The Looked But Failed to See (LBFTS) Motorcyclist Crash Research Findings

(Rev. Feb. 2021)

Note: These key points have been compiled by SMARTER to provide a quick over-view of an extensive body of research. Much of the research from which these points are drawn is posted on our website at www.smarter-usa.org under the main heading RESEARCH. This section contains a dropdown menu. Relevant sections to the points identified here are CONSPICUITY, PERCEPTION, MOTORIST AWARENESS and to a lesser degree CRASH CAUSION.

UK motorcyclist safety advocate and rider trainer, Kevin Williams has written a review of the literature on this subject which he has titled "The Science of Being Seen" which can be accessed at https://smarter-usa.org/wp-content/uploads/2021/01/The-Sceince-of-Being-Seen-Edited-by-SMARTER.docx.pdf. SMARTER is greatly appreciative of Mr. Williams' excellent contribution to our knowledge in this important motorcyclist safety area.

INTRODUCTION

- The most common collision between a motorcyclist and another vehicle happens when the motorcyclist has the right-of-way and another driver turns across the rider's path.
- These collisions occur the driver turns across a motorcycle's path at an intersection (or a junction as they are called in the UK) when the rider has priority.
- The historical research has concluded a major contributory factor in these crashes was that other drivers failed to see the motorcycle/motorcyclist.
- For that reason, they are formally known as Right-of-Way Violations, which you'll often find abbreviated to ROWV. They are also called Looked But Failed To See (LBFTS) collisions or Sorry Mate I Didn't See You (SMIDSY) as this explanation is the one most commonly offered by the driver.
- Many riders DON'T see the SMIDSY coming and they DON'T react in time.
- This crash scenario is world-wide.
- LBFTS or SMIDSY is not a recent phenomenon. Although research might have started relatively recently - in the 1960s and 70s - the crash dates back to the invention of the motorcycle.
- LBFTS crashes do NOT seem to be prevented by training and heavily-enforced rules.
- All the way back in 1977, US researcher Harry Hurt stated: "the most likely comment of an automobile driver involved in a traffic collision with a motorcycle is that he, or she, did not SEE the motorcycle…"

MOTORIST AWARENESS CAMPAGINS

- This research gave rise to motorist awareness campaigns which began in the US in the early 1980's – Look for Motorcycles, Look Twice to Save a Life.
- If these campaigns and interventions worked, we would expect to see a significant reduction in the proportion of collisions between cars and motorcycles occurring at intersections.

- That has simply not happened.
- It has been estimated that if this type of crash could be prevented it would reduce motorcyclist casualties by approximately 25%.

CONSPICUITY

- The common understanding for the failure of drivers to see the motorcycle or motorcyclist has been the motorcycle/motorcyclist is ***not conspicuous.***
- This conclusion was bolstered by the 1981 Hurt report conclusions and recommendations resulted in the creation and implementation of two main countermeasures (1) encouraging riders to wear high-visibility (or Hi-Viz) gear to make themselves more conspicuous and communication campaigns to urge other vehicle drivers to "look twice" or "keep an eye out" for motorcyclists.
- Day-time running lights (DLRs) were also an early recommendation to increase conspicuity.
- Early research (1980s – mid 1990's) generally supports the effectiveness of Hi-Viz gear and DRLs.
- There is less consensus regarding the effectiveness of conspicuity aids in more recent research with many reports more likely concluding "it depends" - mostly connected to the motorcycle and rider's contrast with the background.
- At best, interventions aimed at preventing collisions between drivers and motorcyclists have had limited effectiveness.

RESEARCH INTRODUCTION

- There is an astonishing quantity of scientific research into the causes and consequences of the LBFTS collision.
- This body of research points to the way our eyes and mind work to perceive our world as the likely cause of LBFTS collisions and not the size of the motorcycle, the lack conspicuity of the machine and rider or the failure or drivers to look or to look properly.
- It is commonly believed (by motorcyclists and especially those who advocate for motorist awareness programs) that car drivers routinely violate the ROW of motorcyclists and that this ROWV occurs with motorcyclists much more often than ROWV's between cars.
- Research suggests this is NOT true. Car drivers do not fail to give priority to motorcycles relatively more often than to another car when the car/motorcycle approaches from a PERPENDICULAR angle.
- However, research suggests 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.
- Putting these ROWV crash scenarios in context of all the possible crash intersections between cars and motorcyclists it becomes obvious that violations are actually very rare. If they were not extremely rare few motorcyclists would complete even a short ride.
- It is certainly a fact that sometimes drivers fail to detect motorcyclists especially at intersections. WHY THIS HAPPENS IS VERY COMPLEX.

