The Science of Being Seen

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Editor's note: *This is an edited version* of *a review of the literature written by Kevin Williams on the subject of the motorcyclist/car crash scenario where the car driver violates the right-of-way of the motorcyclist. In the U. S. this crash scenario is often called a Looked But Failed to See (LBFTS) crash. In the U.K, Australia, and New Zealand this scenario is called the SMIDSY crash for Sorry Mate, I Didn't See You. Mr. Williams original work can be accessed at: https://scienceofbeingseen.wordpress.com/*

SMARTER is greatly appreciative of Mr. Williams' excellent contribution to the knowledge base in this important motorcyclist safety area. Much of the research referenced in The Science of Being Seen is posted on our website at www.smarter-usa.org under the main heading RESEARCH and the dropdown sections CONSPICUITY and PERCEPTION and to a lesser degree in MOTORIST AWARENESS and CRASH CAUSION.

In this edited version of *The Science of Being Seen*, SMARTER has underlined some sentences to draw readers attention to important points. In addition, SMARTER has added **Headings** not found in the Mr. Williams' blog postings. We have also *italicized* quotes.

Preface
For many years' road safety experts, police and motorcyclists have known that the most common collision between a motorcycle and another vehicle happens when the motorcyclist has right-of-way and another driver turns into the rider's path. 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…"*

This collision is so common; it has its own acronym. This is the so-called 'SMIDSY' collision where the driver says: "Sorry Mate I Didn't See You".

More than four decades have passed since Hurt and the SMIDSY (or Looked but Failed to See) but it is still the most common crash involving a motorcycle and another vehicle. It still causes significant numbers of injuries and fatalities.

If we've known about the collision for decades, why are we still grappling with what is an age-old problem that goes back to the dawn of the motorcycling age in the early 1900s?

If we're interested in reducing powered-two-wheeler (PTW) crashes and making motorcycling safer, then it's a good question to try to answer. And that's why back in 2011 I created a new presentation called the 'Science of Being Seen' (or SOBS for short). SOBS would draw on the latest research to show just why motorcyclists and drivers come into conflict, and use that knowledge to offer riders effective strategies to stay out of trouble.

The information here provides readers with the research and background material that underpins the presentation.

Introduction

A magician knows that the 'world' we see has been built entirely inside our brains. The magician also knows that the audience about to attend the magic show understands that they are going to be fooled, yet still can't spot the tricks.

When we ride a motorcycle or a scooter, we become the magician and the drivers and other road users all around us are our audience, and one of our magic powers is invisibility. But there are a couple of extra deceptions involved:

- The motorcyclist isn't aware that he/she is a magician and about to fool the audience of drivers and
- The drivers don't know the biker is a magician

Back in the late 70s, I left university with a degree in the biological sciences. As a job wasn't immediately forthcoming, I worked as a motorcycle courier in London. As a result, I very quickly acquired a lot of practical experience in dealing with heavy traffic, including avoiding the most common collision involving a motorcycle and another vehicle in a built-up area, the so-called SMIDSY crash, named for the driver's explanation: "Sorry Mate I Didn't See You!"

The SMIDSY Collision

These collisions occur when the driver turns across a motorcycle's path at a junction (or an intersection as they are sometimes known) when the rider has priority. For that reason, they are formally known as 'Right Of Way Violations', which you'll often find abbreviated to ROWV. As the SMIDSY explanation is the one most commonly offered by the driver, they are also called 'Looked But Failed To See' (LBFTS) collisions.

These collisions are a significant road safety problem. That had become obvious when the Greater London Road Safety Unit identified powered two-wheelers or PTWs as being over-represented in accidents in the mid-70s. They'd found that a major contributory factor was that other drivers failed to see the motorcycles. That news hit the motorcycle press just about the time I was taking up biking. It's possible that the news stories focused me on the problem very early and it's possibly why I managed to avoid all but one driver who 'looked but failed to see' me. Fortunately, I'd seen it coming and had nearly stopped. The resulting crash was at rather less than walking pace - I just toppled over sideways. Once I'd started work as a courier and was dodging my way through traffic for a hundred miles a day, then the frequency of these 'looked but failed to see' incidents was even more obvious. But what I quickly realised - often as I stopped to pick another biker off the deck - was that many riders DON'T see the SMIDSY coming and they DON'T react in time.

SMIDSY and Hi-Vis

Just how frequent are these intersection collisions? It's been estimated that if we could prevent them, it would reduce motorcycle casualties in the UK by no less than 25% (Clarke et al, 2007). So, here's a question for you. If we know the scale of the problem, why are they still happening?

Good question. Whilst working as a courier, I went back to university and funded myself through an MSc – and still couldn't get a job. Eventually, in 1995 I took a training course to become a qualified instructor and being a full-time motorcycle coach has been my day job ever since. So, I've spent the vast majority of my working life on two wheels.

One of the elements of my instructor training course - because it was part of the UK's 'compulsory basic training (CBT) syllabus'- was about 'the need to be clearly visible to other road users'. Looking back on my own 1995 notes from that course, I see that I wrote (because it was the figure quoted by MY trainer) that:

- Hi-vis reduces accidents by 20% - not being seen is a major contributory factor.

What did the Driving Standards Agency (DSA) 'Motorcycling Manual say? In short that "many road accidents involving motorcyclists happen because another road user didn't see them. Using some form of visibility aid will help others to see you." The manual then went onto suggest wearing yellow or orange jackets, tabards or waistcoats, or 'Sam Browne' belts, white helmets and riding on dipped beam during the day. And at night reflective belts, patches or strips were recommended. The official 'Guide to CBT' also said that "it's in your own interest to make yourself easy to see" and that "wearing dull clothing" and "riding a dirty bike" were to be avoided.

Having mentioned this, it was our opportunity to offer the company's 'Sam Browne' belt for sale - it was not quite the same as the one in the illustration as it was fluorescent yellow cloth with a stitched-on silver reflective band.

Authors experience with Hi-Vis
Even back in 1995, that statement about reducing collisions by 20% made me vaguely uneasy. I'd worn an early version of the fluorescent and reflective yellow Sam Browne religiously for my first few years on two wheels whilst at college and it hadn't prevented my minor bump. Then as a courier I'd switched to using a hi-vis jacket. But when it was too hot to wear in mid-summer, I quite honestly couldn't detect any difference in the way drivers saw me or not.

In 1995, although it was still relatively early in the internet timeline, I'd already been online for a couple of years. I knew from my science background that my subjective experience wasn't something to be relied on, so I started to see if I could find some evidence one way or the other. I started to discuss the SMIDSY with riders from around the world including quite a number of other (mostly US) instructors on Compuserve. I'd also discovered it was becoming possible to track down university research papers, so I started to look for research on the 'looked but failed to see' problem and the ROWV.

What is the extent of SMIDSY?
What I learned was immediately significant. This crash isn't unique to the busy roads of UK. It's not unique to Europe, nor the Western world - they happen the world over. Neither is the SMIDSY 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. Nor do they seem to be prevented by training and heavily-enforced rules. These crashes happen where there are relatively good standards of training, where there are strict road rules, where there is strict enforcement of those rules. And they happen where there is next-to-no training, where drivers and riders play fast and loose with the local traffic code, and where there is little police presence. In short, it's a world-wide and historical problem, and motorcyclists have the same collisions with turning vehicles wherever motorcyclists and drivers of other vehicles share the roads.

Are Hi-Vis and motorist awareness campaigns effective?
Once you realise it's a worldwide issue, it's not surprising that there has been world-wide research into these collisions or that the interventions designed to reduce the risk to riders from turning vehicles are also international and also stretch back decades.

But the ultimate measure of success of the interventions would not be demonstrated in laboratory or off-road trials, but would be measured in a real-world change in the overall distribution of motorcycle crashes. ***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 junctions. That's simply not happened.***

SMARTER edited SOBS, Jan. 2021

Conspicuity and intersections
Urban junction collisions remain the single-most common crash involving a powered two-wheeler (PTW - a motorcycle, scooter or moped) and a car or other four-wheeled vehicle. At best, interventions aimed at preventing collisions between drivers and motorcyclists have had limited effectiveness.

So, by 1997, I was setting up Survival Skills as my own post-test training school. What I created was a highly-structured course, which focuses on mixing a framework of theory and practical exercises specifically designed to enhance the rider's understanding of risk by improving hazard awareness and specifically risk assessment and risk management skills. And that requires an understanding of where things go wrong on the roads, rather than more lessons in how to ride the 'right' way. It's recently become known as insight training.

The 1996 edition of 'Motorcycle Roadcraft', a handbook originally aimed at police riders but available to the public, had a whole page on conspicuity and states*:* *"You should do everything you can to make yourself more conspicuous. You can do this by:*

- *Wearing a jacket or over-vest that is fluorescent and has reflective markings*
- *Using daylight running lights*
- *Using a bright quart halogen headlight"*

Interestingly, the police book also threw up some warnings about *"taking into account your conspicuousness" and considering "how well you stand out against the background… [which] can change rapidly… do not assume that because you are conspicuous you are safe".* That advice wasn't available to learners, but it certainly influenced me in writing my own training notes. Here's a sample. You'll see I've added some extra suggestions based more on my own experience and observations:

- Know the difference between retro-reflective clothing and fluorescent kit:
- Fluorescent shows up in daylight, yellow best
- Riders need to be seen from all sides
- Most visible are tops or shoulders front and rear and sleeves to side
- White or brightly coloured helmets best in mixed colours
- Reflective strips on jackets and boots, helmet halo, stickers on bike, especially if positioned low down - picked up by dipped lights
- Use of headlights during daytime recommended in HIGHWAY CODE, if very bright day, don't use as they can make it difficult for car drivers to pick out your speed and distance

Background of this literature review
As you'll see as you read on, I didn't get it all right - 'yellow best' isn't always so and 'mixed coloured' helmets may not be a great idea either. But I was beginning to develop my ideas.

Over the next few years, I continued to develop my thinking on the ‘looked but failed to see’ collision, often on online forums. Increasingly I questioned the advice that told the newest, most vulnerable riders that they would be safer if they rode with hi-vis clothing and day riding lights (DRLs); I suggested that riders should instead be aware of where vehicles could turn into their path, be alert for that possibility, and ready to take evasive action rather than rely on the ‘be bright, be seen’ road safety message. I also found I was writing the same explanations again and again, so in time I assembled my ideas as a riding skills tip on my website in the mid-2000s. That original page is still up.

My position on conspicuity aids began to gain me a certain notoriety. Increasingly I found myself challenged to back up my statements, so I continued to look for evidence in the research supporting hi-vis and DRLs. I found quite a few but in point of fact, I also began to find an increasing number papers that were less supportive of the early work on conspicuity aids. What became increasingly clear is that far from there being consensus on conspicuity issues, the most recent work is more likely to say “it depends”, something that Roadcraft pointed out in 1996!

Then in 2011, on the back of some lively debates online, I was invited by fire fighter James Sanderson to develop a presentation to fulfil the crash avoidance role for a rider safety intervention he was working on for Kent Fire and Rescue. This project, which became known as ‘Biker Down’, originally had twin goals to help a rider cope better with the scene of a crash most likely (but not necessarily) involving another rider:

- accident scene management - to protect and control the accident scene and to prevent it getting worse and to ensure the emergency services are called
- first aid - to render assistance until the arrival of the emergency services

But Jim knew that he also needed a module that had an accident reduction role - something that would help the attendee stay out of trouble in the first place and thereby not need someone else to deliver emergency assistance. He’d seen my writing online, contacted me, we had a chat about what might work and I came up with the ‘Science of Being Seen’ (or SOBS for short) presentation. We trialed the presentation in a few pilot courses, then went full-time in 2012, and the Biker Down course went on to win a Prince Michael of Kent international road safety award at the end of 2012 and an insurance industry award the following year.

Kevin delivering Biker Down, Rochester

The SOBS presentation broke new ground by presenting the background research in a way that is accessible to the ordinary motorcyclist without a science background and gets people thinking. Taking between thirty and forty minutes to deliver, the presentation offers all motorcyclists:

- a fuller understanding of the potential for driver error and specifically the visual perception problems that result in drivers turning in front of approaching motorcycles so riders understand that SMIDSYs don't happen because "drivers don't look properly"
- a critical look at the evidence for the effectiveness of existing conspicuity aids such as hi-vis clothing and day riding lights, and a review of what could constitute an effective motorcyclist conspicuity strategy
- a better understanding of the potential effectiveness of proactive strategies, allowing motorcyclists to become better at protecting themselves from the ROWV by becoming active players in avoiding the collision, rather than a passive partner in the crash

By autumn 2018, Biker Down was being delivered to motorcyclists all over the UK by just over half the UK's fire services, and has been taken up by the UK military. Most - though not all - deliver a modified version of SOBS. I personally still deliver my SOBS presentation for Kent Fire and Rescue. SOBS has begun to receive international recognition. In February 2018, I was invited to New Zealand as a speaker on the NZTA's Shiny Side Up Tour 2018, delivering my 'Science of Being Seen' presentation to audiences of ordinary motorcyclists at no less than nine different venues on the way around the country.

I was fortunate enough to reprise my role in 2019 delivering my presentations at even more locations in front of ordinary bikers who just want to ride safely. I was interviewed by a New Zealand bike magazine before I left and had a short TV interview halfway round the four-week tour.

One of the points I try to get over during the presentation is that as riders we must accept that ALL road users are human, and ALL humans make mistakes. The biker was the focus of the original SOBS presentation first delivered it in 2011 and the rider remains at the focus of SOBS today, but before I go any further, I want to make two points crystal-clear:

1. By suggesting that there are problems with the way that drivers perceive PTWs on the road, I am not casting the motorcyclist in the role of the 'victim' of SMIDSY crashes.
2. Nor by suggesting that there are proactive strategies riders could use to avoid driver error, am I seeking to 'blame' the biker for failing to avoid the crash - SOBS aims to help all riders understand just how our power of invisibility works.

Until there is a complete technological solution, drivers will continue to err and riders who fail to predict driver error will continue to fail to take evasive action. Until that time, it makes sense to improve OUR understanding of the reasons for these collisions, because that in turns helps US as motorcyclists gain a far clearer vision of the effective strategies that offer the best chance of staying out of trouble on two wheels.

