

DRIVER PERCEPTION OF NON-MOTORISED TRANSPORT USERS: A RISK IN TRAFFIC?

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ABSTRACT

As part of an ongoing effort to explore driver behaviour in South Africa, this research investigates non-motorised transport users as an element of risk in the driving environment from a driver perspective. This research made use of a small sample of previously collected naturalistic driving data (NDD) that allows for the investigation and examination of detailed driver actions at a high granularity (microsecond) level. The results of the study show that drivers do not seem to acknowledge vulnerable road users (VRUs), including pedestrians, road workers, and cyclists in their immediate environment the assumption being that the reason for this is the fact that NMT and VRUs are part of the everyday normal driving environment. This paper concludes with an application of the research findings as input into the Road Traffic Safety Management System (RTSMS) in support of the Safe System to design and implement alternative interventions in support of reducing the crashes on South African roads.

1. INTRODUCTION

South Africa became a signatory to the “Decade of Action for Road Safety” (DoA) launched worldwide on 11 May 2011 (World Health Organisation, 2011). With less than three years left in the DoA, there is a need to make a significant effort to reduce the number of road traffic deaths and serious injuries. A large body of international research details the inability of novice drivers to perceive and react to hazards within their driving environment. Indications are that newly licensed South African drivers also struggle with hazard perception in the local driving context. Part of this local context is the prominence of non-motorised transport (NMT). Pedestrian deaths in South Africa have in the past been estimated to contribute to approximately a third of fatal crash statistics, with evidence that this trend is set to continue (Department of Transport, 2015). Traditionally, interventions in South Africa have addressed pedestrian behaviour through education and awareness as well as planning and design of infrastructure that would make the NMT environment safer. Despite these interventions there seems to be little change in the seemingly unsafe behaviour of pedestrians, whom would rather cross a busy road directly, rather than making use of an overhead pedestrian bridge (Van Rooyen et al., 2016). The African road safety context differs from developed countries because NMT as a mode is not necessarily a choice and the lack of choice might influence perceived risk in traffic negatively.

As part of the ongoing research to explore driver behaviour in South Africa, this project shift away from the traditional focus to include a driver risk perception element. The research explored whether NMT in the local driving context, are perceived as a risk and driver behaviour adapted accordingly.

2. BACKGROUND

2.1. South African context

The burden of road traffic deaths and injuries continue to threaten the vision for safe, reliable and sustainable transport in South Africa and hampers socio-economic development with recent indications (Road Traffic Management Corporation, 2016) that crashes cost the country a staggering three and a half per cent of the Gross Domestic Product (GDP). The National Road Safety Strategy (NRSS) published in 2015, states that 27.5/100 000 people are annually killed in traffic crashes in South Africa (Department of Transport, 2015). In the 2016 Cost of Crashes report, use is made of 2015 crash data, adjusted for five per cent underreporting, with indications that in total, the number of people involved in crashes during 2015, amount to 1 708 414. Of this total, estimations were that 13 591 people were killed. Approximately 62 520 people were involved in serious crashes, 202 509 sustained slight injuries and more than million people did not report any injury. Pedestrian deaths continue to form the bulk of road traffic fatalities with these deaths being in excess of thirty per cent of all road traffic fatalities (Gainewe et al., 2010; Road Traffic Management Corporation, 2011). The NRSS 2015 states that human factors are a contributing cause in seventy two percent of all crashes. The most prominent human factors contributing to pedestrian deaths are pedestrians jaywalking (41%) followed by “hit and run” (21 %).

2.2. NMT users and VRUs: part of the driving environment

Road environments and the road safety context in Low and Middle Income Countries (LMIC), such as South Africa, differ fundamentally from that of High Income Countries (HIC) (Congui et al., 2008; Tulu et al., 2013). Roads in LMIC are characterised by congestion with a variety of vehicles, animals and pedestrians competing for road space (Vermaak et al., 2000). The level of sophistication among road users differs according to the level of development of the geographical area (Vermaak et al, 2000). Being a pedestrian or cyclist (NMT user) in LMIC is not necessarily a choice but rather because people are “captive” as they are not able to afford other transportation (Servaas, 2000). Because choice is limited, NMT plays a dominant role as an affordable, but sometimes unpleasant and dangerous, main mode of transport in poor countries (Servaas, 2000). A previous study, investigating the factors that influence modal shift in South Africa, found that NMT practices such as walking and cycling are associated with not being able to afford your own vehicle or being unable to pay for public transport (Venter et al., 2013). In addition, the lack of NMT infrastructure and facilities also influence behaviour and choice of a specific mode (Servaas, 2000; Mokonyama, 2008; Van Rooyen et al., 2016). Other factors that differ from developed countries include for example walking at night, walking