THE FOUR CHANCES FOR ERROR - FREQUENCY OF LBFTS CRASHES

- In fact, the 'Looked But Failed To See' problem can result from a breakdown at several places in a chain of events. 1. Does the driver look? 2. Can the driver see? 3. Does the driver perceive? 4. Does the driver judge correctly?
- If drivers really did fail to look with any regularity, they wouldn't get very far before colliding with anything that was moving, not just motorcycles. In fact, in terms of distance travelled, ALL collisions are rare events.
- An absolute 'failure to look' would only arise in a very limited number of circumstances.
- The crash rate involving motorcycles and drivers using a phone is thus almost certainly much lower than most of us would believe.
- The assumption that whatever the eye is pointed at (a 'fixation') is what the driver's conscious mind is currently processing - known as the 'eye-mind assumption' is FALSE.
- The car driver is not the 'incompetent idiot' that popular motorcyclist myth suggests.
- 'Not looking' isn't a major factor in collisions between motorcycles and other vehicles.
- When we think in terms of OPPORTUNITY to commit a ROWV, it's clear that very few of the opportunities result in the error. The successes outweigh the failures by a huge margin. That means that the vast majority of drivers must 'look properly' for bikes.
- 'Did not look', 'did not look properly' and 'looked but failed to see' are not the same issue. The first is a complete observation breakdown. The second might be a failure to look in the right place at the right time (or even to look at all) but the third is much more about perception failure.

BLOCKED VISION – LOOKED BUT COULDN'T SEE

- An automobiles pillars (A pillar especially) can obscure the drivers view of a motorcycle for as long as 4 seconds.
- We avoid looking near to the edges of a framed scene. The pillars represent the frame so the tendency is for the driver to look out of the areas of the windscreen which are well away from the pillars. So not only are the pillars a physical blind spot, this 'windscreen zoning' phenomenon creates a psychological blind area that is even bigger.
- If the approaching vehicle is hidden behind the A pillar when the driver starts to look to scan the road to check whether it is safe to emerge, and the two vehicles stay on a *constant bearing*, then the vehicle will remain hidden until it is close enough to 'expand' around the pillar.
- The *constant bearing* issue almost certainly accounts for a number of collisions at junctions and roundabouts.
- Olson (1989) reworked data from two earlier studies (including Hurt et al. 1981) to conclude that in 48% of cases where there was a violation of the motorcyclist's right of way, the view of the driver, was obscured.
- Motorcycle riders could be invisible to the driver for a significant period despite being able to see the car quite clearly ourselves.

- If the motorcyclist happens to be in the wrong place at the wrong moment, the motorcyclist won't be seen despite the driver looking.
- Once we understand how easy and how often the drivers view of the motorcyclist is blocked, it's a lot easier to understand why so many of the 'looked but failed to see' collisions aren't "because the driver didn't look properly" but because the driver "looked but COULDN'T see".

BLOCKED VISION AND CONSPICUITY

- Many studies have focused on finding ways of making motorcyclists 'more conspicuous' but despite those efforts, collision statistics remain largely unchanged. This suggests that it may not be a lack of conspicuity that is the likely explanation for car drivers missing motorcycles but it's become accepted as fact rather than asking if the hypothesis is correct.
- It actually seems almost inconceivable that with so many crashes resulting from motorcycles vanishing in blind spots that motorcyclists aren't better-aware of the problem.

