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Motorcycle Lane-Sharing (Lane-Splitting and Lane-Filtering)

Motorcycle advocacy groups have often pushed for changes in law that would allow motorcyclists to engage in lane-sharing, a generic term for the practice of riding along the paving lines between streams of traffic on public roads. Lane-sharing can be distinguished between lane-splitting (between streams of moving traffic) and lane-filtering (between streams of stopped traffic). Motorcyclist jargon sometimes refers to "white-lining" and "stripe-riding." These practices are legal in several European countries and two Australian states but currently illegal in every U.S. state except California. Motorcyclists openly engage in lane-sharing in many parts of the world where these techniques are still illegal. Research from Australia found that lane-sharing did not reduce congestion but did reduce travel times – for motorcyclists alone. The benefits of legalizing these practices, advocates argue, are improved travel times, reductions in traffic congestion, and improvements in rider safety. Are these assertions accurate? This summary will consider these and other factors pertinent to motorcycle lane-sharing.

Numerous studies (primarily from the United Kingdom, France, and Australia) have brought focus to an emerging research consensus. At its core, the issue of lane-sharing involves a conflict of perceptions, attitudes, and needs between motorcyclists and other road users. Researchers agree widely that, apart from self-inflicted motorcyclist errors like speeding and impairment, the leading cause of multi-vehicle motorcycle crashes is right-of-way violations (ROWV) by other vehicle drivers, found consistently in 30% to 40% of multi-vehicle motorcycle crashes. Research further shows that the majority of these ROWV drivers "looked but did not see" the motorcyclists with whom they collided. Motorcyclists involved in crashes have often made the claim that the drivers who struck them did not see them, and that turns out to be true in many cases. However, motorcyclist errors in passing and lane-sharing run a close second in most case studies. One recent study found that lane-sharing motorcyclists experienced a shrinking of perceptual view that reduced their awareness of vehicles and non-motorists around them.

Why do vehicle drivers have such a persistent problem seeing motorcyclists? Inadequate visual conspicuity among motorcyclists is a large problem in both other driver ROWV crashes and lane-sharing crashes. Researchers consistently find that riding with headlights on and wearing retro-reflective clothing and white helmets greatly reduce motorcyclist crash risk. Some motorcyclists resist adopting these practices but continue to blame other drivers for not seeing them. Even where lane-sharing is legal, the failure of other vehicle drivers to see lane-sharing motorcyclists, especially those approaching from behind, is a critical problem. Some evidence shows that lane-sharers often ride in vehicle drivers' blind spots, and vehicle-structure issues, such as bulky A-pillars, contribute to this issue. Other studies show that vehicle drivers may operate from a preset visual-search framework that highlights other motor vehicles over motorcycles, so the sudden appearance of lane-sharing motorcyclists violates their cognitive expectancies. In such cases, drivers are less likely to react as quickly and skillfully as the driving situation calls for. This pattern contrasts with the performance of vehicle drivers who also ride motorcycles. These so-called dual drivers show superior visual-search and situational-awareness skills in traffic compared to vehicle drivers who do not

also ride motorcycles. Dual drivers also excel at picking out motorcycles from a cluttered visual field and then reacting more quickly and appropriately than non-motorcyclists do. Dual drivers know where to look, when to look, and what to look for when driving due to the dual driving experience they possess.

Most surveys find a strong belief among motorcyclists that other motorists pose the primary threat to their safety. Comments like "always assume that a car has not seen you or will not respect your priority," and "expect the worst from other road users, regardless of your priority," illustrate this defensive attitude. However, simply assuming other drivers will not see them is not protection enough. To be safer while lane-sharing, motorcyclists have learned to focus on specific behaviors exhibited by other vehicle drivers, such as those engaged in talking on a cell phone, tuning the radio, or chatting with another passenger. Motorcyclists report that vehicle drivers often commit unsafe actions quite suddenly, such as opening a car door directly in a motorcyclist's path, swerving into the motorcyclist's lane, passing where prohibited, not allowing sufficient following distance, resisting a motorcyclist's attempt to pass legally by speeding up, and other actions.