Since I first delivered SOBS, the role of visual perception in the 'looked but failed to see' collision has begun to garner far wider attention. Whether my work has precipitated that or whether it's coincidence I don't know but a cycling magazine covered the topic in 2012 in an article by an RAF pilot that received a lot of attention, the Association of British Drivers released a video on saccadic masking, and most recently an excellent 'FortNine' video on YouTube has also looked at the phenomenon of 'motorcyclist invisibility'. I can see the results in my audiences. Where I used to see skeptical frowns and shakes of the head, now I see knowing smiles and nods. Rider awareness IS changing, and for the better.

What are the purposes of this report?
This report (and the website) is built on the work I started by creating the presentation, and it has a number of functions:

- Firstly, the website allows anyone who has attended Biker Down and seen a SOBS presentation to discover the science background to the SOBS presentation by referencing the research material on which the presentation itself is based
- Secondly, it's a resource for the far greater number of motorcyclists who do not have access to Biker Down and SOBS
- Thirdly, it's a resource for road safety professionals too
- Fourthly it is – to the best of my knowledge – the first fully-annotated, carefully-structured and in-depth resource for motorcyclists and drivers alike which details the wealth of research that exists out of sight of the ordinary road user

Read on and you'll see there is an astonishing quantity of scientific research into the causes and consequences of the SMIDSY collision. But the vast majority of that research sits in university research libraries and is only ever read by other researchers. This website (document) helps each and every rider access as much of that research as possible.

Ultimately, it's my belief that SOBS can create a generation of riders better-equipped with the knowledge and practical solutions to avoid being caught out by the 'looked but failed to see' driver error. Remember, everything you read here is intended to unmask our very own unintentional motorcycling magic show. So, carry on to discover the fascinating human perception background to the SMIDSY. Discover the science behind the magic, and just how it is that every time we set out on two wheels, we have the potential to turn invisible and fool our audience.

Motorcycling is high risk - why the focus on SMIDSY collisions?
It's long been known that riding a powered two-wheeler (or PTW; - i.e., a motorcycle, scooter or moped) carries a high risk of death or injury. Helman et al (2012) in a recent literature review produced by the UK's Transport Research Laboratory (TRL) states*: "it is far from controversial to say that motorcycling is the most risky form of mainstream transport per kilometer travelled."*

So why focus on the SMIDSY collision? Quite simple. It's long been known that a particular problem for motorcyclists is the collisions at junctions. Do motorcyclists really suffer more collisions with cars? Good question. In a recent paper, de Craen et al (2013) *"…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 license) 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."*

In other words, in this study from the Netherlands, the crash rate with cars that emerge from a side turning is much the same whether the approaching vehicle is a car or a PTW. Cars hugely outnumber bikes on the roads, but that is a surprising conclusion. However, they continue: *"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."*

Remembering that the 'left turn' referred to is a right turn in the UK, it should be clear that the collisions where motorcycles are over-represented involved another ONCOMING vehicle turning across a motorcycle's path when the motorcycle is on the priority road.

Clarke et al (2007) investigated a sample of crashes involving motorcycles in the UK: *"A sample of 1790 accident cases was considered, including 1003 in detail, from UK midland police forces, involving motorcyclists of all ages, and covering the years 1997-2002 inclusive. Significant differences were discovered in the sample with respect to types of accidents involving motorcyclists (and their blameworthiness). There seems to be a particular problem surrounding other road users' perception of motorcycles, particularly at junctions. Such accidents often seem to involve older drivers with relatively high levels of driving experience who nonetheless seem to have problems detecting approaching motorcycles."*

Junction collisions were further described by Helman et al (2012) in the TRL paper: *"It is widely accepted that one key factor in motorcyclist crashes around the world is the difficulty other road users have in detecting an approaching motorcyclist or correctly appraising their speed and position. This is of particular concern at road intersections, when drivers need to detect gaps in oncoming traffic to make turns either across or into traffic flows. If a motorcyclist is not detected by a car driver in this situation (so-called 'looked but failed to see') then this can lead to a manoeuvre that violates the motorcyclist's path, and a potential crash."*

Mini - summary

So, to sum up, a significant number of collisions between motorcycles and other vehicles happen at junctions and are the result of the other road users' actions, and the problem appears to be a detection issue.

Some historical perspective on the research into motorcycle crashes

Why do drivers fail to detect motorcycles? That's a good question. The fact that a paper entitled 'Sorry, Mate, I Didn't See You: A Plausible Scientific Explanation' could be published as recently as 2006 after more than thirty years of research on the issue should serve as a warning - the problem is complex, and we haven't got to the bottom of it yet! So, to make a start on understanding what goes wrong and what we motorcyclists can do about it, some historical perspective on the research into motorcycle crashes is useful.

In 1975, the Greater London Road Safety Unit identified PTWs as being over-represented in accidents. Detailed analysis followed and the results indicated that a major contributory factor was that other drivers failed to see the motorcycles in the general street scene. Helman et al (2012) suggest that the 1976 Greater London 'Right Bright' campaign that followed: *"... may have been the first road safety campaign specifically designed to encourage riders of powered two-wheelers to improve their conspicuity by wearing bright clothing, preferably of fluorescent material, and by switching on their headlights in daytime. The campaign was extensive, running from August to October 1978, and involved radio advertising (on two London-based stations in the UK), a poster campaign, leaflets distributed through a number of routes (including dealers, garages, colleges, businesses and by London's Metropolitan Police Service) and give-away items such as combs, pens and key-rings."*

At around the same time, a US researcher named Harry Hurt (of whom you may have heard) working with Dupont wrote in 1977 that: *"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…"*.

Hurt became synonymous with research into motorcycle crashes a few years later when he put his name to a mammoth study that became known as the 'Hurt Report' (1981). It has become a seminal work and you can find it easily online. Based on his research in California, what Harry Hurt found (amongst other things) was that: *"Approximately 3/4 of motorcycle accidents involved collision with another vehicle at an intersection. The driver of the other vehicle violated the motorcycle right-of-way and caused the accident in 2/3 of those accidents and did not see the motorcycle or did not see the motorcycle until too late to avoid the collision. Most involved passenger cars…"*

A few years later on our own side of the Big Pond, Keith Booth looked at 10,000 motorcycle crashes in London. Although I cannot find the original research, he released a report called "Characteristics of Urban Motorcycle Accidents" through the Institute of Motorcycling. Booth's observation was that in London: *"62% of motorcycle accidents were primarily caused by the other road user. In 2/3 of motorcycle accidents where the driver was at fault, the accident was due to the driver failing to anticipate the action of the motorcyclist."*

In other words, the same crashes were happening in big cities on both sides of the Atlantic. The obvious question was: "why?" Hurt drew much the same conclusion as the earlier GLC study in London*: "The origin of this problem seems to be related to the element of conspicuity (or conspicuousness) of the motorcycle; in other words, how easy it is to see the motorcycle. When the motorcycle and the automobile are on collision paths, or when the vehicles are in opposing traffic, the conspicuity due to motion is very low, if it exists at all. Consequently, recognition of the motorcycle by the automobile driver will depend entirely upon the conspicuity due to contrast. If the approaching motorcycle and rider blend well with the background scene, and if the automobile driver has not developed improved visual search habits which include low-threat targets (such as motorcycles and bicycles, as contrasted with the high-threat targets presented by trucks and buses) the motorcycle will not be recognized as a vehicle and a traffic hazard exists."*

Conspicuity???

Note that phrase "entirely on the conspicuity". It's going to be important. These accidents are often categorised as 'Looked But Failed To See' errors (LBFTS), because the driver claims that they looked in the appropriate direction for conflicting traffic, but did not see the approaching motorcycle. Let's turn to search for practical solutions to the SMIDSY. If drivers were colliding with motorcycles that they hadn't seen because the motorcycle had poor conspicuity, what was the answer?

Visual Salience

Let's introduce the concept of 'visual salience'. Some objects have a distinct perceptual quality which draws our eyes - salience. Saliency is relatively easy to measure by looking relative contrast or brightness. It's been theorized that the human brain has evolved to detect salience, initially processing the visual field below the level of consciousness. Only when our visual system detects something with visual salience does a signal goes to the real-time brain, which makes the particular area or object pop up to the level our real-time consciousness so we pay it attention. But it's ONLY at this point that we become aware that our visual system has detected anything. <u>This is the fundamental concept underpinning the use of conspicuity aids - to increase visual salience.</u>

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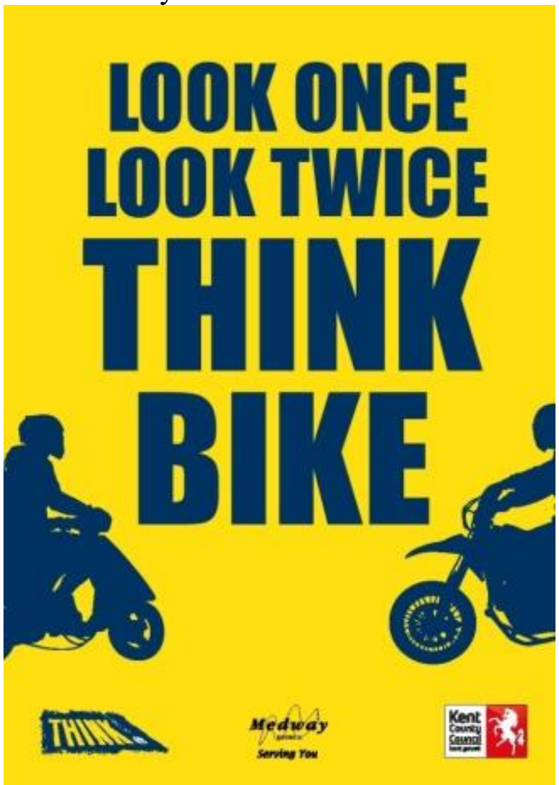
If lack of conspicuity is the problem, what is the solution? Not too surprisingly, the road safety bodies came up with two 'common sense' answers:

1. Motorcyclists should make themselves more conspicuous and easier to see
2. Drivers should 'Think Bike' and look harder for motorcycles



Ways to increase conspicuity

Three possible ways of increasing visual conspicuity were proposed:

1. Increase the profile of the vehicle, in particular the frontal profile via the mounting of a white fairing (which also provides a place to attach other conspicuity-enhancing devices)
2. Use retro-reflective or coloured materials on the motorcycle as well as on for the motorcyclists' garments and helmet
3. Use active lighting; suggestions have included day running lights, dipped (low beam) head lights, additional low-beam lights, high-beam lights, strobes, lights with rotating prisms and many others. Dipped head lights are usually seen as the most practical solution as they are already fitted to virtually all motorcycles

From the mid-70s to the current day, conspicuity campaigns have run all over the world and are still running today - I picked up a hi-vis vest handed out by the local road safety body in Auckland whilst I was in New Zealand in February 2018. Here in the UK, the Highway Code advice to motorcyclists has been to *"wear light-coloured or reflective and fluorescent clothing"* since 1978. The advice to use *"dipped headlights on larger machines"* was added in 1987, and by 1999 PTW operators were being told that *"dipped headlights might make motorcyclists more conspicuous"*. In some places the use of conspicuity aids has been enforced via legislation. In the UK, hi-vis clothing has been a legal requirement for on-road basic training since the introduction of Compulsory Basic Training in 1990 and at least some new riders continue to use it voluntarily after passing the test. Several EU countries including France require day-time lights. Canada and many US states have similar compulsory daylight laws, as do other countries around the world. Whilst the UK has no lights-on rules, new motorcycles in the EU now have no way to turn off the headlight's low (dipped) beam - the switch has been removed. But there's no single policy - there is a mish-mash of voluntary use, coercion and legislation regarding the use of conspicuity aids.

What is the result of conspicuity aids?

So, what was the result? What happened out on the road? If conspicuity aids worked as billed, we would expect to see a reduction in the number of motorcycle crashes happening at junctions.

After the initial 'Ride Bright' campaign in London - and set against a background of increasing motorcycle use in the city - Lalani and Holden (1978) concluded that the results of the campaign were positive: *"Total daylight motorcycle casualties increased by 6-8 percent, while dark accident casualties rose by 14.9 per cent. Had there been no 'Ride Bright' campaign, daylight motorcycle casualties would also have increased by 14.9 per cent (this being confirmed by casualty data trends prior to the campaign for the years 1974-1976). A saving of 8.1 per cent daylight casualties can be attributed to the campaign, or alternatively 570 casualties."*

So that sounds very positive. More recently, a number - though not all - studies suggest that in general, riders using hi-vis clothing and DRLs have a lower crash risk than riders who have not adopted these measures. Helman et al (2012) stated in their literature review*: "The majority of early evidence (mainly from the 1970s and 1980s) concerned bright clothing and daytime running lights on motorcycles. When considering the weight of evidence, both seem to be capable of improving conspicuity, when this is measured in terms of detection (under search and attention conspicuity conditions), and when measured in terms of a behavioural response (such as size of gap accepted in front of a given motorcycle). The majority of studies covered in this review support this conclusion…"*

But there's a problem

But there's a problem. Data from the Department of the Environment, Transport and the Regions (DETR) published in February 1999 showed that in 1998 - twenty years after the 'Ride Bright' campaign and Hurt's work, and well over a decade after Booth - collisions involving a motorcycle and another vehicle STILL accounted for two-thirds of all motorcycle accidents. Let's move forward to 2004 and a UK-based 'In-Depth Study of Motorcycle Accidents'. The authors reported that in about 2/3rds of crashes where the rider was not to blame, the driver failed to see a rider who was in clear view and who was often seen by other road users. In about 12% of these cases, the driver failed to see the motorcyclist even though s/he was wearing high visibility garments or using daytime running lights.

If we look outside the UK but still within Europe, the pan-European study 'Motorcycle Accidents In-Depth Study' (or MAIDS for short), first released in 2004 then updated in 2009, it was found that just over half of all crashes involving a powered two-wheeler (i.e., a motorcycle or moped) took place at an intersection. 60% of these collisions were with a car, 72% of the accidents took place in urban areas, and in 50% the car driver was to blame. And the important conclusion was that in over 70% of the collisions that were the result of an error on the part of the other driver, the collision involved a failure to see a motorcycle.