while fatigued, walking along roads and illegally crossing freeways. Walking at night differs from more developed countries as pedestrians tend to think they are more visible than they actually are. In developing countries such as South Africa, there is often little or no lighting on the road and acquiring safety retroreflective equipment is not only expensive but makes the pedestrian more visible to criminals (Vermaak et al., 2000; Tulu 2013). Walking in the roadway is also not always a choice but a result of inadequate space (shoulder of the road) or sidewalks (Tulu et al., 2013). Even if infrastructure is available, construction of these spaces might be poor or inadequate to allow for the volumes of people making use of them. In most instances, there is no separation of NMT users and motorised vehicles (Vermaak et al., 2000). Illegal crossing behaviour is also a serious concern and Tulu et al (2013) highlights that there are relatively little information known about pedestrians' level of knowledge, enforcement, and reasons for taking these risks. Personality, social and environmental factors are also important to understand non-compliance (Koh and Wong, 2013). Convenience (as appose to safety considerations) is one of the main reasons for jaywalking (Sisiopiku et al., 2003). Characteristics like gender, age, and baggage handling capacity as well as traffic conditions and volumes influence the average crossing speeds of pedestrians (Jain et al., 2014). Distance is a main factor that influences pedestrians to walk or not (Koh et al., 2013). Komba (2016) highlight low levels of safety awareness and consequent behaviour as a key contributory factor to crashes in Tanzania. In addition, Komba (2016) state that road users in urban areas were more prone to traffic rule violations than in semi-urban areas. The research found that risk perception (self being involved in a crash) was lower for people living in urban environments where people are used to busy traffic environments than in rural areas where the traffic environments are less complex.

2.3. Perception of risk in traffic

2.3.1. Overview

The concept of "risk" is subjective, and revolves around the likelihood that an individual will experience the negative or adverse effect of danger (Sjöberg et al., 2004). Perception of "risk-to-the-self" influence behaviour in traffic and many road users do not necessarily view themselves at risk of being involved in a crash (King et al., 2011). Exposure affects risk as traffic risk results from the interaction between the road users, the vehicle, and environment and therefore the more you travel and interact with other road users, the higher the risk of being involved in a crash (Botha, 2005). On the other hand, the ability to recognise and react to risk (hazard perception) is a skill that drivers develop over time and through exposure to the traffic environment (Grayson et al., 2002). Hazard perception is associated with learning the art of recognising potentially hazardous situations and responding to it in the most appropriate manner (Grayson et al., 2002). In Tanzania, risk taking behaviour in traffic were associated with attitude to risk, religious beliefs, willingness to take risks and specific geographical areas (Komba, 2016). The physical environment imposes inherent hazards related to topography, sight lines, and naturally occurring objects in, or next to the road. Within a geographical area, road safety culture constitutes a shared belief system or society's beliefs, values, attitudes, and perceptions of road safety as well as beliefs in terms of what encompasses acceptable behaviour when participating in traffic in a particular road environment (Cooper, 2000; Ward et al., 2014).

2.3.2. Novice drivers and elevated crash risk

Internationally, novice drivers contribute to a large proportion of fatal road crashes due to their inability to perceive immediate threats in their driving environments. This inability to perceive threats are due to the interaction of chronological age (being young), developmental and personality factors and a lack of driving experience (Styles et al., 2005; Ivers et al., 2009; Useche et al., 2015). There is agreement that in comparison to novice drivers, experienced drivers scan roadways and traffic environments more effectively (Crundall et al., 1998; Underwood, 2007). Novice and learner drivers are more likely to miss hazards or environmental cues obscured by the environment such as for example a pedestrian emerging from behind a parked truck (Lee et al., 2008). Novice drivers tend to fixate on irrelevant objects in traffic, using inefficient visual search strategies. When the road environment is complex, novice drivers tend to stare directly in front of them rather than to scan the road environment for potential hazards (Lee et al., 2008). Novice drivers spend less time scanning the mirrors and they are not inclined to check the area around the vehicle. Furthermore, novices are unsuccessful in predicting the potential outcomes of other drivers' actions, which may prevent them from taking necessary hazard avoidance alternatives as quickly as possible (Sümer et al., 2007).