Vehicle drivers express strong opinions regarding both motorcyclists generally and lane-sharing specifically. Consistent majorities believe that lane-sharing should not be legalized. They believe the practice is inherently unsafe and that all vehicles in traffic should be compelled to follow the same general rules. Vehicle drivers believe that motorists following different rules in the same traffic situation will lead to unpredictable and hazardous conditions. A smaller minority of vehicle drivers also believe that allowing motorcyclists to lane-share is intrinsically unfair. Consistent driver majorities also report that motorcyclists often engage in unnecessary risk-taking.

While these descriptive studies have provided many useful insights into inter-vehicular dynamics and other nuances of motorcycle lane-sharing, they lack quantitative estimates of the risks to motorcyclists, pedestrians, and other vehicle drivers. However, a recent French project developed a naturalistic study to derive such risk estimates. These estimates revealed that motorcyclists engaged in lane-sharing were roughly four times more likely to be injured in a traffic crash than motorcyclists who were not splitting or filtering (Relative Risk 3.94, Confidence Interval 2.93-5.89). Much more work is still needed to determine whether and to what extent these results are generalizable to traffic environments in other locations. Other critical research questions remain as well, such as the issue of who is at fault in lane-sharing crashes. However, this inventive and careful investigation offers a useful milestone along the path to a fuller understanding of the risks associated with motorcycle lane-splitting and lane-filtering.

Reference Summaries:

Aupetit S, Espié S, Bouaziz S (2015). **Naturalistic study of riders' behaviour in lane-splitting situations**. *Cognition, Technology & Work*: 17 (2), 301-313. https://www.researchgate.net/publication/272828552_Naturalistic_study_of_riders%27_behaviour_in_lane--splitting_situations

This study monitored the riding and situational behaviors of 11 motorcyclists traveling during commuting periods on instrument-loaded motorcycles along urban expressways in the Paris region. While French data show that up to 5% of police-reported crashes involve motorcycle lane-splitting, the authors cite data from Mutelle des Motards, a French insurance company, indicating that as many as 60% of motorcyclist crashes involve lane-splitting. This study involved vehicle-borne video camera recordings (four cameras on each motorcycle) and other data (e.g., vehicle kilometers-traveled), as well as in-person interviews. From this information, researchers were able to document that nearly three-fourths of motorcyclist travel times (72%) and travel distances (77%) were spent "riding between traffic lanes" (i.e., lane-splitting).

Primary visual focal-points for subject motorcyclists centered on the distance between traffic streams traveling in adjoining lanes (i.e., the width of the lane-splitting corridor) and the speed differential (i.e., the difference between motorcycle speeds and those of other vehicles). Focal point attention was also given to the wheel angle of vehicles ahead; when turned toward an adjoining lane that often predicted that another vehicle was more likely to change lanes and cut off the lane-splitting motorcyclist. Driver behavior inside other vehicles (especially drivers focused on electronic devices or conversing with other passengers) is a predictor of swerving. Motorcyclists also focused on other lane-splitting motorcyclists, for the obvious reason but also in order to yield the right-of-way to faster motorcyclists, and vehicle license plates (among other vehicles, those identifying out-of-region drivers who were not used to lane-splitting motorcycles).

With traffic stopped, motorcyclists filtered between lanes at an average of 38 kilometers per hour [kph] (24 mph). When speed differential increased beyond about 50 kph (31 mph), many subject motorcyclists stopped lane-splitting altogether. Participants reported feeling that riding between lanes of stopped traffic (in this study called filtering forward) seemed to be the safest situation, since other vehicles were much less apt to change lanes.

Beanland V, Pammer K, Sledziowska M, Stone A (2015). **Drivers' attitudes and knowledge regarding motorcyle lane-filtering practices**. In *Proceedings of the 2015 Australasian Road Safety Conference*: Gold Coast, Queensland, AU. http://acrs.org.au/files/papers/arsc/2015/BeanlandV%20077%20Drivers%20attitudes%20and%20knowledge%20regarding%20motorcycle%20land%20filtering%20practices.pdf

This study investigated the knowledge and attitudes of vehicle drivers (90% were not motorcycle riders) in the Australian Capital Territory with regard to motorcyclists, specifically the practices of

lane-splitting and lane-filtering. Survey results revealed that two-thirds of respondents were unfamiliar with the terms ("splitting" and "filtering"). Among vehicle drivers, 28% believed that lane-splitting was already legal but the majority of respondents thought the practice should not be legal. Vehicle drivers expressed that lane-splitting should be illegal owing to safety reasons; respondents reported that it is harder to see motorcyclists than other vehicles, especially while they are lane-splitting, and lane-splitting riders would "violate drivers' expectations". A minority of respondents felt that splitting and filtering should be illegal because motorcyclists would no longer follow the same rules as other vehicles. Respondents were more likely to support legalizing lane-splitting if they were older, if they rode a motorcycle themselves, or if they believed it was already legal.

