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A different perspective on conspicuity related motorcycle crashes

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ABSTRACT

The most common type of conflict in which a motorcyclist is injured or killed is a collision between a motorcycle and a car, often in priority situations. Many studies on motorcycle safety focus on the question why car drivers fail to give priority and on the poor conspicuity of motorcycles. The concept of 'looked-but-failed-to-see' crashes is a recurring item. On the other hand, it is not entirely unexpected that motorcycles have many conflicts with cars; there simply are so many cars on the road. This paper tries to unravel whether – acknowledging the differences in exposure – car drivers indeed fail to yield for motorcycles more often than for other cars. For this purpose we compared the causes of crashes on intersections (e.g. failing to give priority, speeding, etc.) between different crash types (car–motorcycle or car–car). In addition, we compared the crash causes of dual drivers (i.e. car drivers who also have their motorcycle licence) with regular car drivers.Our crash analysis suggests that car drivers do not fail to give priority to motorcycles relatively more often than to another car when this car/motorcycle approaches from a perpendicular angle. There is only one priority situation where motorcycles seem to be at a disadvantage compared to cars. This is when a car makes a left turn, and fails to give priority to an oncoming motorcycle. This specific crash scenario occurs more often when the oncoming vehicle is a motorcycle than when it is a car. We did not find a significant difference between dual drivers and regular car drivers in how often they give priority to motorcycles compared to cars.

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1. Introduction

Motorcycles are vulnerable in traffic. In comparison with drivers of motorised four-wheeled vehicles, a motorcyclist has a high risk of death or serious injury as a result of a crash (SWOV, 2010). The main type of conflict in which a motorcyclist is injured or killed is a collision between a motorcycle and a car or van. In the Netherlands this is the case in around 50% of the crashes (SWOV, 2010). The second most frequent conflict type (almost 40% of motorcycle casualties in the Netherlands) is a single vehicle crash (i.e. not involving another party). Not only in the Netherlands, but also in other countries, many car–motorcycle crashes are caused by the car driver failing to give priority to the motorcyclist (e.g. Pai, 2011). According to a European in-depth study this is mainly because the car driver fails to notice the motorcyclist (MAIDS, 2004, 2009). In traffic literature these types of crashes have become known as "looked-but-failed-to-see" crashes, or "motorcycle conspicuity related" crashes, because they are thought to be related to the lacking conspicuity of motorcycles (Clabaux et al., 2012; Helman et al., 2012; Mitsopoulos-Rubens and Lenné, 2012).

There is extensive research on factors contributing to motorcycle conspicuity related crashes. Crash analysis show, for example, that motorcyclists wearing fluorescent or reflective clothing, or a white or light helmet, have a reduced risk of motorcycle crashes (Wells et al., 2004). Even more important than wearing bright clothing seems to be contrast with the environment (Hole et al., 1996; Rogé et al., 2010; Gershon et al., 2012). For instance, Hole and colleagues found that in urban environments observers responded quicker to motorcyclists with bright coloured or fluorescent clothing than to motorcyclists with dark clothing. This effect was reversed in rural settings (with clear blue sky), where observers responded quicker to motorcyclists wearing dark clothing. Contrast with the environments seems to be an important factor in the effectiveness of daytime running lights (DRL) as well. In general DRL enhances the conspicuity of motorcycles during daytime (e.g. Thomson, 1980; Torrez, 2008). Most studies report this effect to be dependent on the specific situation, such as the characteristics of the environment (Hole and Tyrrell, 1995; Hole et al., 1996), the motorcycle's speed (Howells et al., 1980 as cited in Pai, 2011), or the weather conditions (Pai, 2011).

A motorcycle is smaller than a car, especially the front view. Furthermore, since the size and shape of motorcycles vary a lot, a motorcycle gives less reliable information about its speed and distance than a car. This can explain why depth, distance

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and speed are not as easily derived from a moving motorcycle than from a moving car. Horswill et al. (2005) found that car drivers accept smaller gaps when crossing a road in front of a motorcycle compared to a car. They explain this result with the size-arrival effect that was described by Delucia (1991), which states that smaller objects are perceived to arrive later than larger objects.

In addition to motorcycle characteristics explaining conspicuity related crashes, the expectancy of car drivers for motorcyclists is also often mentioned as an important factor. The human capacity for information processing is limited; humans cannot process all information they are presented with (O'Donnell and Eggemeier, 1986; Coren et al., 1994; Wolfe, 1998). Attention helps people to filter which information they process and which information they do not process (Simons and Chabris, 1999; Mortier et al., 2003; Martens, 2011); expectations in turn help to direct attention (Martens, 2000). So, the theory suggests that car drivers do not expect to encounter motorcycles on the road, and therefore, have more problems perceiving them. Gershon et al. (2012) confirmed the importance of expectancy for the perception of powered two-wheelers. Results of their experiment indicated that when observers were instructed to look for powered two-wheelers in photographs, detection rates were three times higher than without instruction.

