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Exploring factors distinguishing car-versus-car from car-versus-motorcycle in intersection crashes

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ABSTRACT

This research examines a case-control ($N = 305$) for CVC (car versus car) and CVM (car versus motorcycle) crashes from the New Zealand drawing from the 2004 to 2009 police reports entered into the Crash Analysis Systems (CASs) database. The characteristics of the crashes are compared across the vehicle configurations to distinguish the features of CVM crashes. The analyses show that CVM-type crashes are not easily distinguished from CVC-type crashes. The two crash types are similar, contrary to overseas recent findings but consistent with those reported nearly 20 years ago by Cercarelli, Arnold, Rosman, Sleet, and Thornett (1992). Four exceptions are that CVM-type crashes occur more often than expected in urban speed zones, between the times of 4–7 pm, and at uncontrolled intersections. CVM crashes occur less often in merging traffic. These findings are discussed in the context of the conspicuity hypothesis that posits that crashes with motorcycles occur more frequently because they are harder to detect.

1. Introduction

New Zealand traffic accident data establish that motorcycles account for 9% of road crashes (MOT, 2008a) but undertake only around 0.5% of travel time or trip legs (MOT, 2008b). From these statistics it is determined that motorcyclists are around 16–20 times more likely to be involved in a fatal or injury crash than car drivers. When considering these fatal crashes, the motorcyclist or their pillion passenger is the fatality in around 95% of cases. Based on vehicle registrations, motorcycles constitute only 3.47% of the NZ vehicle fleet, though they have grown to over one hundred thousand registration with the largest increases in occurring from 2004 to 2008 (MOT, 2012).

Motorcycle crashes at intersections are separately considered by Clarke, Ward, Bartle, and Truman (2007) because they are found to be grossly over-represented against other vehicle crashes in the Hurt Report (1980). The most common car-versus-motorcycle (CVM) crash-type is a right-of-way violation (Horswill, Helman, Ardiles, & Wann, 2005). Estimates indicate that 40% of all CVM crashes in Britain (Clarke et al., 2007) and 64% in New Zealand (Walton, 2010) involve right-of-way violations. Clarke et al. (2007) attributed fault to the motorcycle rider in only 19% of right-of-way crashes, compared to 71% of non-right-of-way crashes, with similar results being found in a New Zealand study (12% and 78% respectively; Walton, 2010). For T-intersections, Pai and Saleh (2008a) found that right-of-way crashes resulted in the greatest level of injury to the motorcyclist compared to other crash types, especially when the car driver was at fault.

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Further implicating the car driver as the critical factor for CVM crashes, Brown (2002) observed and coined the 'looked-but-failed-to-see' (LBFTS) effect, now widely used by others (Clarke et al., 2007; Koustanaïa, Boloixa, Van Elslande, & Bastiena, 2008). The concept underlies the theory is that motorcycles are more susceptible to intersection crashes than other motor vehicles due to their relatively lower frontal conspicuity (e.g. Lin & Kraus, 2009; Pai & Saleh, 2008a, 2008b; Thomson, 1980; Wells et al., 2004; Williams and Hoffman, 1979). Not all researchers find evidence supporting the theory that poor conspicuity underlies the LBFTS problem (e.g. Clarke et al., 2007; Hole, Tyrell, & Langham, 1996). The LBFTS effect persists in different forms, potentially as an 'expectation-bias' or 'cognitive deficit' rather than a function of failing-to-see *per se*. Thus 'conspicuity' and 'LBFTS' may be separate concepts. Despite being challenged over twenty years ago, the so-called 'conspicuity hypothesis' (Olson, 1989) has dominated efforts and policy. Wulf, Hancock, and Rahimi (1989) reviewed twenty studies evaluating the effectiveness of improving motorcycle conspicuity and found it 'inconclusive'.

