to model validation, further research should thus investigate the feasibility and effectiveness of interventions that draw on the models' identified components and processes.

Competing interests - None

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