Nothing much has changed

Whilst we cannot see if there has been a reduction in crash NUMBERS, what those percentage figures - 66%, 66% and 70% - reveal is that in terms of accident DISTRIBUTION, nothing much has changed. We haven't seen a genuinely significant reduction in the proportion of junction collisions where drivers do not see the motorcycle. I don't seem to be the only one to have spotted this. In a study involving a simulator, Sager and his colleagues noted in 2014: *much previous research has focused on motorcycle properties, such as size, shape, and color to explain its inconspicuousness… Much of the motorcycle safety research conducted since has focused on making motorcycles more conspicuous, generally through various lighting treatments such as headlight modulators, additional lights, and bright reflective garments… "There is some debate, however, regarding the effectiveness of these measures…it has been suggested that the problem may not be one of conspicuity at all…collision statistics remain largely unchanged, suggesting that the issue may not be related solely to the motorcycle's static properties."*

Effectiveness of conspicuity aids and motorist awareness not supported by scientific evidence

If collision statistics remain unchanged, it's hard to see that conspicuity aids or 'Think Bike' campaigns have had the results that were proposed for them. Espié in the foreword to the book 'Increasing Motorcycle Conspicuity - Design and Assessment of Interventions to Enhance Rider Safety' states that*: "several approaches may be proposed to increase the PTW/rider conspicuity… however many proposed solutions were not supported by scientific evidence."*

But let's remember…

This is a good place to make the point that whilst SMIDSY collisions may dominate the accident statistics for motorcyclists, a moment's thought should tell us that for every 'looked but failed to see' event that results in a ROWV and a subsequent collision, an untold number of drivers actually successfully spot motorcyclists and do NOT turn in front of them. If that were not true, the average rider would never complete his or her journey! Crundall et al (2012) recognise this. The report says*: "Despite the over-representation of motorcyclists in crash statistics, by far the majority of motorcycle journeys do not result in a crash. Car drivers do not want to have a crash, and it is reasonable to assume… that in the majority of cases drivers will respond appropriately to motorcycles. It is the occasional situation that we are concerned with, where attention might lapse, or judgement is made too hastily, which may result in a crash."*

I personally have been drawing attention to this specific point for a number of years. When considering collisions between motorcycles and cars, it's important to understand that the vast majority of drivers will NEVER precipitate a ‘Looked But Failed To See’ collision. That has serious implications for ‘Think Bike’ driver education and deterrence programmes.

We need a standard lexicon

At this point, it’s worth noting that despite decades of research and hundreds upon hundreds of studies, there has been little attempt to create a standard lexicon (that is, a specialised vocabulary) to accurately describe these collisions. We’ve now seen three terms in common use: SMIDSY (Sorry Mate I Didn’t See You), ROWV (Right Of Way Violation) and LBFTS (‘Looked But Failed To See’) to explain just how the ROWV occurred.

What’s more, studies have been performed from both the ‘drive on the left’ (for example, in the UK, Australia and New Zealand) and from the ‘drive on the right’ (e.g., the EU and USA) perspectives. When driving on the left, a turning on the nearside is on the motorcyclist’s LEFT. For studies from other countries such as the rest of the EU and the USA, this is reversed and the turning on the nearside is on the motorcyclist’s RIGHT. Whilst the scenarios are a mirror image, few authors make it absolutely clear whether a drive on the left or a drive on the right regime is the subject of their study. If a driver is stated to have ‘turned right’, the actual manoeuvre depends on which side of the road the vehicles are driving. The answer can usually be determined by the location of the study but is rarely explicit.

Another lack of clarity arises when studies use expressions such as the vehicle ‘turned right’ or ‘turned left’. Even when clear which side of the road the driver is driving on, this is an inadequate description of the manoeuvre. From where, to where? Whilst the two collisions we are most concerned about involve EITHER a vehicle that emerges and turns across the rider’s path from an opening at the rider’s nearside OR an oncoming vehicle that turns across the rider’s path towards an opening at the rider’s nearside, a moment’s thought should show us there are four possible ‘turned right’ manoeuvres that could be performed at a crossroads when driving on the left - a driver could:

- emerge and turn right across the rider’s path from the nearside – the side of the road nearest the rider
- emerge and turn right into the rider’s path from the offside – the side of the road furthest from the rider
- slow and turn right into a side turning whilst leading – moving in the same direction ahead of the motorcycle
- slow and turn right across the rider’s path whilst oncoming – approaching from the opposite direction

Whilst the manoeuvre can usually be inferred from the context, it’s not always the case. I will use the terms ‘nearside’, ‘offside’, ’emerging’, ‘oncoming’ and ‘leading’ be applied to define the manoeuvres more precisely. It’s worth noting that road layouts and priorities exist which have different priority systems, even though the layout is likely to cause specific problems. The roundabout is one example. The four-way stop is another. In much of Europe the system of ‘priority to the right’ exists.

An attempt to standardize our description and understanding

There has been at least one attempt to standardise the understanding of these collisions. In a summary report prepared for the Department for Transport: London, Crundall et al (2008) proposed a framework on which to base understanding of the work that has been carried out on these collisions which related "attitudes, knowledge and skills/strategies to three behaviours". They proposed three questions that research needed to ask:

1. Does the driver look at the motorcyclist?
2. Does the driver realise that it is a motorcyclist?
3. Does the driver correctly decide whether the motorcyclist poses a hazard?

Over the next dozen pages, I'll be looking in detail at the research that has been carried out into these questions. I have investigated in-depth the research on each issue connected with motorcycle conspicuity and visual perception and how the problems uncovered relate to the SMIDSY collision.

A Review before moving on

For decades, riders have been told that motorcycle crashes at junctions are the result of drivers 'failing to look' or 'not looking properly' But official crash reports are largely subjective as they reflect the opinion of the reporting officer There are more reasons for LBFTS collisions than 'the driver didn't look' or 'look properly'. The crash rate involving motorcycles and drivers using a phone is almost certainly much lower than most of us would believe. In terms of OPPORTUNITY to commit a ROWV, very few of the opportunities result in the error The vast majority of drivers must 'look properly' for bikes.

BECAUSE the SMIDSY collision between a motorcycle and another vehicle involves a 'Right-Of-Way Violation' (ROWV) committed by the other road driver, and because the driver often confesses "I didn't see the motorcycle", police forces throughout the world usually report 'Looked But Failed To See' (LBFTS) collisions as being the result of poor observation skills and negligence on the part of the driver. For example, in Great Britain in 2013, in accidents involving at least one motorcyclist and other vehicles (with no pedestrian casualties), the official report on statistics said: *"The most common contributory factor allocated to vehicles involved in accidents with motorcyclists is failed to look properly. Between 2009 and 2013, 46 per cent of cars and 47 per cent of light vans involved in an accident with a motorcyclist failed to look properly."* As road safety organisations are heavily influenced by police practice, the result has been several decades of 'Think Bike' style campaigns which in essence tell drivers to 'look properly' or 'look harder' for motorcycles. Not surprisingly, the broader motorcycling population has largely come to believe that the SMIDSY results from poor driving skills and "not looking properly".

The four chances for error

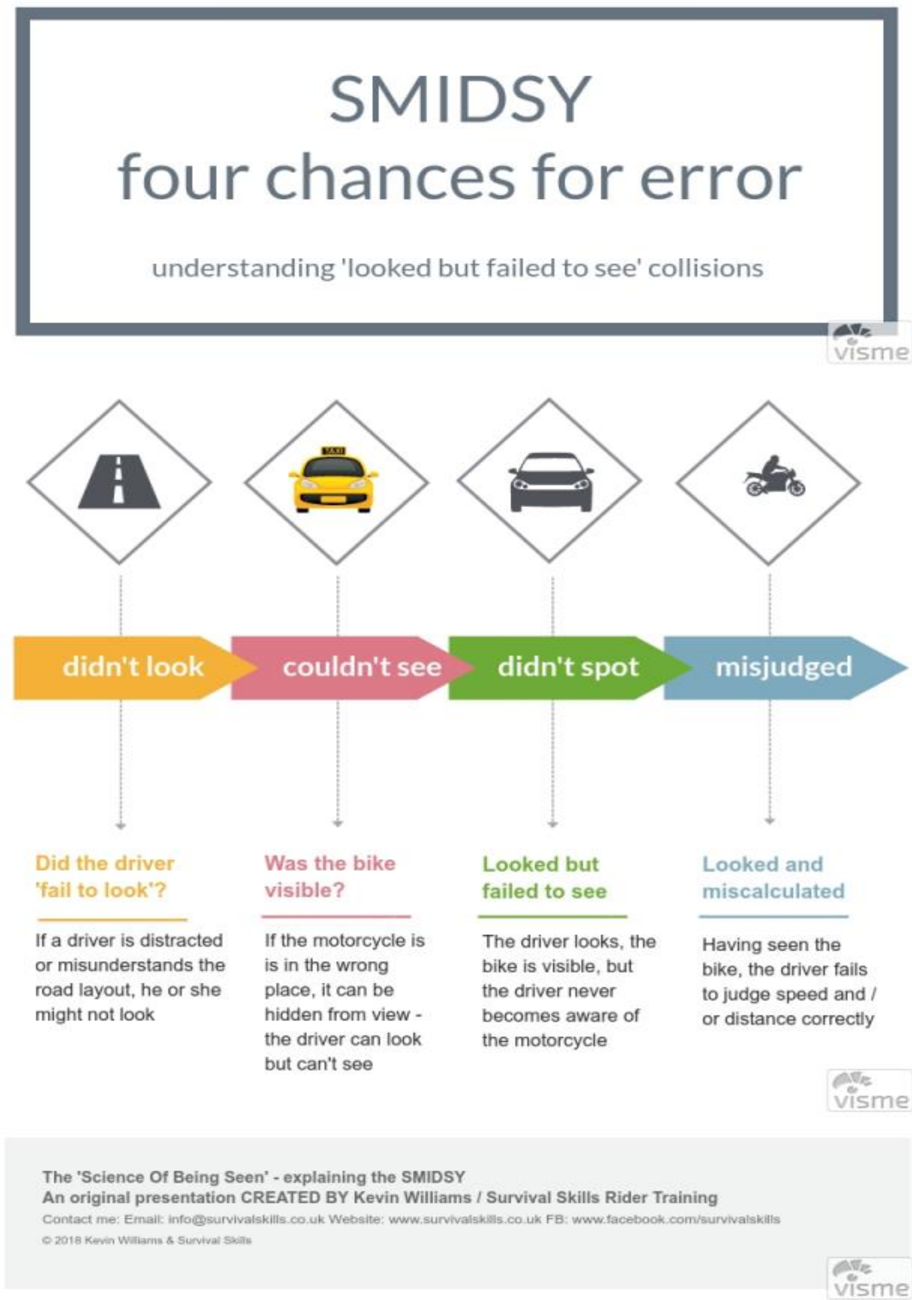
In fact, the 'Looked But Failed To See' problem can result from a breakdown at several places in a chain of events (see Crundall et al (2012) and Helman et al (2012)):

1. The driver has to look - if he / she doesn't look, the driver will not see the motorcycle
2. If the driver looks, the driver has to look and perceive the motorcycle – if the motorcycle is not perceived, the driver will not see the motorcycle
3. If the driver perceives the motorcycle, the driver has to assess speed and distance correctly - if the driver misjudges either, the result is likely to be an unsafe manoeuvre

One more step

There's actually another step in the chain - once the driver has actually looked but before the driver can perceive the PTW, the motorcycle has to be where the driver can actually see it. So, a corrected chain of events is:

1. Does the driver look?
2. Can the driver see?
3. Does the driver perceive?
4. Does the driver judge correctly?



A breakdown of the points in the chain – didn't look

A breakdown at any point in the chain could result in a collision. Let's start with the most obvious possibility - the driver "failed to look". It's a popular theory. For example, an accident claims company states on their website: "Careless car drivers, not reckless bikers, are the number one cause of motorbike accidents in the UK." And the article produces some statistics to back up the claim: *"In 70% of reported incidents the driver simply didn't see the motorbike, those that saw the bike misjudged its speed, or distance, or both. It's a finding consistent with the official government figures compiled by the Department for Transport, which revealed of the 19,534 motorbike accidents recorded in 2010, no fewer than 13,051 occurred at junctions."*

With articles like this, it's hardly surprising that every generation of motorcyclists grows up with the idea that motorcycle crashes at junctions are the result of drivers 'failing to look' or 'not looking properly'. It's reinforced by frequently-repeated statements that 'dual drivers' (i.e., those with both a car and motorcycle license) are better at spotting other motorcycles when behind the wheel of the car, the implication being that "bikers look properly for bikes". Motorcyclists come to think that when a driver says that he or she "looked but failed to see" the bike, it's simply an attempt to cover up the true reason - that the driver was either 'careless' and didn't look, or was distracted - the current popular belief is that drivers involved in collisions are being distracted by mobile phones.

So, is it true? Are motorcyclists are being put at risk by car drivers? Some authors seem to think so. A 2012 TRL report entitled "Literature review of interventions to improve the conspicuity of motorcyclists and help avoid 'looked but failed to see' accidents" stated: *"Sometimes drivers simply do not look at all when pulling out of a junction-– this is not a conspicuity issue."*

Unfortunately, having read the paper I can see no hard evidence for that statement, and certainly no indication of how often a driver might "not look at all". The lack of numbers is explained by suggesting that it may be that a driver's memory of the incident that is at fault so using the witness statement given by the offending driver to disentangle actual 'failed to look' collisions from 'looked but failed to see' incidents is difficult: *"…for actions preceding an accident is so distorted, that drivers genuinely believe that they looked but failed to see, despite this belief being based on an inaccurate reconstruction of events."*

Whilst the driver's recollections may be unreliable, that hardly supports the statement about 'drivers not looking at all'. <u>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.</u>

The 2015 report "Facts on Motorcyclist Casualties" gives an explanation of how the "driver did not look properly" assessment comes about. Whilst "contributory factors provide an insight into how and why accidents occur", the report also provides a caution: *"The factors are largely subjective as they reflect the opinion of the reporting officer, therefore they should be interpreted with caution… [they are] assigned quickly at the occurrence of the accident and often without extensive investigations. These differences may therefore be in part due to preconceptions of certain vehicle user groups."*

In other words, that's a fairly clear warning about relying on the contributory factor's column in police accident reports when looking at collisions involving motorcycles. The warning is reinforced by explaining that failing to look properly *"…is commonly referred to as the 'looked but failed to see' problem in road safety literature. This is particularly common where motorcyclists are hard to see and for motorists to fail to notice them when looking around the road."*

<u>But now we're starting to talk about a completely different issue - 'did not look', 'did not look properly' and 'looked but failed to see' are not interchangeable as explanations for 'failing to notice' a motorcycle, yet the 'failed to look' issue is frequently confused with 'looked but failed to see' collisions.</u> For example, in Chapter Four of a major report, 'Improving Safety for Motorcycle, Scooter and Moped Riders', the authors argue that 'failing to look' can be defined as: "*inadequate visual screening: failing to look at the correct location at the correct moment."*

I would argue that this is NOT 'failing to look' but a completely separate error arising from different causes, and so should be considered separately treated - later on, I've used the heading 'looked but in the wrong place'. It is important to be absolutely precise when we define 'failed to look' because it directly affects the way we motorcyclists perceive the problem of junction collisions. Conflate 'failed to look' and 'looked but failed to see' errors, and it's easy to arrive at the kind of conclusion that the insurance company made on the website I mentioned earlier.