MORE ON CONSPICUITY – WHY HI-VIZ ISN'T ALWAYS EFFECTIVE

- Objects that attract our attention and are easily detected are known as having 'high saliency.'
- Many early studies concluded that poor saliency and poor sensory conspicuity were the causes of LBFTS crashes.
- One particular bottom-up influence seems especially relevant: spatial frequency (the width of the vehicle). The theory suggests that we extract low spatial frequency items from a visual scene first (including wide vehicles such as cars). Thus, we are more likely to miss narrow motorcycles, which are considered to be high spatial frequency items.
- By and large, the results appear to demonstrate that light-colored clothing and headlights do make motorcycles stand out better.
- Many of the studies - which are still quoted and still used as evidence for the effectiveness of conspicuity aids - placed the rider against a relatively uniform backdrop.
- The most conspicuous clothing and lighting changes moment-by-moment depending on the and local environment - there is no straightforward 'one size fits all' solution.
- Road safety observations have concluded that highly visible road users are less likely to be involved in crashes, suggesting that saliency is important in real-world tasks.
- On the other hand, actual crash statistics don't support that conclusion.
- Categorical statements such as "motorcyclists should wear hi-vis kit and use day riding lights to be more visible" should be seen as inaccurate since there is clearly no 'one size fits all' solution.
- <u>A key point of understanding is that the human eyes and brain are not the equivalent of the lens and the camera. The commonsense argument that "if it's visible, we will see it if we look hard enough" simply isn't true.</u>

FOVEAL AND PERIPHERAL VISION

- To give us the ability to detect detail within the visual field, the human eye is constructed in a way that allows us to focus full attention on just a tiny part of the background.
- Just how narrow our foveal vision is can easily be demonstrated. Make a 'thumbs up' sign. Look at your thumb nail, then look at your top knuckle. You'll discover you cannot do this without physically shifting your gaze.
- Outside of the fovea, the image from the outside world falls on a part of the retina which has a very different construction - our peripheral vision. And here our view of the world changes. It turns increasingly blurry as well as black-and-white.
- What fools us is that our brains do an amazing job of stitching together visual input as we move our eyes, which gives the illusion of full-color vision over a wide area. But it IS an illusion.
- One consequence of the tiny cone of color, focused vision is that 'eye contact' proposed in motorcyclist safety literature as a good way of 'communicating' between rider and driver seems a doubtful concept at best.

SACCADES

- When we turn our heads quickly, our vision is shut down in a series of 'saccades.' This causes 'saccadic masking.' Drivers at junctions turn their heads quickly left and right, and generate saccades. The motorcyclist falls behind a saccade, the driver can appear to look right at the rider and yet will not see him/her.
- When we move our eyes to scan a scene, the background would move rapidly through this zone of vision. This would cause disorientation and dizziness. So, our eyes don't move smoothly across the background, as we commonly think. Instead, they move very rapidly from one selected object - a fixation - to another. These movements are called saccades.
- Now, ask yourself: "what does a driver do at a junction?" The answer is that he/she looks right and left, momentarily fixating in each direction before moving head and eyes rapidly from one scene to the other. Just like the dancer, to prevent blurring of vision and disorientation, saccadic masking shuts down the visual processing system as the eyes move.
- Even an attentive driver, looking in both directions to check for oncoming traffic, may fail to see an approaching motorcycle if it falls within a saccade. This isn't 'carelessness' or 'failing to look properly', it's a fundamental limitation - and illusion - of the human visual system.

MOTION CAMOUFLAGE

- The human visual system is sensitive to lateral movement across the background but we are particularly poor at spotting things moving directly towards us. This is known as 'motion camouflage.' Motorcyclists approaching a driver waiting to turn may not create any lateral movement and the driver may fail to spot the bike and rider due to motion camouflage.

- It is lateral (i.e., side-to-side) movement that usually helps us detect an object at a distance because it's difficult to detect movement via change of apparent size.
- A moment's thought should tell us that a motorcyclist approaching a vehicle that is waiting to turn at a junction is on also on an approach path that barely moves relative to the background, and so also suffers motion camouflage.