2.3.3. NMT users and elevated crash risk

Pedestrians are vulnerable in traffic due to a lack of protection and limited physical tolerance when in a crash (Congui et al., 2008). Similar to novice drivers, pedestrian crash risk is also associated with age and gender (Holland et al., 2009). However, where novice drivers concern a very specific group of drivers in terms of age and experience, pedestrians encompasses a wider range, across age groups, physical ability, cognitive and developmental ranges (Congui et al., 2008). Young children for example have problems interacting with traffic at a young age due to undeveloped eyesight and depth perception, hearing, height and experience (Congui 2008). Indications are that perceptions of risk in traffic in Sub-Saharan Africa might also vary from high income countries due to the different road environments and the different interacting elements (Tulu et al., 2013). In LMIC reports are that inconsiderate attitudes from drivers toward pedestrians, are contributory in crashes (Congui et al., 2008). This stems from the perception that pedestrians have a "lower status" than drivers (Congui et al., 2008). The interaction between drivers and NMT users' impact on the behaviour of pedestrians and driver behaviour is therefore a factor to consider. Pedestrian behaviour and especially compliance when using NMT facilities differ from community to community (Sisiopiku et al., 2003). On the other hand, a driver's perception of pedestrians is sensitive to the pedestrian's attitude as Gaynard (2012) found that a "provocative" pedestrian arouses aggressiveness in a driver while a courteous pedestrian arouses positive feelings from drivers. Drivers perceiving pedestrians as obedient in terms of the law are more courteous to pedestrians while a poor pedestrian attitude influences driver behaviour negatively even if the driver is aware of the pedestrian's vulnerability (Gaynard, 2012).

3. PURPOSE OF THIS PAPER

This paper makes use of a sub-set of findings used as input into another project that entailed the development of a Soft Systems Methodology (SSM). The aim of the SSM was to improve and facilitate better decision-making about planning practices for non-motorised transport facilities in South Africa (Van Rooyen 2016). The research explored non-motorised transport (NMT) users or vulnerable road users (VRUs) as a risk in traffic, from a driver perspective. The research question was whether (or not) South African drivers acknowledge NMT users in the driving environment, and whether (or not) drivers perceive NMT users as a risk within the driving environment and adapt behaviour accordingly.

The sub-set of findings are employed in this paper to illustrate the value that evidence-based research could potentially have as input into the RTSMS which in turn could be used to design targeted interventions in support of addressing road user behaviour

4. RESEARCH APPROACH AND FINDINGS

4.1. Methodology

During 2013, a naturalistic driving study (NDS) collected naturalistic driving data (NDD) for four South African drivers (two novice and two experienced drivers) over a period of six months. The 2013 study explored differences in hazard perception between novice and experienced drivers (Venter et al., 2014). NDS utilizes a number of sensors or a Data Acquisition System (DAS) to collect data from the driver, environment, as well as the vehicle (Muronga et al., 2014). The DAS used in this experiment had 3 cameras (cameras facing the front, back and driver of the vehicle) as well as an on-board computer that collected information from the vehicle (speed and GPS coordinates). Approximately two hours of image material collected from cameras facing the four drivers the 2013 were analysed. The NDD included observations on different types of roads in the Tshwane area with speed limits varying between 120 km/h; 80 km/h; 70 km/h and 60 km/h

4.2. Findings

The research team, utilising the front-facing camera identified potentially hazardous situations in the road environment. The type of hazardous situations (129) included vehicles merging suddenly from the left or right; public transport vehicles pulling into or off the road in front of the driver; pedestrians and cyclists in the road way; road workers busy with construction work on the roadway and motorcycles entering or passing the driver. The corresponding driver-facing camera image material was then analysed to measure driver reaction in the situations where NMT users and VRUs were identified. Scanning behaviour was coded when the driver turned his/her head towards the NMT user (Scan left or Scan right) or no reaction (Look straight) and measured in seconds. Six per cent of the identified hazardous situations involved NMTs or VRUs (Table 1 below).