<u>It's likely that an absolute 'failure to look' would only arise in a very limited number of circumstances.</u> For example, perhaps:

- If the driver was confused by the road layout. Perhaps a foreign driver in an unfamiliar country where vehicles drive on the opposite side of the road looks the 'wrong' way down the road at a T junction – I dare say most of us have done that in Europe.
- If the driver was paying attention to the road but failed to detect a junction and/or its priority. As an example, not too many years ago, I rode straight ahead and onto a priority road which merged with the side road on a bend. The priority warnings weren't visible – the warning sign had been knocked down and the road markings were under a large puddle. Because I didn't realise I was exiting onto a priority road, I didn't look for traffic – I was lucky no vehicles were approaching.
- If the driver was distracted and failed to detect a junction and/or its priority. Perhaps by talking to a passenger or the phone or by some in-car gadget like a GPS or even by something outside the car like advertising – there is an increasing trend to put brightly illuminated, moving and distracting advertising at the roadside, on over-bridges and even on other vehicles.
- If the driver was impaired, perhaps by alcohol and recreational drugs, medicinal drugs, illness, fatigue, or age.

Many motorcyclists are concerned about driver distraction, particularly the number of drivers using a phone whilst driving. It's a common belief their widespread use contributes significantly to collisions with motorcycles. However, an IAM report entitled "Licensed to skill: contributory factors in road accidents: Great Britain 2005 – 2009" looked at over 700,000 items of official crash data from the UK and found that 'driver using mobile phone' was the cause of 0.8% of fatal crashes, and just 0.2% of all injury crashes. I should point out that these are crashes involving ALL vehicle types, but the implication is that the crash rate involving motorcycles and drivers using a phone is thus almost certainly much lower than most of us would believe. By contrast drivers found to be 'impaired by alcohol' accounted for 10% of fatal and 7% of serious accidents. The IAM data did not record driver fatigue as a cause, but there is some evidence it causes more crashes than alcohol impairment.

Beanland et al (2013) believed that inattention and distraction represent a major problem in road safety and that they are believed to contribute to increased crash risk but point out that there is currently limited reliable information on their role in crashes. Looking at data from the Australian National Crash In-depth Study, they investigated 856 crashes from 2000 to 2011, in which at least one party was admitted to hospital with crash-related injuries. 60% of the crashes had insufficient information to attribute them to distraction and/or inattention. Of the remaining 40%, just over half showed evidence of driver inattention. Intoxication and/or fatigue were commonly implicated in reduced attention, whilst distraction most commonly involved voluntary, non-driving related activities originating within the vehicle, such as passenger interactions. Of course, we have to be careful assuming that the same results apply in the UK – it's known that Australia has a more serious drink-drive problem than the UK.

However, many crashes involve fit and healthy drivers. According to Pammer and her fellow researchers (2017), *'looked but failed to see' crashes are particularly troublesome because, despite clear conditions and the lack of other hazards or distractions, drivers will look in the direction of the oncoming motorcycle – and in some cases appear to look directly at the motorcycle – but still pull out into its path.'*

How can we look at something and not see it?

One theory was advanced by Helman et al in a 2012 TRL review. The authors noted that our conscious attention can wander to another pattern of thoughts and be disconnected from visual input. The first researchers using eye tracking to attempt to identify where drivers were looking started by assuming that whatever the eye is pointed at (a 'fixation') is what the driver's conscious mind is currently processing. This is known as the 'eye-mind assumption' and is, as the authors point out, a fallacy. As they put it: *"…not every commuter who stares out of a moving train window is interested in railway embankments".*

How often do ROWV actually occur?

Do we have any actual evidence for how often the ROWV occurs? Back in 1980, the TRRL sent a motorcycle lapping a big roundabout behind a car, with the rider controlling the following distance to see how other drivers responded by either staying put or pulling out (gap acceptance). The results might surprise you. The motorcycle passed four roads (the two being surveyed by the camera plus two others) making a total of 3708 passes for the 927 circuits: *"…during this time there were no conflicts between the motorcycle and other vehicles."*

In other words, in over 3700 'affordances' (i.e., opportunities for a driver to turn into the motorcycle's path) there was not one single driver who committed a ROWV because of a 'failure to look' or even 'looked but failed to see' error. The motorcycle was seen each time it needed to be seen.

The TRRL study is limited and dated but there is other, more recent work we can look at, and that show that the car driver is not the 'incompetent idiot' that popular myth suggests.

Aware that the 'Looked But Failed To See' collision was being blamed on poor observation skills, Crundall and his team (2012) set up an experiment which compared the way in which inexperienced drivers, experienced drivers and dual drivers (those with both a car and a motorcycle license) arrived at T junctions and decided if it was safe to pull out. What they found was that (my bolding): *"When compared to dual drivers, all other drivers do indeed look appropriately. Visual search is similar across all our groups until after a conflicting vehicle is spotted, while time taken to first fixate a motorcycle does not appear to differ either."*

They concluded (and again, I've highlighted an interesting observation): *"The most immediate finding from the analyses was the greater caution given to conflicting motorcycles than to conflicting cars [reflecting] a greater safety margin in responding to motorcycles. While one might argue that this is driven by the fact that the participants are taking part in a laboratory experiment in which they presumably want to appear as competent drivers (and thus make more cautious responses to more vulnerable road users), it would be unfair to the vast majority of drivers to suggest that such safe behaviour toward motorcyclists does not reflect decisions made during actual driving."*

It's fair to say that the Crundall report inserts a cautionary statement that the participants are taking part in a laboratory experiment *"in which they presumably want to appear as competent drivers"* but the results of these and other studies indicate that 'not looking' isn't a major factor in collisions between motorcycles and other vehicles.

In another study, Prijs (2014) looked at how drivers responded to approaching motorcycles at junctions and found that although car drivers pulled out from a side turning into a smaller gap ahead of the motorcycles, they also gave way to oncoming motorcycles significantly earlier than to other cars.

The conclusions of a 2011 Netherlands study by de Craen et al make for particularly interesting reading (once again, my bolding): *"The majority of motorcycle crashes are crashes with a car. In these crashes, the police register the car driver as first offender more often than the motorcyclist. So, 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. An analysis of different crash causes at intersections indicates that, relatively speaking, car drivers fail to give priority to a motorcycle as often as to a car. "*

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That statement comes from a paper entitled *"The roles of motorcyclists and car drivers in conspicuity-related motorcycle crashes".* The authors went on to point out that motorcyclists are at greater risk ONLY in one scenario; when an oncoming car turns across a motorcycle's path into a side road: *"In one situation 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 type of crash occurs more often when the oncoming vehicle is a motorcycle than when it is a car."*

Their explanation was that 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".

So, let's look at those insurance company figures again. Whilst the insurance company states "no fewer than 13,051 [out of 19,500] occurred at junctions", that doesn't mean all 13,000 were the result of an error on the part of the other road user. As it happens, a significant number of car - motorcycle collisions at junctions happen when the rider runs into the back of the vehicle ahead. In the UK, around 40% of junction collisions involving a motorcycle are actually the result of a ROWV by another driver.

So, if we take 40% of that total, we can estimate there were 5200 collisions that resulted from a ROWV. For strict accuracy, we would need to verify that from another source, but if we take that as a ballpark figure, let's now put it into context with all the times that motorcycles pass junctions in a year. Even considering the relatively scarcity of powered two wheelers on the roads compared with other vehicles, there are untold numbers of 'affordances' where a vehicle could turn into a motorcycle's path. Each and every one of us riders pass dozens, if not hundreds of other vehicles at junctions, even on a relatively short ride.

So, the truth is that although we can point a finger of blame at drivers when they commit a ROWV, when we think in terms of OPPORTUNITY to commit a ROWV, it's clear that very few of the opportunities result in the error. Even in countries with a much higher rate of collisions between motorcycles and other vehicles, such as Singapore and Thailand, the successes outweigh the failures by a huge margin. That means that the vast majority of drivers must 'look properly' for bikes.

Mini Summary
What I hope to make very clear over the next series of pages is that '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.

We could – and I believe should – conclude that 'looked but failed to see' errors are actually remarkably rare. And if that is the case, then genuine 'did not look' errors must be even rarer. And it therefore follows that the widespread belief that drivers 'don't look properly' is almost – if not quite – a myth.

New section introduction
Motorcycles are small and easily hidden. The motorcycle can be concealed by the vehicle itself or by objects outside the car. The A pillars either side of the windscreen have steadily got thicker to provide better crash protection. A 'framing effect' means we avoid looking at the edges of the windscreen When two vehicles are moving towards an intersection and due to arrive at the same time, the 'bearing' between the two vehicles stays constant. If one vehicle is hidden when the bearing remains constant, it will remain hidden even though the rider can see the vehicle, the driver may not see the bike.

As we've seen the commonest collision between a motorcycle and another vehicle happens when the motorcycle has right-of-way yet the other vehicle turns across the motorcycle's path. In the last post, I began to look at the research that has been carried out into the ROWV and the consequent SMIDSY collision and described four possible failures:

1. The driver doesn't look
2. The driver looks but cannot see the motorcycle
3. The driver looks but fails to see the motorcycle
4. The driver looks, sees the motorcycle but still makes an unsafe manoeuvre

The previous section examined the first idea - that the driver simply doesn't look - and concluded that whilst lack of attention or distraction may contribute to some collisions involving a motorcycle and another vehicle, it's far from clear how many. In fact, it's far more likely that the driver did look appropriately, but failed to see the motorcycle.

A breakdown of the points in the chain - looked but couldn't see
So, let's move onto the second issue. Although these collisions often happen when witnesses report that they saw the motorcycle, does that mean that the driver can see the bike from where he or she is sitting?

It's been noted many times (e.g., Olson (1989) that because motorcycles are smaller than other road users, the view of the motorcycle may simply be physically obscured. Here are two straightforward explanations. The approaching motorcycle is not in a position to be seen by the road user about to commit the 'looked but failed to see' error because:

- it's hidden by other vehicles, pedestrians or roadside furniture
- it's hidden by part of the vehicle itself – most frequently the A pillars (the supports either side of the windscreen) are known to create blind spots for the driver

How often does this happen? In a study from Victoria, Australia in 1992, Hentlass (reported by Paine et al (2005)) found that in 37% of the collisions where the other driver did not see the motorcycle, the driver's view was obstructed.

For example, two common collisions where the bike isn't where it's capable of being seen involve:

(1) A car emerging from a side turning into the path of an overtaking (or filtering) motorcycle
(2) A car turning right into a side turning crosses the path of a PTW moving to the left of the main flow of traffic (this is a common crash involving cyclists too)

In either case, the driver is blindsided (blinded) by the vehicle(s) between the car and the bike and simply cannot see the motorcycle. Although most riders are actually dual drivers (i.e., holding a car license too) most of us give to little thought to just how difficult it is to see an overtaking or filtering motorcycle from a car and rely far too heavily on the driver turning cautiously. Crundall et al (2008) noted that both riders and drivers seem unaware of the issue, stating that: *"drivers and motorcyclists can be made aware of this form of obscuration, with the hope that drivers subsequently resist making hasty decisions in the face of high-sided vehicles that could be obscuring other traffic…"*

However, it doesn't require a high-sided vehicle to blindside (blind) a driver. From the driving seat of an average car, the majority of the motorcycle and rider will be hidden by another car if it is in the line-of-sight. The driver may catch a glimpse of parts of the machine and rider through the other vehicle's windows but the only object that the driver is likely to be able to see clearly is the rider's crash helmet. If the partial view of the machine is not recognised as being a motorcycle, the driver is highly unlikely to respond appropriately.

It's not just other vehicles that block lines-of-sight. Anything that sits between the driver and the rider is a potential problem - pedestrians, tree and telegraph poles, letter boxes and phone kiosks. Even following another motorcycle can hide the second bike, which is something to consider when riding with a partner or group, even when training! The list of 'vision blockers' is endless.

In many cases, witnesses will state that the motorcycle was "in plain view". To them, perhaps but the construction of the modern car itself results in significant areas outside the vehicle being obscured. If a car is sat directly facing oncoming traffic (when the driver is looking out of the windscreen) or at right-angles to a major road (when the driver is looking out of the side windows), the driver is looking through the middle of a window. But that's not always the case.

If the vehicle is angled towards the traffic flow, then the A pillar (supporting the front of the roof at the sides of the windscreen) can obscure the view if the vehicle is angled away from the traffic flow, then the B pillar (supporting the doors) and / or the C pillar (supporting the rear of the roof) can obscure the view.

The A pillars either side of the windscreen are the usual culprit but it's important to be aware when the B and C pillars, as well as headrests on seats and the passengers sitting on them, can severely restrict the driver's vision.

How much of a problem are the pillars? Crundall (2008) quotes a Transport Road Research Laboratory (TRRL) report from 1963 that found that a pillar that obscured 4 degrees of the driver's vision would conceal the END profile of a car at 60 feet (18.3 metres), and demonstrated how this 'zone of obscuration' could sweep across the background hiding a pedestrian, cyclist or motorcyclist. That TRRL report - over four decades old – recommended that A pillars should be designed to be as thin as possible, and preferably less than 2 inches (approximately 5.1 cm) wide, including the window frame. Crundall (2008) notes that vehicle design has changed considerably since 1963 with the A pillars becoming thicker to increase vehicle occupant safety. The then - current EU regulations, which allowed 6 degrees of view obscuration from a car's A pillar, were found to be able to hide a car in SIDE profile a distance of 50 metres.