Research into the aetiology of motorcycle crashes has tended to examine factors influencing one type of crash (Pai, Hwang, & Saleh, 2009), or compared one type of motorcycle crash and another (e.g. right-of-way crashes versus crashes on curves; Clarke et al., 2007). This methodology is criticised as logically flawed by Olson (1989). He pointed out that, for example, right-of-way violation crashes are very common for motorcycle accidents and also generally a common type of crash. Olson (1989, p. 142) noted that researchers who establish the 'astonishingly high' figure for motorcycles do not also then "... think it remarkable enough to inquire whether it was any different in the case of similar car–car crashes". For example, although Clarke et al. (2007) observed that at-fault drivers in CVM right-of-way crashes were likely to be older, they did not compare the age of drivers in CVM right-of-way crashes with the age of drivers in car-versus-car (CVC) right-of-way crashes. Thus, it is possible that older drivers are more generally overrepresented in right-of-way crashes, regardless of whether they collide with a car or motorcycle. Isler, Parsonson, and Hansson (1997), for example, find significant decrement in maximum achieved head movement relating to a useful visual field in drivers aged over 60 that might account for such a finding.

Cercarelli et al. (1992) followed Olson's (1989) recommendation to challenge the conspicuity hypothesis comparing CVM and CVC-type accidents. Cercarelli et al. (1992) investigated around 500 CVM crashes comparing these to over 3000 CVC crashes. They did not observe the expected relationship between crash-type and lighting (measured as rates of night-time and daytime crashes) that would support the conspicuity hypothesis. They reinforced the need to further compare CVC type crashes with CVM crashes.

This study examines a sample of intersection CVC crashes and CVM crashes, where the motorcyclist was reported as not at-fault, to determine whether systematic differences between the two crash types exist in relation to the LBFTS hypothesis. For instance, differences between CVC and CVM crashes for time of day or month (representing light levels) or speed zones would support the LBFTS hypothesis. T-intersections and crossroads were chosen because right-of-way CVM accidents most frequently occur at T-intersections (Clarke et al., 2007; Huang & Preston, 2004; Pai et al., 2009; Walton, 2010), and crossroads can be conceptualised as two adjoined 'T's.

2. An overview of the crash analysis system

Data for the study was drawn from the New Zealand's Crash Analysis System (CAS) launched in 1998. Comprehensive standardised Traffic Crash Reports (TCRs) are provided to CAS by the attending police. TCRs represent coded details of the crash event. The codes (available within Land Transport, New Zealand (LTNZ), 2005) enable limiting a search to specific types of crashes (e.g. wet weather crashes on curves) as well as providing information about the crash. The quality of the data is subject to some criticism as, for example, police codes for injury severity, excluding fatal injuries, do not necessarily match injury severity based on hospital discharge forms (McDonald, Davie, & Langley, 2009).

Hypotheses: Following the recommended method of Olson (1989) the hypotheses are formed comparing random independent samples of two crash types (CVC and CVM) drawn from the population of two-vehicle crashes (2004–2009) at non-signalised intersections:

(1) That lower ranked lighting conditions will be more often attributed to the CVM crash types than CVC crashes with the corollary that rates for CVC and CVM-type crashes interact with seasonal variation in natural lighting.
(2) The movement codes, classifications of impact location and other crash characteristics of the at-fault vehicle will not occur with the same frequencies for CVC and CVM-type crashes indicating a specific signature type for CVM-crashes.
(3) That other factors in the crash code classifications will distinguish CVM crash types from CVC crashes when considering factors broadly classified as related to the driver, the environment and the at-fault vehicle.

3. Method

3.1. Sample selection

A sample of 68,294 crossroads or T-intersection crashes was extracted from the CAS database, representing all crashes for 2005–2009. Approximately 63% of these crashes occurred at T-intersections and 71.5% resulted in at least a minor injury. Three types of crashes were excluded from the sample: (1) CVM crashes where the motorcyclist was deemed at-fault; (2)