Table 1: Parent Codes (N=2328)

Parent codes (categories)	% codes
Driving behaviour (scanning; skill; manoeuvre)	53
Driver distraction	1
Road type	19
Traffic control type	21
Potential hazards	6

Only nine (13%) of the sixty-eight potential hazardous situations involving NMTs or VRUs identified by the research team were observed by the drivers. Road workers were not acknowledged at all by either novice or experience drivers although experience drivers on average drove slower (34 km/h) past these situations than novice drivers (43 km/h).

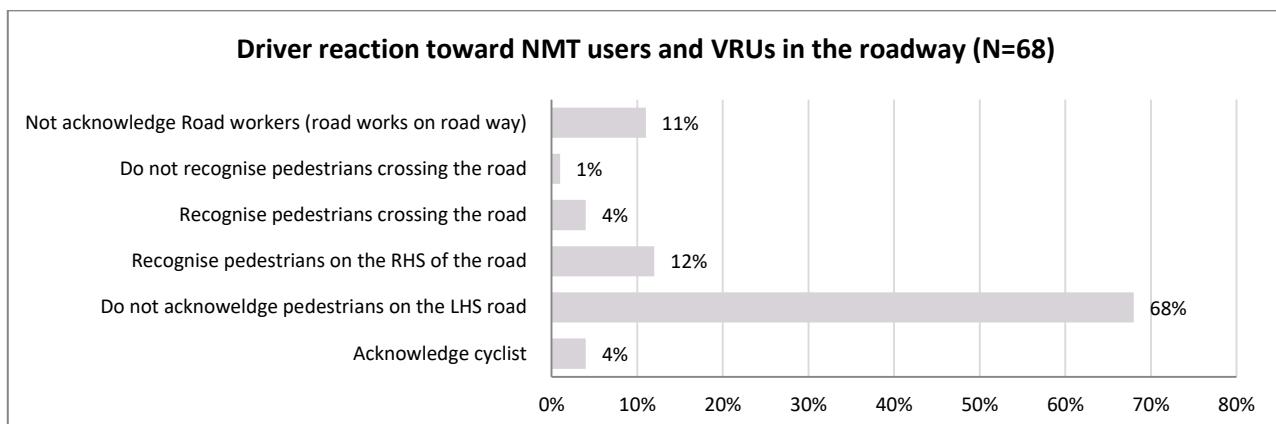
**Figure 1: Driver Reaction Toward Nmt Users And Vrus In The Roadway**

Figure 1 illustrates the percentage of reactions for drivers towards NMT users and VRUs in the roadway. Pedestrian's crossings at pedestrian crossings were recognised by novice drivers and who stopped for these pedestrians to cross. Experienced drivers did not seem to acknowledge pedestrians crossing. Novice drivers recognised pedestrians walking on the right-hand side of the road but not on the left-hand side of the road. Experienced drivers acknowledged pedestrians walking on the left as well as the right and side of the road. Experienced drivers spent an average of 10.5 seconds scanning the area along the road when observing an NMT user compared to the novice drivers whom spent an average of 4 seconds.

4.3. Discussion

In this study, the reactions to the NMT and VRU hazards by novice drivers were much less, than the potential hazards identified by the research team. There is agreement internationally that in comparison to novice drivers, experienced drivers scan roadways and traffic environments more effectively (Crundall et al., 1998; Underwood, 2007). Novice and learner drivers are more likely to miss hazards or environmental cues obscured by the environment such as for example a pedestrian emerging from behind a parked truck (Lee et al., 2008). Novice drivers tend to fixate on irrelevant objects in traffic, using inefficient

visual search strategies. When the road environment is complex, novice drivers tend to stare directly in front of them rather than to scan the road environment for potential hazards (Lee et al., 2008). Novice drivers spend less time scanning the mirrors and they are not inclined to check the area around the vehicle. Furthermore, novices are unsuccessful in predicting the potential outcomes of other drivers' actions, which may prevent them from taking necessary hazard avoidance alternatives as quickly as possible (Sümer et al., 2007). Recently, findings from South African research conducted by Chokotho et al (2012) confirmed that similar to international trends, young novice drivers were over represented in Western Cape fatal crashes and concluded that there might be a need to include hazard perception training as part of learner driver curriculums.