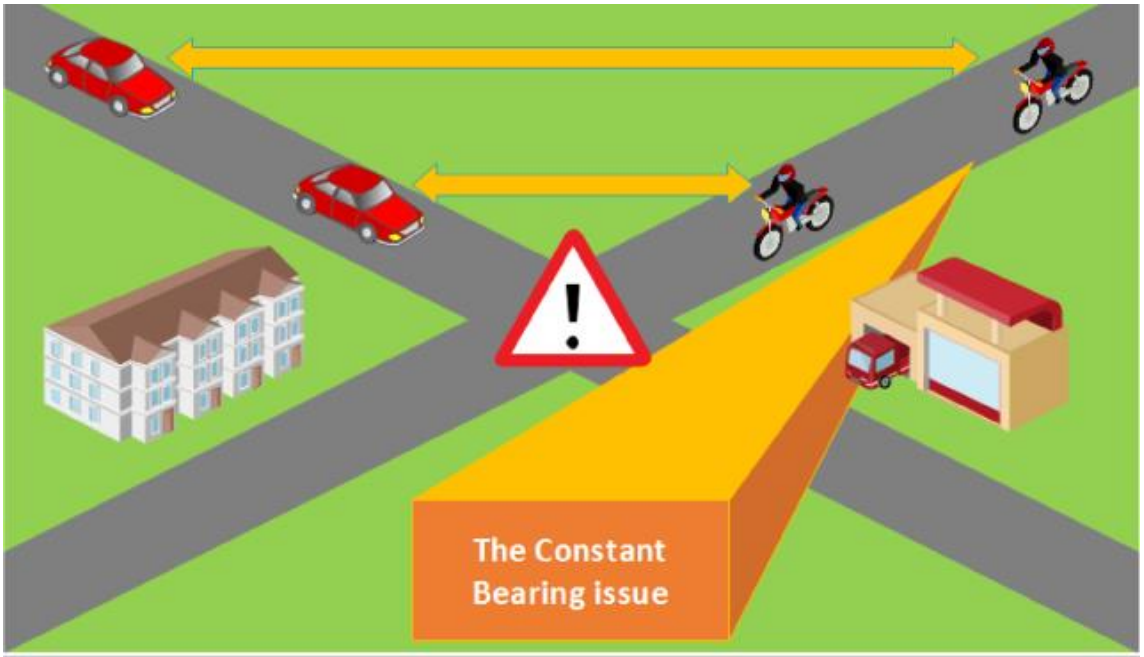
Since 2008, the A pillars have become wider to accommodate air bags and/or to improve roof strength in the event of a roll over. I've just measured the A pillars on a late model Skoda and found at the front the A pillar to be no less than 12 cm wide. Using an online calculator, if the driver's eyes are around 45 cm back from the driver's side pillar (the seat is fairly far back on the runners), then a 12cm wide A pillar obscures a cone of vision that across extends 15 degrees of view on the driver's side. And as we know, the head-on profile of a motorcycle is considerably narrower than the side profile of a car. A TRL report reconstructed ten crashes in which it was thought A Pillar obscuration could have been a factor. Three involved motorcycles, all at T intersections where a car was emerging to turn right so the motorcycle was approaching from the driver's right. In one case the motorcycle was obscured for 4 seconds and in the other two for about 2 seconds.

To get some practical idea of how much of our view is obscured by the A pillar, here's a simple practical demonstration. Hold your arm out and lift your hand up so the back of the hand faces you. Your hand is pretty close to the thickness of a typical A pillar and at arm's length, it's approximately the same distance from your eyes as seen from the driving seat. Now step outside and stop about ten metres from your bike, looking at it head-on. Hold up your hand, and cover up the bike. Walk towards your bike and see how close you can get before you can see the edge of the machine around your hand. Having a narrow frontal area, it won't be until the motorcycle is frighteningly close. Now it should be obvious why motorcycles can be out of sight for as long as four seconds. It's worth pointing out that the rear C pillar in a typical hatchback is around twice as thick and creates huge blind areas, and there is also some evidence that the large mirrors on modern lorries and coaches create large blind areas behind them.

Even if the machine is visible around a windscreen pillar, it appears that 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. Windscreen zoning appears to be something known in aviation circles where it has been implicated in mid-air collisions but is virtually unknown in road safety. I'm speculating but my guess is that it happens because the frame is at a different focal length to the scene visible through the frame, and this creates discomfort.

Another problem is created by movement. Here's a quote from a yachting website: *"If you are watching another vessel approach your vessel and its "relative bearing" is not changing, then your two boats are on a collision course."*

This 'constant bearing' problem is well-known in nautical and aviation circles, and it's also well-known that if another boat or a plane are on a collision course and hidden by some part of the structure, then the other craft will remain hidden almost to the moment of collision. The same applies on the road. 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. Although it's most likely to be a problem when the car is stationary and waiting, and the motorcycle is approaching on a near-collision course, the constant bearing issue can arise when both vehicles are moving towards an intersection and due to arrive at the same time - see the diagram below.



The 'Science Of Being Seen' - explaining the SMIDSY
An original presentation CREATED BY Kevin Williams / Survival Skills Rider Training
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Of course, the rider can usually see the approaching car, and makes the mistaken assumption that the driver has the bike in view too. And when the driver doesn't stop, the rider is taken completely by surprise. The constant bearing issue almost certainly accounts for a number of collisions at junctions and roundabouts. It's remarkable that this problem is almost unknown in motorcycling circles, but there is a solution as both sailors and pilots know - the motorcyclist only has to change speed and/or direction to get the machine out from behind the obscuring pillar.

Why don't drivers simply move their heads to check into the blind spot behind the pillar? There's a suggestion that when driving, we can actually become 'blind' to the blind spot itself. Crundall considers that*: "…drivers may theoretically understand the potential for windscreen pillars to obscure the road, yet may fail to heed the advice when it is needed. This is because the situation does not necessarily provide clues to the problem. The windscreen pillar may act in a similar fashion to the retinal blind spot… where the optic nerve joins the eye. At this point there are no receptors and the eye can process no information. Everyone has two such areas in their visual field where there is no visual information, yet the visual system extrapolates from the surrounding visual scene and 'fills in' the gaps such that these areas are not noticeable."*

As a result, we don't see a visual stimulus that falls on the blind spot. Crundall suggests:

"*...drivers may be so used to the obscuration posed by windscreen pillars that they are no longer noticed. Instead, the perceptual system may fill in this 'external blind spot' and make it difficult for drivers to remember the potential problems of obscuration and to take preventative action to avoid it."*

Or, to put into just a few words, "out of sight, out of mind".

How common is the 'looked but could not see' collision?
Olson (1989) pointed out that after a collision between a motorcycle and another vehicle, if the circumstances were such that the motorcycle was out of sight at the moment the driver turned into the bike's path, the driver of the other vehicle would say that he or she "looked but failed to see" rather than "looked but could not see". Olson 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 offending driver was obscured. Olson states that no mention is made of this in either study.

On the other hand, a 2006 TRL study argues: *"...whilst 'A' pillar obscuration can occur, there is rarely only one factor that contributes to an accident and at this stage there is not enough evidence to suggest that changes to the current legislation regarding 'A' pillar design would be of benefit."*

Whatever the numbers, it's essential for us to understand that we could be invisible to the driver for a significant period despite being able to see the car quite clearly ourselves. Once we appreciate that we are in a blind spot, then it should be obvious why conspicuity aids such as day riding lights and hi-vis clothing cannot help prevent the 'looked but could not see' error. What we need to look for are 'lines of sight' - covered on CBT as 'see and BE SEEN'. Ask yourself:

(1) What might be blocking another other road user's view of me?
(2) If I'm not where the other road user can see me, what might happen?
(3) Can I place myself where that other road user can see me?

We don't even need to be concealed all the way to the point of the collision. Remember, we don't have constant 360-degree awareness of what's around us, but have to look in several directions and in a number places one 'snapshot' at a time. What we think of as 'situational awareness' is actually a cut-and-paste operation, joining these snapshots together. The danger should be obvious – if the motorcycle happens to be in the wrong place at the wrong moment, we won't be seen despite the driver looking. Once we reverse-engineer the conspicuity issues this way, it's a lot easier to understand why so 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".

It turns out that we've been aware of this problem for even longer than I thought. I came across this interesting page on the Safe Speed site, which shows some pages from a book dating from as early as 1963. The diagrams clearly show the problems. We may argue that the driver should have taken extra care to look around windscreen pillars and other obstructions but debating who caused the collision isn't going to prevent it happening in the first place. It actually seems almost inconceivable that with so many crashes resulting from PTWs vanishing in blind spots that motorcyclists aren't better-aware of the problem. We don't live in a perfect world, and the possibility that a driver might simply not have seen us should always be at the forefront of our planning. As long as we remember that, we can significantly reduce our exposure to 'looked but could not see' collisions.

Section Summary

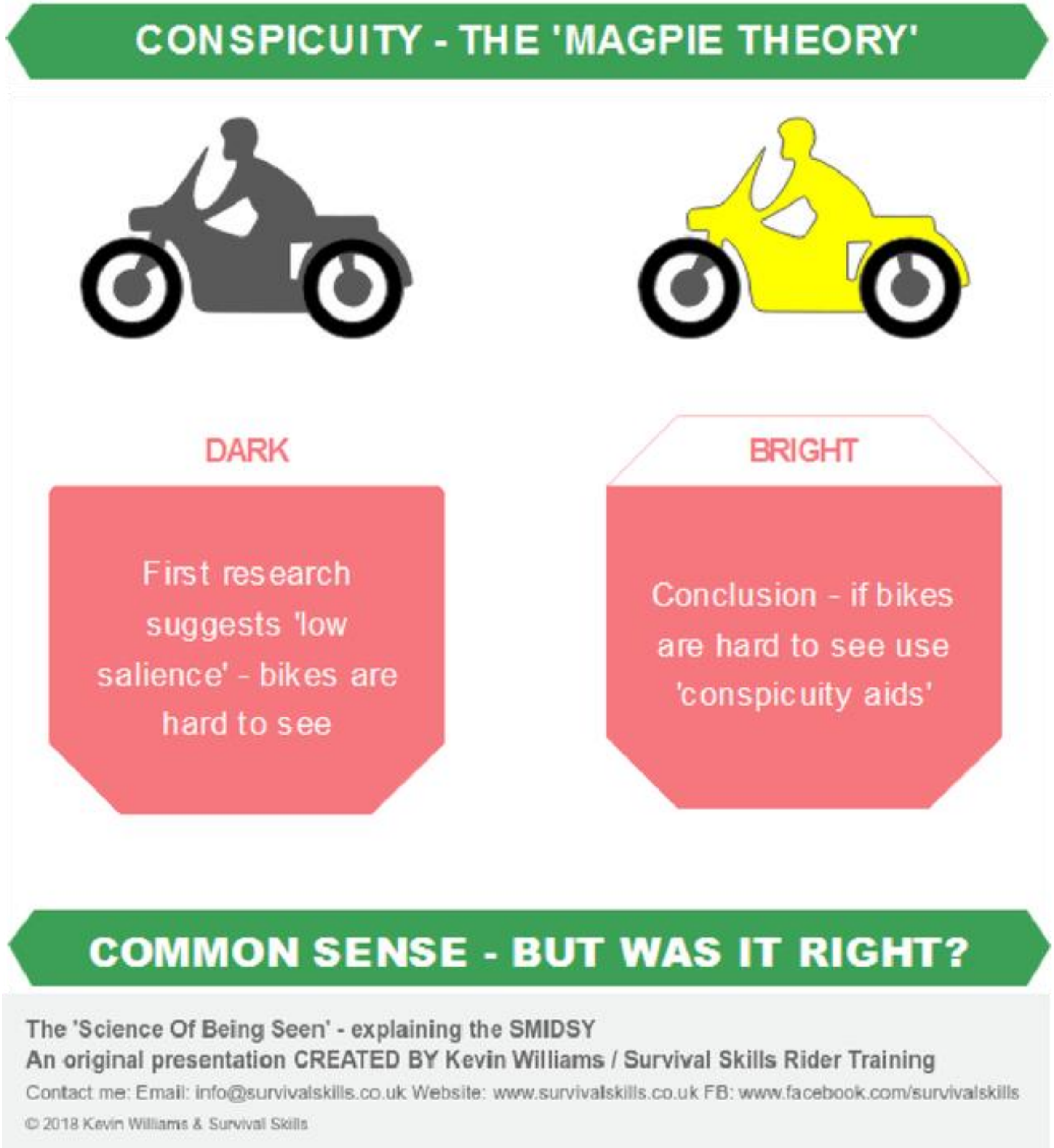
Many early studies implicated poor saliency and poor sensory conspicuity as the reason for 'looked but failed to see' errors. The narrow frontal shape of a motorcycle makes it harder to spot than a car. Many studies have focused on finding ways of making motorcyclists 'more conspicuous' but despite those 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.

So far, I have dealt with two explanations for the ROWV that results in a collision between a motorcycle and another vehicle; 'did not look' and 'looked but could not see'. In the first case, the driver simply failed to check in the right direction and in the second the motorcycle was physically out of sight from the driver's perspective. But not looking or being unable to see the motorcycle doesn't explain all collisions. Even when there is a line-of-sight between the driver and the motorcycle, and the driver looked in the right direction, things still go wrong. Crundall et al (2008) characterised the two main error types as: (1) detection errors - i.e., a failure to look at and identify the presence of a motorcycle and (2) decision errors - i.e., a failure to correctly appraise the speed and /or path of an approaching motorcycle

Section Introduction - Looked, saw and misjudged

I'll be looking at the 'looked saw and misjudged' decision error in the next section, so for now let's try to understand how the 'looked but FAILED to see' detection error can happen.

It's long been known we are more likely to notice - and thus remember and make use of - some kinds of information more than others. Although it's not the only way that an object can be conspicuous (we can smell or hear too), we generally think of conspicuity in terms of an object's visual characteristics – that is, its size relative to other objects, its shape, and its colour, luminance and its brightness against the background compared to surrounding objects.



Objects that attract our attention and easily detected are known as having 'high saliency' and is a measure of an object's ability to attract the observer's attention. The important image characteristics are luminance contrast, colour, and edge orientation. A good example of objects that have high visual salience - thus attracting our attention - would be colourful round red berries on a background of oval green leaves. This visual distinction of one object within the environment has been termed ‘sensory’ conspicuity and it’s been theorised that the human brain has evolved to detect salience.

As vision is our primary sense when driving, how easily seen or noticed a particular object is an important issue for all road users. We may pick out highly salient objects as a result of scanning a scene, or our attention can be drawn involuntarily towards salient objects for example, by the sudden onset of a bright stimulus. When our visual system detects something with visual salience, a signal goes to the real-time brain. Whatever caught our attention pops up to the level our consciousness and we become actively aware of whatever the visual system has detected.