PREVALENCE, COGNITIVE LOAD, GAP ACCEPTANCE

- Studies regarding prevalence (how frequent) were conducted using a driving simulator experiment, with the target vehicles being motorcycles and buses. Half of the subjects experienced a high prevalence of motorcycles with a low prevalence of buses, and half experienced a high prevalence of buses with a low prevalence of motorcycles. What they found was that drivers detected high-prevalence targets faster than low-prevalence targets for both vehicle types.
- When driving the brain needs to process sensory information. This is known as the 'cognitive workload.' As driving tasks increase in difficulty, the workload starts to increase. Even relatively simple tasks create an incoming information stream that exceeds the brain's ability to process it all.
- One of the key theories behind research into car/motorcycle collisions is termed 'gap acceptance', which seeks to understand how the driver calculates the 'time to collision' with an approaching motorcycle, decides whether or not a gap ahead of an approaching motorcycle represents a safe distance, and then makes a decision whether or not to pull out.
- The complexity of the driving task could lead to a disconnect between eyes and brain. Workload offers at least a partial explanation for 'looked but failed to see' collisions between a motorcycle and a car.
- It should be clear that excess workload can significantly affect a driver's situational awareness at junctions and in some instances a failure to spot other vehicles (including motorcycles) isn't 'lack of attention', it's 'not enough to go round'.
- The surprise is not that drivers fail to spot motorcycles (and other vehicles) but the fact that they spot them many, many more times than they don't.
- It's been known for a long time that when we are focused on performing a 'high load' task where we are processing some specific information, it reduces our response to other objects which are unexpected but in plain sight.

INATTENTIONAL BLINDNESS

- Rather unfortunately, this phenomenon is known as 'inattentional blindness'. The term 'inattentional' unfortunately leads motorcyclists to believe it confirms what they think they already know - that drivers "aren't paying attention", and that if drivers were

'attentive' instead of 'inattentive' it would fix the problem. It's a complete misunderstanding. Inattention blindness occurs when we ARE paying attention but tightly focusing on a particular part of the visual field and performing a highly-demanding task. As a result, we fail to perceive an unexpected stimulus that is in plain sight.

- When looking at an environment with a number of moving objects, we can look right at an object and have our eyes drawn away from it towards something that demands more visual attention. Inattentional blindness should not be seen as a criticism of drivers.
- Rather than being drawn to those parts of a scene that are salient and 'stick out', it may be that our visual attention is drawn to parts of a scene that have strong meaning or 'semantic richness', because humans are primed towards identifying objects which connect with us in some way.

MEANING OR COGNITIVE GUIDANCE

- These studies reflect an alternative theory of 'cognitive guidance', where our attention is directed towards parts of a scene that our prior knowledge tells us are likely to hold meaning. And if we are drawn to areas of meaning within a scene, this makes sense of a body of research which suggests that motorcycle license holders who also drive (so-called 'dual drivers') are better at detecting motorcycles when behind the wheel than drivers without experience of riding bikes.
- Motorcyclists are much better at spotting other riders at least partly because we are actually interested in motorcycles. And that in turn would explain why 'Think Bike' (Look Twice) campaigns don't seem to have lasting effects. However hard we try, to a driver with zero interest, motorcycles will never leap out of the background in the same way that they do to another motorcyclist

SALIENCE

- If the visual scene combines a motorcycle with a car some seconds behind it, the larger of the two objects is likely to be more salient. When the driver looks, the more salient object - the car - will draw the eyes and it's the other vehicle that is likely to win out in the competition for attention.

LEARNED POOR SEARCH PROCEDURE

- With experience, drivers may develop shorter search times at junctions and may extract from complex traffic scenes only a minimal amount of information, based on prior expectancies about what they are likely to see.
- When a motorcyclist was approaching, both the novice and dual drivers moved their gaze back along the road towards their vehicle. But humans learn. It's a fundamental part of being human. Learning often involves discovering shorter, quicker and most importantly, less energy-costly ways of doing something. Experienced drivers (as opposed to novice or dual drivers) may miss motorcyclists because of this tendency to take short-cuts - but this is rare.
- And because we are dealing with tiny numbers of failures amidst all the correct decisions, it's arguable that interventions aimed at improving drivers' abilities to detect motorcycles (motorcyclists) (like think bike or look twice) are unlikely to have any significant effect on the SMIDSY collision.

MISJUDGE APPROACH – TIME TO COLLISION

- Sometimes the driver sees the motorcycle but miscalculates 'time to collision. It's possible for the driver to look in the right place at the right time, see the approaching motorcycle, yet still misjudge its distance and speed.
- What we do on a motorcycle can catch out a driver. If the motorcycle accelerates more rapidly or moves faster than the driver expects from monitoring other traffic, it's likely to add to the problems of calculating an accurate time-to-collision.
- The crux of the issue when we decide whether or not to accept a gap is our estimation of 'time to collision'.
- ROWVs aren't as common as motorcyclists typically believe, but it is true that motorcycles are particularly vulnerable to gap acceptance errors.
- How does the brain make this 'time to collision' judgement? It was originally thought that we used motion-based cues.
- In fact, this theory seems to be inadequate. We actually appear to hold a mental picture of the object where the size of the object gives us a clue to the object's distance.
- As we typically look left-and-right at a junction for less than 0.5 of a second, it would seem that it is this 'snapshot' glimpse of other vehicles that we rely on to make the time-to-arrival judgement.