5. APPLICATION OF FINDINGS WITHIN THE RTSMS

5.1. Towards a safe road traffic system in South Africa

Worldwide, 'results focus' is at the core of programmes by countries that have successfully managed to reduce road casualties through the setting of data driven targets, informed by evidence based research (Labuschagne' 2016). Road safety management is a production process (Bliss and Breen, 2012) where institutional management functions produce interventions that in turn deliver results (fewer crashes and injuries). The Safe System aims, through infrastructure and vehicle design, to guide and encourage alert and compliant road users through targeted data driven interventions aimed (Buttler, 2014). Countries making progress towards the DoA goals, have a sound scientific base upon which they build their strategy and road safety programmes (Wegman et al., 2010; Labuschagne et al., 2016). Any actions are rooted in scientific evidence, have a proper research base and the research enables these countries to set research agendas, in support of addressing specific road safety problems in a targeted manner (Wegman et al., 2010; Wegman et al. 2015). In this lie the success as these countries and their approach to road safety is focused as opposed to "quick wins or fixes" (Labuschagne' 2016). These countries have long-term political commitment and a political will to change the situation for the long-term (Wegman et al., 2015).

Research and development (R&D) is the seventh institutional management function and key in terms of informing the setting of road safety targets, working towards understanding the problem, informing legislative reform, as well as the development of effective and efficient road safety interventions, which within the DoA are referred to as intermediate interventions or the DoA pillars. Research informs the targets set to achieve results (reduction in pedestrian crashes) and targets are set once baseline information of the problem known. Targets are measureable and serve as a reference point for monitoring and evaluating progress towards meeting these objectives (Figure 2).

5.2. Defining the problem

Detailed road traffic information (e.g. the number of crashes caused by novice drivers) is not readily available in South Africa (Wegman 2013). South Africa is under significant

pressure to produce cost effective targeted interventions that will alleviate the burden of road traffic crashes in the country and subsequently the DoT commissioned the development of the 2015 NRSS (Department of Transport, 2015). As part of the five problem statements, the NRSS states (priority goal number 5) that there is an urgent need to address the high number of pedestrian deaths in the country (Department of Transport, 2015). The targets for reducing fatal NMT crashes (across the spectrum) follow a five per cent reduction pattern set for every five years up to 2029. Factors highlighted as contributory in pedestrian crash rate include poor planning and design for NMT, awareness regarding the role alcohol and speed plays in pedestrian crashes, which lack as part of road safety education for pedestrians and drivers (Mabunda et al., 2008; Labuschagne' et al., 2014). However, the short, medium, and long-term interventions put forth in the NRSS make no mention of programmes or initiatives to raise awareness about VRUs/NMT among the driving population but mainly focus on pedestrian education programmes. Education has been at the forefront of many pedestrian management plans (Ribbens, 2002). According to the crash statistics, it would seem that these approaches have not been successful in the past. Reasons for this might include the fact that for NMT users "risk-to-the-self" is a secondary consideration especially if the NMT user is "captive", without a choice but to walk or cycle in order to access employment and education opportunities, to access health and other services. Limited information is internationally available as to how novices react to other road users such as NMT users, the type of road environments in which they drive and how they react towards different demands from the driving environment. By understanding the problem from a different angle, (drivers do not acknowledge pedestrians as a risk in traffic), it becomes possible to plan and design alternative campaigns targeting driver behaviour change as appose to solely focusing on pedestrian behaviour.

5.3. Application of findings

Drivers might not be as attentive to NMT users in this complex environment because it is part of the everyday "normal" environment. The results from this small study imply that drivers in South Africa are potentially not fully aware of NMT users within the driving environment or on the road network. One possible explanation might be that drivers encounter NMT users frequently as part of everyday driving situations, which dilute the perception of NMT users as a risk. The fact that experienced drivers scanned the roadway almost twice as long as novice drivers might be an indication that when NMT users are recognized, the perception of them being hazardous in the road way was more prominent by experienced drivers than in-experienced drivers. In terms of the RTSMS, this finding could potentially have implications for the entry and exit of drivers to the road network or according to the pillars for "safer road users." Training and education of new drivers could for example include specific types of hazard perception training to alert drivers to the presence of NMT users and their elevated risk in traffic. In addition it might have implications for testing of new drivers if a hazard perception test that include environmental elements such as NMT users are developed and implemented as part of the driver evaluation test.