In the earliest studies of the ‘looked but failed to see’ collision between a car and a motorcycle, it became clear that even when witnesses reported that a motorcycle was in plain sight and accident reconstructions concluded it was visible from the driving seat of the car, the drivers often said they didn’t see the motorcycle. It’s not therefore entirely surprising that many early studies implicated poor saliency and poor sensory conspicuity. Many of the earliest expressions of this ‘conspicuity theory’ came from Hurt. For example, in 1977, Hurt and Dupont considered that: *“When the motorcycle and the automobile are on collision paths, or when the vehicles are in opposing traffic, the conspicuity due to motion is very low, if it exists at all. Consequently, recognition of the motorcycle by the automobile driver will depend entirely upon the conspicuity due to contrast.”*

This supposition was repeated in a later study by Hurt et al (1984): *“The majority of motorcycle-automobile collisions are the result of a violation of the motorcyclist’s right-of-way by the automobile driver. The predominating cause of the multiple vehicle collision is a failure of the automobile driver to detect the presence of the motorcyclist in traffic when a traffic conflict develops. Such detection failures are associated with low conspicuity for the motorcyclist…”*

It’s widely accepted that since motorcycles have poor sensory conspicuity and where the environment contains other, more conspicuous objects such as nearby cars, the driver’s attention is likely to be drawn towards that object rather than the less conspicuous motorcycle, which is thus more likely to be overlooked, resulting in a delayed response by the car driver or even a complete detection failure. Studies looking at gap acceptance - whether or not another driver will turn in front of another vehicle - which have shown that drivers are more likely to accept turn into smaller gaps ahead of motorcycles than other vehicles have been used to support the low visual salience theory (although there are other explanations, as we’ll see). An approaching car is also more likely than a motorcycle to generate an ‘eye fixation’ immediately before the driver makes a decision to turn.

So, what makes motorcycles tough to spot? Crundall et all (2008) suggested that: *“One particular bottom-up influence seems especially relevant: spatial frequency (the width of the vehicle). Global Precedence 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.”*

You're probably wondering what spatial frequency means. I had to look it up too, but in essence, it refers to the level of detail present across the horizontal visual angle of the object - its width, if you like. The motorcycle's vertical edges are close together. By contrast, the car's vertical edges are much further apart. Essentially, the very shape of the PTW makes it harder to spot than a car.

Given the saliency issue, it's not surprising that finding ways of making the motorcyclists 'more conspicuous' has been the subject of numerous investigations. By and large, the results appear to demonstrate that light-coloured clothing and headlights do make motorcycles stand out better. These observations have been used to advocate the use of day riding lights and high-visibility clothing for motorcyclists, on the basis that drivers are more likely to be cautious when a visually-salient motorcycle is present, reducing collisions, thus resulting in fewer injuries. You'll remember I mentioned the mid-70s Greater London 'Right Bright' campaign that was probably the first to encourage motorcyclists to improve their conspicuity by wearing bright clothing, preferably of fluorescent material, and by switching on their headlights in daytime.

But what about the test conditions? It should be obvious that whether or not a motorcyclist stands out depends at least partly on what is behind the rider. What matters is not so much whether the rider is using light coloured clothing or a low beam headlight so much as whether that creates contrast between rider and the background. 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.

There was a second problem - motorcycles are usually moving in front of other moving vehicles, and many of these studies - particularly the early ones - used photos which required the subjects to detect a static motorcycle against a static background. More recent studies have become aware of these limitations. For example, Pai in a literature survey published in 2011 noted that: *"A substantial number of studies have manipulated physical characteristics of motorcycles and motorcyclists to enhance conspicuity… Although various conspicuity aids have proven effective, some researchers reported that motorcyclist's/motorcycle's brightness per se may be less important as a determinant of conspicuity than brightness contrast between the motorcyclists and the surroundings."*

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In their book on motorcycle conspicuity, Roessger et al (2015) state*: "PTW conspicuity may be related to the motorcycle, to other vehicles, to the riders themselves, to other drivers, to the road environment or any combination of these factors… for example, riders can use daytime riding lights to decrease their probability of collision with another vehicle, but they do not control ambient traffic conditions… most importantly, conspicuity is not constant but changes with the time of day, the weather conditions, the urban environment, the presence of absence of other road users."* In other words, 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.

The crucial question is whether or not conspicuity aids have actually reduced collisions at junctions. Almost thirty years after Hurt, Underwood et al (2011) continued to argue that: *"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. Given the widespread use of conspicuity aids, there's no obvious reduction in the proportion of collisions occurring at junctions, which is what we could expect were conspicuity aids effective.

Sager et al (2014) noted*: "…collision statistics remain largely unchanged, suggesting that the issue may not be related solely to the motorcycle's static properties."*

The first study I have found that questioned the conspicuity theory was written as long ago as 1989. Olson challenged motorcycle conspicuity as the likely explanation for car drivers missing motorcycles and found "it lacks empirical support". He observed that: *"The conspicuity hypothesis has not been seriously challenged. Almost all investigators have accepted it as fact, concentrating their efforts on means to improve conspicuity rather than on asking whether the hypothesis is correct. This is unfortunate because alternative hypotheses can be advanced. Some have research data to support them; some are speculative. All are consistent with the known facts…"*

Section Conclusion
I believe that we should conclude that road safety advice that relies entirely on the conspicuity theory must be treated with some caution, and 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.

Next Section Introduction
We tend to assume that the eye acts like a camera but because a motorcycle is within the driver's field of view, there's no guarantee that the driver will actually see it. Clear, colour and focused vision only occurs across a tiny zone. The vast majority of incoming visual data falls into the fuzzy, colourless peripheral vision. It's our brains that give us the illusion of full-colour vision over a wide area. Given the tiny 'foveal zone' the concept of making 'eye contact' seems of doubtful value.

As we've seen on earlier pages, a great deal of work has been conducted investigating just how 'looked but failed to see' crashes involving motorcycles happen. Although we generally think of conspicuity in terms of an object's physical characteristics, that is, its size relative to other objects, its colour and its brightness against the background, this 'sensory' conspicuity is not the only factor in whether or not an object stands out.

There is a second kind of conspicuity and it's much more subtle because it depends on how the human brain processes the data the eye is sending. A motorcycle may be within the driver's field of view (something commonly reported by witnesses to a car/motorcycle collision) but because the motorcycle COULD be seen is no guarantee it is ACTUALLY seen.

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, as any stage illusionist knows. There are a number of reasons it is entirely possible to look towards, yet not perceive, objects within the visual field. It's important to understand just why this happens. Here are three issues:

(1) The eye's foveal zone
(2) Saccadic masking
(3) Motion camouflage

The eye's foveal zone
Let's start with the first. 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. Only a narrow cone in the centre of our field of vision is actually clear, focused, and full-colour vision because only a tiny patch of the retina, known as the fovea, actually transmits this camera-like image to the brain. To see detail, we need to orient our eyes so our 'line-of-sight' connects the fovea to the 'fixation point' (the focus of our gaze) in the outside world.

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. That demonstrates the coverage of foveal vision is actually smaller than the size of our thumbnail at arms-length. In fact, it's approximately two degrees of visual angle. So, to get that clear, focused and full-colour image of nail and knuckle, we actually need to move our eyes to change the fixation point. Although few of us ever pay conscious attention to our vision, this phenomenon has been known to visual science for centuries - the discovery of the line-of-sight is attributed to Leonardo da Vinci.

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, as Da Vinci observed, it turns increasingly blurry as well as black-and-white. Although with both eyes we have visual coverage which extends slightly more than 180 degrees left-to-right, the vast majority of the incoming visual data falls into our fuzzy, colourless peripheral vision.

Why is our foveal zone so small?
Why does the human eye have this limitation? There's a simple answer - transmitting the data to the brain. Processing ALL the visual data that falls on the retina to the same high fidelity as the fovea would require an optic nerve bigger than the eye. There simply isn't the capacity to carry, let alone process the data. Interestingly, it seems designers of VR goggles have come across the same issue. To get a high pixel density and thus high realism imagery across the entire goggle would require more computing power than any domestic computer or phone can deliver. So, they are trying to use this phenomenon to sharpen up the pixel density of the image ONLY where the user is looking. That way the screen provides increased resolution where the eye can see it rather than attempting to display it across the entire screen, frying the processor in the process.

Of course, we still have peripheral vision and, in the experiment, I just asked you to perform, you can still see all of your thumb (and your hand, and your arm and what's behind it) but what you see lacks detail. Just 20 degrees off the line-of-sight, our clarity of vision (or 'visual acuity') is about one tenth of that of the fovea. 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-colour vision over a wide area. But it IS an illusion.

However, peripheral vision is good at is detecting light/dark contrast (particularly sudden bright stimuli) and movement. In either case, the involuntary response is to turn the head to bring the attractant into our line-of-sight so we can examine it with the fovea's high-resolution vision. In terms of detecting vehicles on the road, that means we are likely to see big objects in our peripheral vision, but smaller objects, such as a motorcycle, are much harder to detect unless:

(1) they have significant contrast against the background. This is what underpins conspicuity theory
(2) they are moving laterally against the background (see 'motion camouflage')

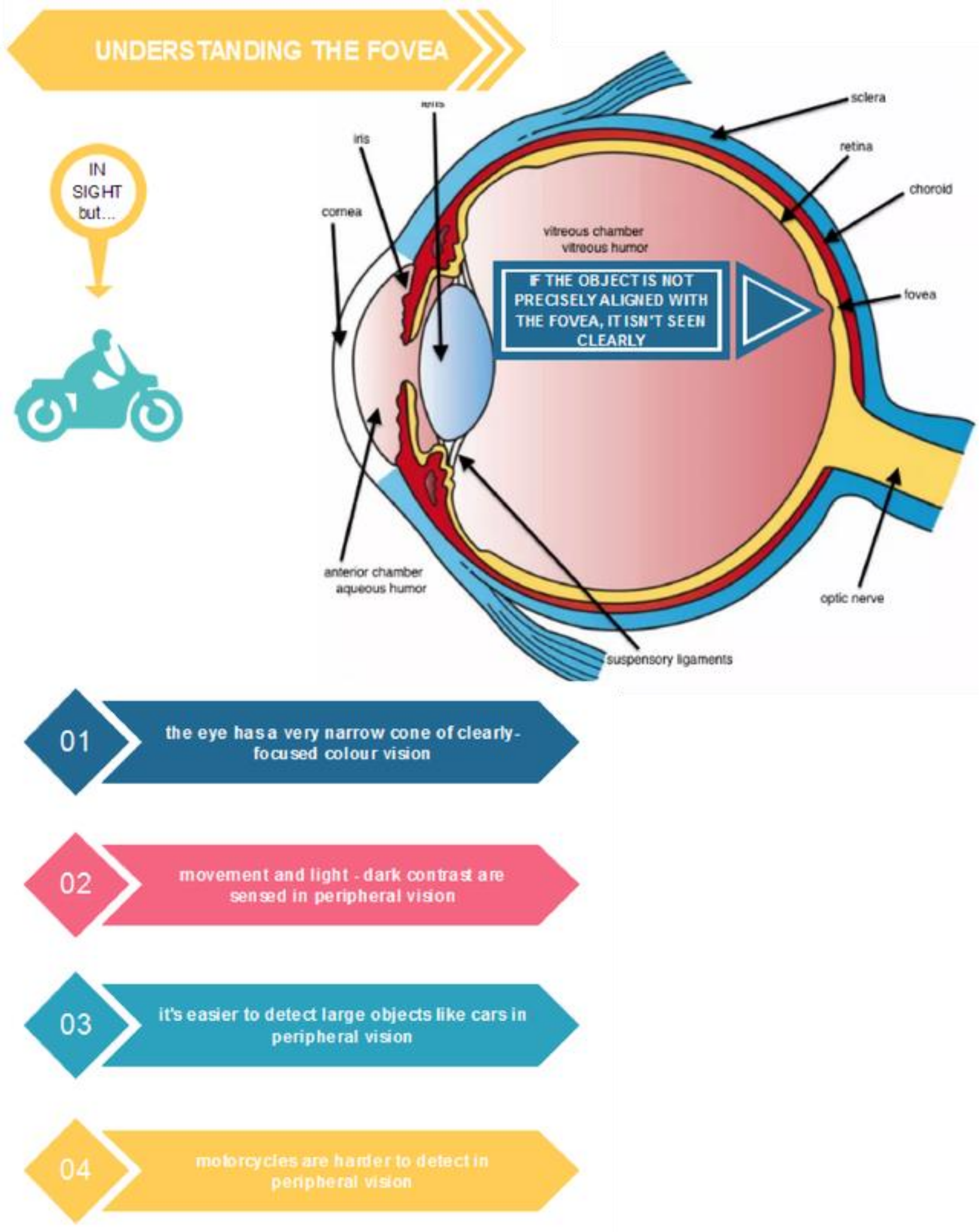
Crundall et all (2008) suggests: *"If one looks far off into the distance, then though the head turns and the eyes jump in the direction of the motorcycle, the subsequent fixation may still not land on the motorcycle if it is relatively close to the driver's vehicle. As we shall see in the following section, the distance of any stimulus from the fixation point is crucial to detection. The fixation point describes the location in the world at which the most sensitive part of the retina is aimed. The acuity of the retina at this point is very high but covers a very small area. Objects which fall outside this area around the fixation point will be presented on a part of the retina with less acuity and therefore will be harder to detect."*

It's also worth pointing out that the eye also has a lens, which focuses the image sharply onto the fovea. The real-life driving environment is 3D, something overlooked by many 2D studies using photograph and film. If a motorcycle is significantly nearer or closer than the object that first drew the driver's attention, the bike will be out of focus. It takes time to refocus onto the new object of interest.

Incidentally, what about the eye's retinal blind spot? Where the optic nerve enters the eye to connect with the retina (you can see it in the diagram) there is an area with no visual receptors, giving rise to the blind spot. It's sometimes suggested that the blind spot might account for a driver's failure to spot motorcycles. Whilst the other eye can usually see the area of where one eye is blind, we usually have a 'dominant' eye - close your eyes alternately and you'll see what I mean. So, it may be possible that an object in the blind spot of the dominant eye doesn't 'appear' in the other eye either. However, the blind spot is also offset to the outside of our combined vision, away from the foveal pit which produces our cone of clear, colour vision. This means it falls within our peripheral vision. In theory, we could lose sight of a motorcycle within the blind area, but for that to happen it would need to be on a constant bearing AND we would need to be staring at something else and not moving our eyes, nor even our head. Whilst I would hesitate to say it never happens, for a bike to vanish in the blind spot right up to the point of collision would seem to require a rather unlikely set of coincidences.