A final concept in relation to conspicuity related questions is the suggestion that car drivers have no "awareness and acceptance" for motorcycles (e.g. Crundall et al., 2008). In contrast with expectancy discussed in the previous section this factor has a sort of 'motivational' aspect. Several studies describe that car drivers have negative attitudes towards motorcycle riders (e.g. Savolainen and Mannering, 2007; Crundall et al., 2010; Musselwhite et al., 2012). There is however no evidence that negative attitudes affect car drivers' behaviour and can be related to car–motorcycle crashes. Although many studies report findings by Brooks and Guppy (1990), that drivers with family members or close friends who ride motorcycles are less likely to cause a crash with a motorcyclist, it is important to realise that the original study did not find the reported effect. There is, however, evidence that car drivers who also have their motorcycle licence (so-called dual drivers) are less likely to collide with motorcycles than car drivers without a motorcycle licence (Brooks and Guppy, 1990; Magazzù et al., 2006). But these results can also be explained by dual riders having more technical knowledge about riding a motorcycle, higher expectancy for motorcycles in traffic, and/or more driving/riding experience in general.

The vast amount of literature on conspicuity related crashes is based on the assumption that this is a typical car–motorcycle interaction problem. However, it is not entirely unexpected that motorcycles have many conflicts with cars; there simply are so many cars on the road. This paper aims to answer: (1) if – acknowledging the differences in exposure – it is indeed true that car drivers more often fail to yield to motorcycles than to cars; and (2) whether dual-drivers (i.e. car drivers who also have their motorcycle licence) have fewer problems in their interaction with motorcycles? Especially the first question has not been answered in previous research; probably because it is difficult (or impossible) to correct for differences in exposure between the two vehicle types. For example in the Netherlands, there is some information about the average distance travelled by motorcycle or car. But these estimates are not reliable enough to use as a correction for exposure. In this paper the problem of differences in exposure was circumvented by comparing *relative* crash causes (e.g. failing to give priority, speeding, etc.) on intersections between two different crash types: car–motorcycle or car–car. In addition, we compare the crash cause of dual drivers with that of regular car drivers.

2. Method

The analyses in this paper are based on police *registered* crashes with at least a serious injury[1] in the period 2000–2009 in The Netherlands, i.e. the Dutch Road Crash Registration (BRON). The severity of a crash is defined by the most serious injury of one of the persons involved, so a serious injury crash is a crash with at least one victim being seriously injured[2]. There are a number of considerations with the Dutch Road Crash Registration, which are discussed in the next section: (1) crash registration rate, (2) determination of first and second collider, and (3) determination of crash causes.

2.1. Limitations of available data

It is important to realise that the number of reported crashes, is not the same as the actual number of crashes (or casualties). For all kind of (practical) reasons the police does not register all crashes and casualties. It is estimated that for fatalities, the registration rate in BRON is still over 90% whereas for serious road injuries among motorcyclists, the registration rate in BRON dropped from about 60% in 2000 to 35% in 2009. In other words, in 2009 the majority of serious injured motorcyclists were not registered in BRON. For more information on Dutch crash registration and registration rates see (SWOV, 2013). For the crash analyses in this report it was not possible to use the estimated ('real') number of serious crashes, because we needed detailed crash information. Therefore we had to resort to the BRON database itself, with imperfect registration. However, because only the relative occurrence of different crash types on intersections are compared, this analysis is most likely not influenced by a lower registration rate.

The analyses use information about the first and second collider in a crash, as available from the BRON registration. The first collider is, according to the *police*, probably the one who caused the crash. It is extremely important to realise that this is the opinion of the policeman who dealt with the crash and recorded it. This does not always have to be the actual causer of the crash. It is possible that, after more research the (legal) responsibility is changed to the other crash partner. However, this is not changed in the registration of the first and second collider in the police records.

Related to the first and second collider issue, there is the issue of the recorded crash cause, which is also the opinion of the policeman recording the crash. Although we know that most crashes have more than one cause, the cause registered in BRON is the cause that is reported for the first collider. There is a tendency to report certain crash causes over others, especially those that are more judicial oriented (i.e. that can be proven more easily). As mentioned before, we only study *relative* occurrence of crash causes for certain conflict types, i.e. we compare the relative occurrence of failing to give way within motorcycle–car crashes with the occurrence of the cause within car–car crashes. Therefore we assume that the preference for a certain causation type does not influence the conclusions of our analysis.

2.2. Analysis

We analysed crashes on *intersections* in which someone was killed or seriously injured in the period 2000–2009. The police records describe several different crash causes, such as red light

[1] With the exception of Table 2 where more data was needed and crashes with slight injuries or property damage only were included as well.

[2] The injury severity, Maximum Abbreviated Index Scale (MAIS), was used to identify serious injuries. A serious injury is defined as an injury with at least a MAIS 2 score.

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