The NRSS highlight poor planning and design for NMT users as a factor that contributes to the high pedestrian death toll. Research findings could influence motivations for the

lowering of speed limits in environments frequented by NMT users. This would then provide input into the “planning, design, and use of the road network or “safer roads.” Road design elements such as wider roads, which allow for higher speeds, are one of the main contributors to the high crash rate globally (Johannson, 2009). A key issue in especially developing countries is the lack of separation of different road users (motorised and vulnerable) at an early stage. Understanding the road and related risk from a driver’s perspective is a key principle in designing roads that separate motorised and vulnerable traffic users (Johannson, 2009).

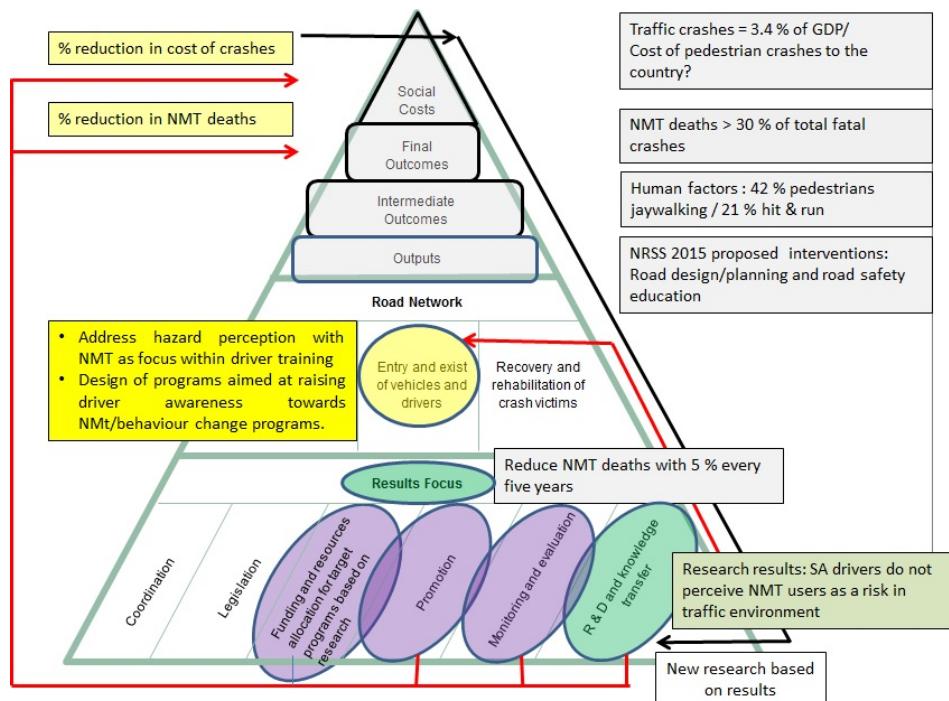


Figure 2: Application Of Research In Support Of Designing Interventions Aimed At Entry And Exit Of Drivers And Vehicles (Safer Road Users).

6. CONCLUSION

Countries working toward zero fatalities have through the implementation of the Road Traffic Safety Management System (RTSMS), been able to design programmes and interventions that have significantly reduced fatalities. At the root of these strategies are reliable data and evidence-based research. The purpose of the research was to provide input into a larger research project, highlighting driver risk perception (or the lack thereof) as a possible contributory factor in pedestrians crashes. On its own, the findings from the study are insignificant and although this study is too small to make any inferences toward behaviour in general, it does illustrate the value of specific research as input into the RTSMS for the design of targeted interventions, which in turn will produce results. The study highlights the value of alternative research methodologies such as NDS to show that it is possible to quantify aspects of road user behaviour that traditionally was difficult to measure. The need for research that can inform alternative approaches (interventions) to address road safety in the country (results focus) is clear. Reports highlight human factors,

as the biggest contributory factor in road traffic crashes. The fact that road environments in South Africa and behaviour within these environments, differ significantly from that of developed countries again highlight the need for local research to inform local strategies and action plans. Previously, Labuschagne' et al. (2016) emphasised the importance of a South African political as well as a scientific research programme to inform the development of intervention strategies. Research need to inform the development of road safety measures and interventions, monitored scientifically to ensure effectiveness and efficiency. The need for a scientific research agenda to support road safety initiatives becomes more and more pressing.

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