Eye contact?

One consequence of the tiny cone of colour, focused vision is that 'eye contact' proposed in motorcycle safety literature as a good way of 'communicating' between rider and driver seems a doubtful concept at best. The Canadian Thinking Driver website says: *"Eye Contact - The only way to know if another driver sees you is to make eye contact with them. If they are looking at you and you see them making eye contact with you, you can be fairly sure (but not guaranteed) that they see you."* And a download for motorcyclists produced by Norfolk council says: *"In daylight try gaining eye contact with the driver."*



The 'Science Of Being Seen' - explaining the SMIDSY

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Yet anecdotally, I have heard motorcyclists say many times: “I had eye contact with the driver and he/she still pulled out”. It’s happened to me. I believe that whilst we can make eye contact across short distances - say, across a room - it’s highly unlikely we can genuinely make eye contact approaching a junction, given the distances involved. Even in an urban context, the motorcyclist would need to make eye contact twenty or thirty metres away to be able to prevent the ‘looked but failed to see’ collision being set up. So, whilst the driver’s eyes may be turned in our direction, there is a very real risk that his line-of-sight is fixated not on us, but on the more conspicuous car just behind us.

Mini - summary

The best we can say is that if the driver is looking our way, we MIGHT have been seen, and if the driver is looking in some other direction then he/she almost certainly hasn’t spotted us. I searched for scholarly articles on ‘eye contact’ in driving and though I found numerous references in road safety literature, I found just one research paper concerning pedestrians making eye contact at crossing points. I believe motorcyclists would be wise to forget the concept of eye contact as a line of defense.

Saccadic masking

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 motorcycle falls behind a saccade, the driver can appear to look right at the bike and yet will not see it.

Although the ‘looked but failed to see’ collision between a motorcycle and another vehicle is frequently blamed on a lack of visual conspicuity, we also have to consider how the brain processes the visual data. A key point to accept is that our eyes and the brain are not the equivalent of the lens and the camera.

I’ve already discussed the limitation of the eye’s foveal vision, but there are two other issues we need to understand: (1) saccadic masking (2) motion camouflage

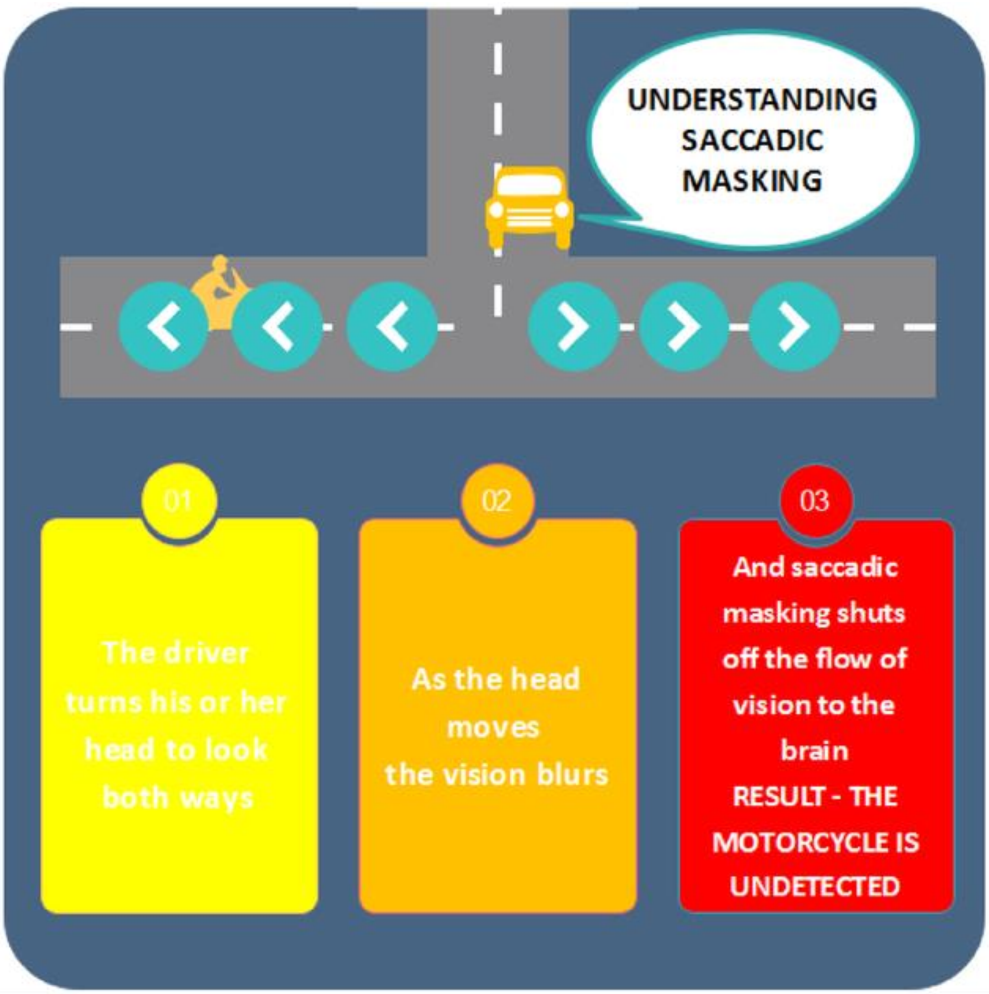
We previously saw that only in the fovea, a tiny part the retina, do we have clear, colour, focused vision, and that to examine an object of interest in detail requires a shift of our line-of-sight to a new position. Once the attractant is in our line-of-sight, it comes in to our awareness, and we can examine it in detail with the fovea’s high-resolution vision. And if it’s moving, we can track it by moving our eyes using what are called ‘smooth pursuits’. Smooth pursuits are very common in our everyday visual behaviour.

But there’s a problem. 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. This mechanism is very effective in processing complex scenes, but there is a drawback. The brain ceases to process retinal images between saccades. This is known as saccadic masking or saccadic suppression.

So smooth movement as we track a moving object is quite distinct from the two other events: (1) the fixations that occur when we examine at a point of interest (2) the saccades that occur when we move our eyes quickly from one fixation to another. Once again, this phenomenon has been known about for a very long time.

Back in the 1880s, French ophthalmologist Émile Javal observed how the eyes moved when reading and discovered that it involves a succession of rapid but discontinuous individual movements. He that coined the term ‘saccades’, after the French word for ‘jerk’.

Saccadic masking is exploited by dancers during fast turns. The dancer ‘spots’ by keeping head and eyes still as long as possible by focusing on a fixed location, then turning the head faster than the body. Spotting enhances the dancer’s control and prevents dizziness.



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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. As a result, it is only during the stationary fixations that an image is processed. In consequence, all drivers (and motorcyclists too) are left with gaps in visual perception whenever we scan both ways at a junction. Because the brain synthesizes the missing visual data to give the impression of continuous vision during the scan, drivers, just like dancers, are unaware of the visual shut-down and believe they have completed a full scan of the entire zone whereas the true visual feed is more akin to a series of snapshots.

There's an excellent video on saccadic masking by the Alliance of British Drivers. You can find it here: https://www.youtube.com/watch?v=XL_NvUHGgi8 Whilst you're watching that, notice just how the A pillar blocks the view also. I snipped the screenshot below from the video.

Drivers (and riders) typically look for around 0.4 seconds in each direction before turning their head, so how much data do we lose? Saccadic masking shuts off the visual flow for around 0.03 to 0.04 seconds before the rapid head turn, and for around 0.1 seconds after the initiation of the saccade (Roessger et al 2015).

Mini Summary: So, 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. Watch the driver's head. When the driver's head is moving both ways, there's a very real risk that our motorcycle will fall within a saccade. Only if we can clearly see that the driver's head movements are tracking our motorcycle can we be reasonably sure we've been spotted, and that the driver's visual system is using 'smooth pursuit' to follow our path.

New section introduction: 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.' Motorcycles approaching a driver waiting to turn may not create any lateral movement and the driver may fail to spot the bike due to motion camouflage.

We've seen how visual conspicuity is not the only factor to consider when looking at collisions between cars and motorcycles. We've also seen that the vision system has two particular limitations (1) the eye's foveal zone and (2) the phenomenon known as saccadic masking. So now we'll turn to a third perceptual issue (3) motion camouflage.

Motion camouflage is actually a topic that I was previously aware of, because it comes from my own field of study, the biological sciences. It's well-known that hunting animals stalking prey will approach along a line that keeps them motionless relative to the background from the perspective of the prey animal. If the prey animal moves, the hunters subtly adjust their own paths so that they stay in that same relative position. This is how big cats operate. Some male insects use the same technique to sneak up on a potential mate. The hunter can get surprisingly near before it is close enough to be detected by 'looming' – but this only happens when it is now so close that it fills the background.

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. Artists exploit perspective – if they decrease the apparent size of an object, the distance to that object appears to increase. It works because we hold in our head a kind of 'reference size' which allows us to quickly estimate distance. There's a simple rule artist follow. To make an object appear twice as far away, it must be one-quarter the original size. Of course, this works the other way. A small, distant object that starts small stays relatively small even as the distance is closing down.

So, this stalking technique works because the hunter avoids lateral movement. The only clue is that the apparent size of the object increases as it gets closer, but just as the prey fails to spot a big cat until the last moment, drivers often fail to detect other vehicles until they are right on top of them. Even buses, as bus drivers will tell you. A moment's thought should tell us that a motorcycle 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. It's only when the bike is almost on top of the driver that it is so close that it fills the background – the phenomenon known as looming. This size/distance issue is well-known to artists, but is ignored in safety literature.

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How important is motion camouflage? Sager et al (2014) stated: *"A driver turning left* and failing to notice an oncoming motorcyclist until too late is the most common cause of motorcycle collisions. Consequently, much previous research has focused on motorcycle properties, such as size, shape, and color to explain its inconspicuousness. However, collision statistics remain largely unchanged, suggesting that the issue may not be related solely to the motorcycle's static properties."* (* whilst driving on the right)

To test this, the team used a simulator to investigate the effect of lane position on whether or not an oncoming driver would turn in front of a motorcycle. They found that*: "…drivers are more likely to turn in front of an oncoming motorcycle when it travels in the left-of-lane position than when it travels in the right-of-lane position".*

It's important to understand that this study looked at drivers turning INTO a side road across the motorcycle's path, not the better-known SMIDSY collision with an emerging driver. *(SMARTER editor note: In north America the situation tested by Sager seems the more common)* The left-of-lane position therefore places the motorcycle near the centre line of the road. By shifting to a right-of-lane position, the motorcycle is positioned further away from the potentially turning vehicle. It's logical to deduce that opening the angle in this way would increase the apparent rate of movement of the motorcycle against the background as it closed on the driver's position. I'll come back to this idea later.

Summary: The way our brain scans our environment means that we can miss rare objects. Only 3% of the vehicles on the road in Europe are PTWs so meeting one at a junction is actually a relatively rare event. Even when drivers know there are particular vehicles around, they'll miss the unusual ones. In experiments, drivers are even more likely to miss spotting buses than motorcycles.

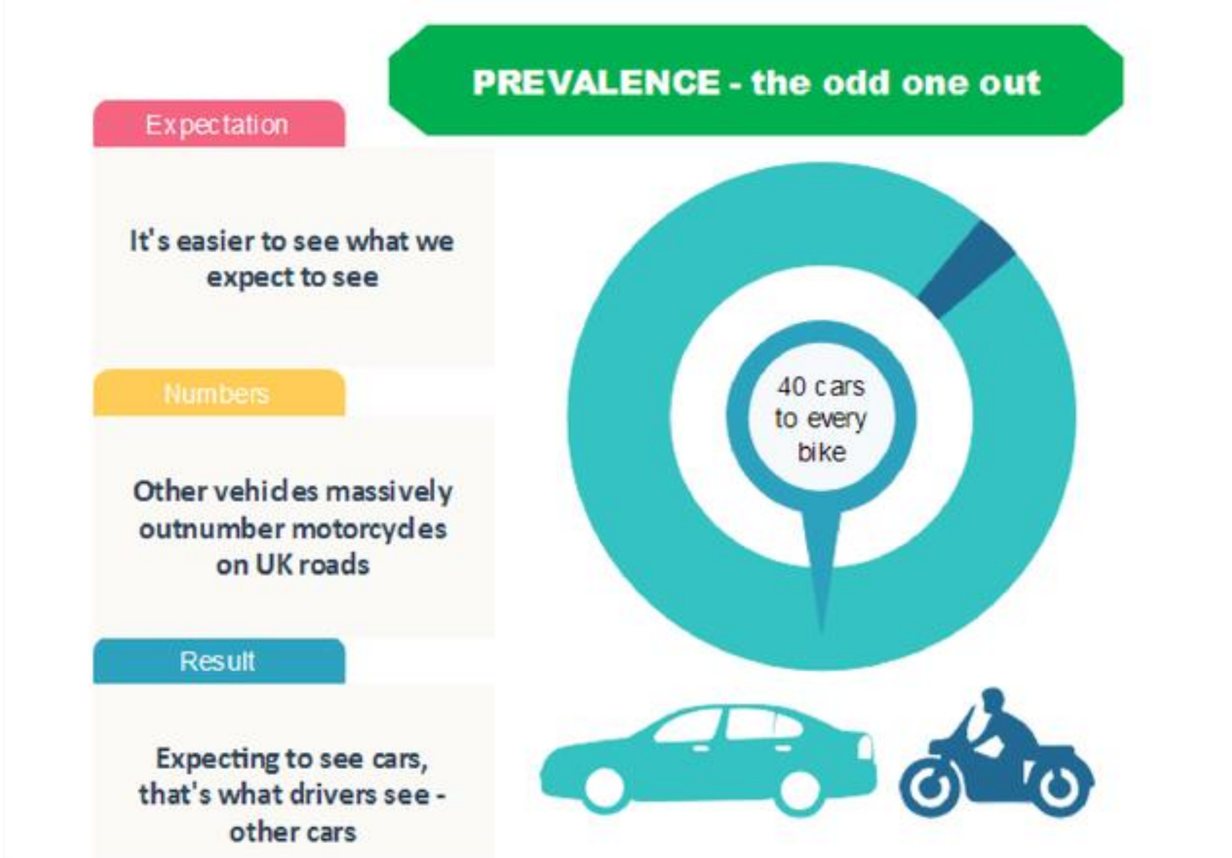
So far, we've looked at how a motorcycle's physical characteristics - its relatively small size and visual conspicuity - as one factor in the 'looked but failed to see' problem. We have also seen how the way visual data flows between the eye and the brain plays a part.