Centre for Road Safety (2014). **Motorcycle lane-filtering trial – summary of trial results.** Sydney, NSW, AU: Transport for New South Wales. http://roadsafety.transport.nsw.gov.au/downloads/motorcyclists/lane-filtering-results.pdf

This report summarizes the results of a lane-filtering trial in specific sub-areas of Sydney Australia's central business district. The authors distinguish between lane-filtering (riding between lanes of stationary traffic) and lane-splitting (between lanes of moving traffic), in accord with the definition offered by the Federation of European Motorcyclists' Associations and their comprehensive investigation. The trial aimed to investigate the impacts of lane-splitting – behavioral (riders, pedestrians, other vehicle drivers), and transportation effects like congestion and travel time. The study found that the safety of riders and other vehicle drivers was not jeopardized but that of pedestrians might be if motorcycle lane-splitting is more widely practiced. Most motorcyclists overshot the stop-line at intersections, thereby encroaching into pedestrian safety space. The trial did not find any congestion relief associated with lane-splitting but concluded that an increase in motorcycle prevalence would likely contribute to such relief. Finally, travel times were reduced for the splitting motorcyclists only.

Clabaux N, Fournier J-Y, Michel JE (2016). **Powered two wheeler riders' risk of crashes associated with filtering on urban roads**. *Traffic Injury Prevention*. 18:182-187. https://www.researchgate.net/publication/307592488_Powered_two_wheeler_riders%27_risk_of_crashes_associated_with_filtering_on_urban_roads

This study investigated the risk of motorcycle crashes while lane-filtering compared with the crash risk associated with motorcycling while not lane-filtering. From video recordings of commute-hour traffic along specific sections of fourteen urban arterials in the Marseilles, researchers calculated the vehicle kilometers traveled (VKT) by lane-splitting and non-lane-splitting motorcyclists. Using travel data from existing traffic loops along those same sections of roadway, the researchers calculated motorcycle-travel percentages for all roadway sections video-recorded. Finally, using police-reported crash data (for three earlier years) that happened along the same road-sections, investigators were able to calculate relative-risk estimates for motorcyclists who were injured while

lane-splitting and for those who were injured while riding in normal travel lanes. The study was conducted along 14 sections of urban roads in Marseille, France (comprising 18 km of roadway), and employed direct observations of motorcycle traffic in order to estimate kilometers of motorcycle travel—both while filtering and while traveling within an existing travel lane—of total measured VKT. The results showed that motorcycle travel while lane-filtering accounted for roughly one-fifth of all motorcycle kilometers traveled on the road sections observed. Results also showed that lane-filtering carries a nearly four-fold increase (Relative Risk 3.94, Confidence Interval 2.93-5.89) in crash risk compared to non-filtering motorcycle travel (i.e., riding within the designated traffic lanes).

Clarke DD, Ward P, Bartle C, Truman W (2004). **In-depth study of motorcycle accidents**. London: Department for Transport. *Road Safety Research Report No. 54.* http://img2.tapuz.co.il/forums/1_144667370.pdf

This study reviews research findings related to the perceptual, cognitive, and motor skills affecting the habits and behaviors of other vehicle drivers with respect to motorcyclists. The authors conducted a comprehensive review of motorcycle crash cases in the United Kingdom, finding that right-of-way-violation errors committed by vehicle drivers constitute the most frequent cause leading to motorcycle crashes, followed by the combination of overtaking (passing) and lane-filtering errors, and then by motorcycle loss-of-control crashes at road curves.