SIZE-ARRIVAL EFFECT

- Not only are bikes harder to see but experiments looking at perception of objects have shown that smaller, nearer objects are incorrectly judged to arrive LATER than larger, more distant objects. This has become known as the size-arrival effect.
- Drivers adopt smaller safety margins when pulling out in front of motorcycles compared with cars. One possible explanation is the size-arrival effect in which smaller objects are perceived to arrive later than larger objects.
- If we are looking for plausible explanations of why drivers pull out into tighter gaps in front of motorcycles, this 'looked but misjudged' explanation seems much more reasonable than the commonly-held belief that drivers don't see motorcycles as a threat and so deliberately pull out in front of them.

MOTORCYCLIST SPEEDING

- There is one other factor to consider. Non-motorcyclists often accuse motorcyclists of riding too fast. Is this true?
- A study in Wellington, New Zealand found that motorcycles were moving around 10% faster than the other traffic. Another study found that a motorcycle was 3.4 times more likely to be exceeding the speed limit than a car.
- In the majority of collisions where one road user was speeding and the outcome was a fatal accident, it was much more likely to be the rider speeding - not the other driver.

THE MYTH OF A DELIBERATE DRIVER CHOICE

- Do drivers make a deliberate choice to turn in front of the PTW with an intention to force the motorcyclist to cede right-of-way, in a maneuver the driver would not be attempted in front of other vehicles? In a word, NO. There is no research to support this theory.

- But car drivers have more crashes with motorcyclists than cars, yes?
- In absolute numbers, many motorcycle crashes seem to be caused by car drivers. However, when adjusted for exposure, car drivers do not crash with motorcycles more often than motorcyclists with other motorcyclists.

THE LEFT-TURN SCENARIO – see motion camouflage

- Motorcyclists are at greater risk ONLY in one scenario - when an oncoming car turns across a motorcycle's path into a side road.
- The head-on view of the motorcycle which is narrower than a car and has only one front light instead of two… gives less information about speed.

RIDER ADVANCED CRASH AVOIIDENCE SKILL

- What is alarming is that Hurt reported that the majority of riders in 900 crashes demonstrated poor collision avoidance skills. About one-third took no evasive action at all. Most of those who did take evasive action either chose the wrong action or executed their chosen action poorly, or both. Worryingly, rider training had no effect on collision avoidance performance.
- Time from 'precipitating event' (i.e., the moment the collision partner began to turn into the rider's path) to impact was just under two seconds. Around one in five riders had more than three seconds from the precipitating event but still crashed, and between 1-5% had more than four seconds.
- Add recognition time to reaction and avoidance maneuver and it is unlikely that even a skilled motorcyclist can rely on physical skill to avoid a crash.
- A three-second gap in a stream of oncoming traffic would not allow for the safe execution of a left turn, that a four-second gap would allow for the safe execution of a left turn, but leave very little safety margin, and that a five-second or more gap in the stream of traffic would allow for the execution of a left turn and leave a reasonable safety margin.

THE SAW BUT FORGOT ERROR

- The authors of a paper entitled: *"The 'Saw but Forgot' error: A role for short-term memory failures in understanding junction crashes?"* have proposed some motorcycle collisions which are classified as 'looked but failed to see' crashes are actually the result of a memory issue. The motorcycle is seen and brought to conscious attention, but is then somehow forgotten again
- Here is the interesting part: *"...failures to report a motorcycle were not predicted by how long a driver fixated on the vehicle, but were associated with their subsequent behavior."*

SUMMARY

- The implication of the available research is that the current recommendations to look HARDER and LONGER for motorcycles is likely to be ineffective.
- The LBFTS ROW violation crashes it's not so much a failure in the way that drivers search for motorcycles, it's a FAILURE IN THE WAY THE BRAIN PROCESSES INFORMATION.