Crundall D, Bibby P, Clarke D, Ward P, Bartle C (2008). **Car drivers' skills and attitudes to motorcycle safety: a review**. London: Department for Transport. *Road Safety Research Report No. 85.* http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.469.201&rep=rep1&type=pdf

The authors again revisit the subject of right-of-way violations by drivers of other vehicles, especially where drivers "looked but did not see" the motorcyclists squarely in their field of view. These errors stem largely from faulty or incomplete priming of other-vehicle drivers' information-processing operations: "Expectations not only influence whether one looks in a specific location…and influence what features are processed…, but they can also reduce the actual processing time" (31). These expectations, sometimes called cognitive expectancies, are based on prior experience and can become powerful determinants of what we actually perceive in the world. Vehicle drivers who have encountered few motorcycles on the road are less likely to bring that cognitive expectancy to the driving task than drivers who are accustomed to seeing motorcycles in the traffic streams. Such inexperienced vehicle drivers are often even more unlikely to perceive motorcycles during lane-splitting events since they add yet another feature that is unfamiliar to those drivers.

Crundall D, Bibby P, Clarke D, Ward P, Bartle C (2008). **Car drivers' attitudes towards motorcyclists: a survey**. *Accident Analysis and Prevention*. **40**: 983-993. https://www.researchgate.net/publication/5393357_Car_drivers'_attitudes_towards_motorcyclists_A_survey

This study reports the results of 1,355 driver surveys sent through surface mail and the internet to investigate the attitudes of licensed vehicle drivers towards motorcyclists. Respondents were grouped by years of driving experience as well as age, gender, and three primary driving behaviors; violations (e.g., "How often do you drive or ride while above the legal blood-alcohol limit?"), errors (e.g., "How often do you miss yield signs?"), and lapses (e.g., "How often to do you unintentionally drive in the wrong gear?").

Not surprisingly, vehicle drivers without experience operating motorcycles expressed stronger negative feelings towards motorcyclists than did drivers with experience. For instance, respondents in these groups were more apt to agree that "car drivers are more law-abiding than motorcyclists," that "the motorcycle test is easier than the driving test," and that "when a car and a motorcyclist collide it is typically the fault of the motorcyclist." Also unsurprisingly, respondents with motorcycle operation experience strongly agreed that "other drivers should take more care to look out for motorcycles," that "when driving in interweaving traffic I am aware that motorcycles are hard to spot," and that "motorcycles are easy to spot, even against a cluttered background." Non-motorcyclists either remained more neutral to these assertions or disagreed with them altogether.

Finally, non-motorcyclists agreed strongly "motorcyclists often perform maneuvers that are inappropriate," and "I am often surprised by motorcycles filtering," whereas drivers with motorcycle operation experience disagreed with these statements. Drivers with motorcycle operation experience also showed the lowest violation, error and lapse rates among all groups. Long-term experience with operating both motorcycles and other vehicles resulted in better cognitive and perceptual motor performance, especially when driving another vehicle in the presence of motorcyclists.

Federation of European Motorcyclists Associations, FEMA (2009). **A European agenda for motorcycle safety – the motorcyclists' point of view.** Brussels, Belgium. http://www.fema-online.eu/uploads/documents/safety/EAMS2009.pdf

This document is a motorcyclist advocacy paper containing a mix of facts, opinions, and wishes. The authors define lane-filtering as "moving between traffic when other surrounding traffic is stationary," and lane-splitting as "moving through traffic when other traffic is in motion" (p. 31). The authors further state that "filtering contributes to road safety as it can increase the road space between motorcyclists and other mixed traffic," and is "a defensive driving measure that increases motorcyclist visibility to car drivers and prevents rear end motorcycle collisions.

Huth V, Füssl E, Risser R (2014). **Motorcycle riders' perceptions, attitudes and strategies: findings from a focus group study**. *Transportation Research Part F*. 25:74-85. https://www.researchgate.net/publication/262923098_Motorcycle_riders'_perceptions_attitudes_and_strategies_Findings_from_a_focus_group_study

This study relied on motorcycle rider focus group discussions to assess rider motorcyclists' underlying attitudes towards other road users, including other motorcyclists, as well as their awareness of risks they face in the traffic environment. Overall, the study authors concluded that motorcyclists were exquisitely aware of the driving faults of other vehicle drivers but less aware of the risks they pose to themselves as well as other road users. Several rider statements were especially telling: "always assume that a car has not seen you or will not respect your priority," and "expect the worst from other road users, regardless of your priority situation".

Mulvihill CM, Salmon PM, Filtness AJ, Lenné MG, Walker GH, Cornelissen M, Young KL (2013). **Lane-filtering and situation awareness in motorcyclists: an on-road proof of concept study**. In *Proceedings of the 2013 Australasian Road Safety Research, Policing & Education Conference:* Brisbane, Queensland, AU. http://acrs.org.au/files/arsrpe/Paper%20114%20-%20Mulvihill%20-%20Motorcycle%20Risks%20and%20Crashes.pdf

This study investigated the differences in situational awareness between motorcyclists who engage in lane-splitting and motorcyclists who do not. Results indicated that motorcyclists who do not lane-split are more apt to focus on the greater traffic environment, including the presence and actions of other traffic users than are those who lane-split. "Overall, the analysis of shared and unique concepts suggests that motorcycle riders who filter tend to shed their focus on perceptions of surrounding hazards and traffic moving through or approaching the intersection to tasks associated with their own actions whilst moving to the front of the traffic queue." In other words, the situational awareness of lane-splitters narrows dramatically to encompass only details pertaining to the goal of moving through traffic as quickly and strategically as possible. The result is that they are more vulnerable to crashing with other peripheral vehicles because they do not see them.

Rice T, Troszak L, Erhardt T (2015). **Motorcycle lane-splitting and safety in California.** Berkeley, CA: Safe Transportation Research & Education Center, University of California. http://www.ots.ca.gov/pdf/Publications/Motorcycle-Lane-Splitting-and-Safety-2015.pdf

This study investigated 5,969 California motorcycle crashes occurring between June 2012 and August 2013 on roads patrolled by the California Highway Patrol (CHP), including 997 cases where a crash occurred during lane-splitting. As the authors state, this is a descriptive study that enabled them "only to examine the collision, personal, and injury characteristics of the riders" in the sample. Moreover, since no useful exposure data exists, the data obtained in this study "cannot be

used to compare the collision risks for lane-splitting or non-lane-splitting riders" (p. 18). In other words, it is useful only for descriptive purposes.

To that end, the findings reveal some contrasts between lane splitters and non-lane splitters. Lane-splitters were more likely than non-lane-splitters to be riding on weekdays (86% to 63%), to be riding during commute hours, 6-9 AM and 3-6 PM (62% to 37%), and to be traveling on a state highway (94 % to 66%). Lane-splitters were also more likely to be wearing a full helmet with a face-shield (81% to 67%) and to be alcohol-free (99% to 97%). Lane splitters were more likely to crash into the rear of another vehicle (38% to 16%) but were less likely to suffer head, neck, or torso injury (9% to 17%, 7% to 9%, 19% to 29%), and also less likely to be fatally injured in a crash (1% to 3%).

This study has several notable flaws. First, several of the factors noted are clearly covariates of each other. For example, lane-splitting motorcyclists were more likely to ride on weekdays and more likely to be riding during commute hours and in congested traffic conditions. Since commute hours generally occur on weekdays and are far more likely to involve congestion, this finding is of dubious value. Likewise, the study found that lane-splitters were more likely to be wearing full-faced, standard motorcycle helmets and "markedly less likely" to suffer a head injury than non-lane-splitters. Clearly, these are very strong cofactors, so this finding also is not especially noteworthy. Moreover, since lane-splitters were more likely to be riding on state highways under the jurisdiction of the CHP, it is not surprising that they were also more likely to use better helmets than non-lane-splitters.

Wells S, Mullin B, Norton R, Langley J, Connor J, Lay-Yee R, Jackson R (2004). **Motorcycle rider conspicuity and crash related injury: case-control.** *British Medical Journal*. 328 (7444): 857-862. http://www.bmj.com/content/bmj/328/7444/857.full.pdf

In this case-control study, researchers investigated the role of rider conspicuity in motorcycle crash injury. The study matched 463 injured motorcycle riders (cases) either deceased or admitted to hospital for treatment in Auckland, NZ. Controls were 1,233 motorcycle riders recruited from randomly selected roadside survey sites in the same geographic area. The study measured the relative risk (odds ratio) and population attributable risk of injury related to helmet color (white or black), clothing visibility (retro-reflective or not), headlight use (on/off), motorcycle color, and other binary variables. The authors found that motorcyclists wearing high-visibility clothing, wearing white helmets, and riding with headlights on during daylight hours were 37%, 24%, and 27% (respectively) less likely to suffer a crash injury.