Section Introduction: There is yet a third, even more complex, form of conspicuity. This time, the issues are the result of how the brain tries to make sense of the outside world - what's known as 'cognitive conspicuity'. In the next series of posts, we'll look at what are sometimes referred to as:

- prevalence
- workload
- inattentional blindness
- semantic meaning

Prevalence refers to how common an object is. The understanding of this issue grew out of research into medical screening procedures. It's been known for some time that highly trained staff looking through microscopes at tissue samples tend to miss the rare anomalies, even though they are highly trained to see what they are looking for. Initially, it was thought to be poor training, tiredness or even carelessness, but studies showed that isn't the case. It's the way the brain scans the visual data which is the problem.

A few years back, I came across a study carried out by Lenné et al (2013) which looked at the behaviour of drivers primed to look for two different types of vehicle in a stream of vehicles. Lenne and his team noted that motorcycles make up a very small proportion of the overall flow of traffic - less than 1% on UK roads. They wondered if they are rare enough that even though drivers know they will encounter motorcycles, they would miss them and focus on other parts of the scene, just like missing medical anomalies.



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To test their theory, the researchers suggested that the ability to detect motorcycles could be changed by making the observer more aware of motorcycles. They would do this by the simple expedient of showing the observers more motorcycles, but they also showed the participants a stream of traffic with a lot of buses. The drivers were split into two groups, placed in the simulator and sent on a 7.5 kilometre 'exposure' drive. All they had to do was drive following normal road rules, but the traffic stream was different. One group encountered an unusually high number of motorcycles with no buses appearing. The other drove with an unusually high number of buses but with no motorcycles appearing. The test drives were set in urban areas, with regular intersections and with a 60 kph / 37 mph speed limit. Apart from the target vehicles, everything else was four-wheeled. Vehicles appeared from right and left, as well as ahead. Traffic was moderate, with the target vehicles appearing at random.

The simulator was based on a vehicle cab constructed from genuine vehicle parts and standard controls together with an audio feed, to give an accurate 'look and feel', whilst the visual environment was provided by three 19″ screens providing a 120-degree view and what the researchers describe as ‘medium fidelity’. Two custom buttons on the steering wheel allowed the subjects to respond by pressing the appropriate button when they detected the targets. The participants were recorded as having missed a target if they failed to respond, or responded after the target had passed them. At the same time, their driving performance was monitored by a range of sensors including speed, lateral position, braking and acceleration.

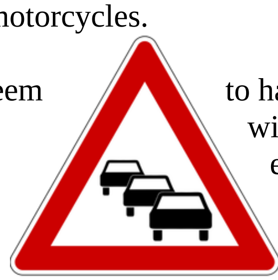
Having completed that, both groups were sent on a second, longer 39 km drive, where they were asked to count the number of motorcycles or buses, they saw, and they were told that their reaction time and accuracy were both being measured. In this longer drive, the ‘high motorcycle prevalence’ drive contained 120 motorcycles and 6 buses. In the ‘high bus prevalence’ drive, the numbers were reversed, with just 6 motorcycles and 120 buses.

You’ll probably not be surprised that the drivers told to look for buses missed seeing some motorcycles. You’ll remember that it’s commonly-held that motorcycles are hard to spot - ‘low salience’ in the jargon.

But I can almost guarantee you WILL be surprised that when tasked with looking for motorcycles, the drivers being assessed missed spotting EVEN MORE buses. That’s almost certainly not what we’d expect. If drivers aren’t spotting something as big as a bus, then it’s not a simple question of salience! I must make clear again that this isn’t ‘carelessness’, ‘not looking properly’, ‘bad training’ or any of the other blame-game explanations we adopt so readily. It’s an example of the hidden power (and weakness) of the brain, working below the level of our awareness. Neuroscientist David Eagleman explains in his TV series ‘The Brain’: *“This is not a failure of the brain. It doesn’t try to produce a perfect simulation of the world. The internal model is a hastily drawn approximation and more details are added on a need-to-know basis.”*

The key point here is that “placing your eyes on an object is no guarantee of seeing”. Neither group of participants realised they hadn’t seen some of the motorcycles or some of the buses. As far as the brain’s concerned, ‘what we see is all there is’, and we see what we are used to seeing.

As motorcyclists, that should make us think twice. Firstly, what WE think we see around us is almost certainly not the whole visual story. And because what OTHER drivers believe they see is just as incomplete, and it might be our motorcycle that’s gone missing. And if drivers don’t see buses, that should really be a warning, although before you panic, most of the drivers successfully detected ALL vehicles. The successful detection rate was actually over 99%. But looking at the less than 1% of cases where drivers failed to see one or the other, 68% detected all buses and 78% detected all motorcycles.



Beanland et al (2014) then seem to have conducted a slightly different driving simulator experiment, again 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 motorcycles occurred more frequently, the subjects detected them an average of 51 metres further away than in the tests where they occurred less often. At a simulated driving speed of 60 kph, this would allow the drivers an extra three seconds to respond. Predictably, the higher salience buses were spotted even further off when subjects saw a lot of them, giving drivers an additional 4.4 seconds to react.

Their conclusions were that increasing the prevalence of visual search targets makes them more salient, and consequently easier to detect.

Motorcyclists only represent about 3% of road users in Europe so meeting one at a junction is actually a relatively rare event for a driver. As an aside, Lenné et al concluded that the detection rates for motorcycles would be improved by the 'simple' expedient of putting more motorcycles on the road. Not too surprisingly the research was picked up by interested parties such as the riders' rights organisation FEMA and the UK's industry body MCIA and used as an argument that motorcycles should be promoted as a means of transport to make them safer. In reality, we're not about to see floods of powered two-wheelers on the roads, and so no 'prevalence effect' is about to influence drivers' motorcycle detection rates overnight.

Workload

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. Stress in driving tasks further reduces the brain's ability to process data. Once the workload limit exceeded, a driver's situational awareness at junctions is significantly degraded.

More about workload

Back in the early 2000s, on my 'blog before they were called blogs', I wrote about 'workload' and military helicopters and how much the pilot actually had to do whilst flying the machine, navigating AND using the weaponry. In trials, it turned out that even hugely increased automation wasn't enough for one design to be a single-seater as planned. There was simply too much going on even for a highly trained pilot. As a direct result, the Comanche helicopter was modified to carry two crew.

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. However, the research usually pre-supposes a straightforward task - that there are no distractions and having seen the motorcycle, the driver simply estimates the motorcycle's distance and speed to calculate 'time to arrival'.

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It wasn't hard to predict that workload would also be an issue for the typical driver (or motorcyclist, come to that), who doesn't have a fraction of the training of a helicopter pilot. In the article I predicted that in a complex driving environment, the driver would experience high workload. A common solution, adopted by many animals including primates (the group that includes humans), is to process just a small area or a few objects at any one time. We can then scan the visual scene in small chunks, subjecting each to more detailed visual analysis. This scanning technique has been compared to a 'virtual spotlight', highlighting different regions and objects for a closer look.

But it all relies on being able to slow down the scan. Pammer et al (2017) noted in their conclusions that: *"When we are driving, there is a huge amount of sensory information that our brain must deal with. We can't attend to everything, because this would consume enormous cognitive resources and take too much time."*

In other words, 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. Some of the visual information within the scene would simply not reach the conscious, thinking part of the driver's brain. Focused on one visually-intensive task - perhaps searching for road markings indicating the correct lane on a busy, complex roundabout - other visual input goes missing and the driver loses track of the motorcyclist. Even when the driver looks in the direction of the oncoming motorcycle - in some cases appearing to look directly at the motorcycle - the motorcycle goes missing and the driver pulls out into its path.

Picture yourself emerging from a side turning then turning right onto a busy road - the situation in which the classic SMIDSY collision occurs. We're searching for, then monitoring, multiple moving objects, which are travelling at different speeds in at least two different directions - three if the junction is a cross roads. We're looking in several different locations - the two lanes of the road itself, the nearside margin of each lane (where bicycles might be expected), plus pavements to check for pedestrians. We need to detect stationary objects which are in our lines-of-sight and be aware how they might create blind spots. We need to move our eyes from one search zone to another to visually acquire the targets to be scanned. Each eye movement (a 'saccade') takes time, and then the eye has to refocus on the new scene, which also takes time. And we should be keeping an eye on the mirrors too. 'Looking properly' is far from a trivial task.

Stress is known to affect our ability to process information. Trying to follow complex road layouts in an unfamiliar town, we rapidly move towards a condition of stress where we are not able to process as much information. Once the workload exceeds the level we can handle, the results include what are termed "compensating behaviours":

errors – we make the wrong decision
slow task performance – it takes a long time to reach the right decision
task shedding – we never make a decision
rapid task switching – we keep mentally jumping from one part of the overall task to another

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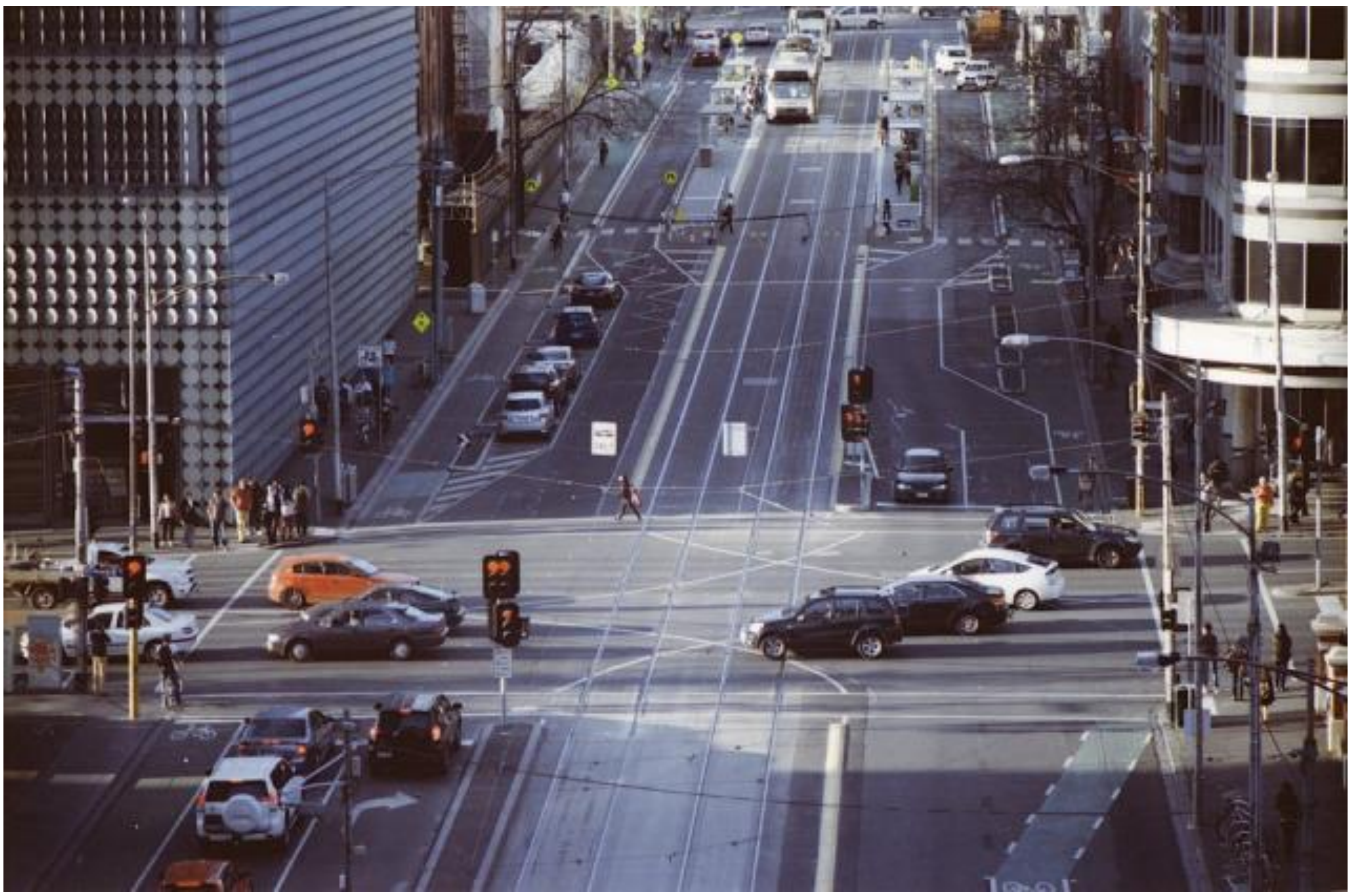
In the worst case, we might fail to perform a task altogether, a condition known as ‘task shedding’. From working in motorcycle training, I know how novice riders who are experienced drivers can actually forget a ‘simple’ task like looking for conflicting traffic when pulling out of a junction.

Few of us are consciously aware of just how much workload even relatively simple tasks create. A study by Murphy and Greene in 2016 put forty-two drivers into a life-size Volkswagen Polo driving simulator where they performed a series of gap perception tasks involving judging if their vehicle could fit between two parked vehicles. There were cars parked on either side of the simulated road. When the gap between the parked cars was easy to negotiate, 22 of 41 drivers noticed an unexpected pedestrian in a red blouse. But when the gap was reduced so that it was barely wide enough for the car to negotiate, only seven noticed the pedestrian.



Passing between two parked vehicles is a trivial task compared with monitoring busy roads to decide if it is safe to turn. 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’. However, hardly any quantitative work has been done to investigate this. The authors point out: *“This study is the first to demonstrate perceptual load effects on awareness in an applied setting and has important implications for road safety”.*

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Summary

So next time someone says that "drivers should look harder for bikes", just have a think about how complex the task actually is. 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.

'Inattentional blindness' does not mean that drivers are "not paying attention." It occurs when we are tightly focused on one particularly demanding task at the expense of other, apparently less-demanding tasks. We fail to notice anything that's not part of that immediate task.

I looked at the effect of workload and how when involved in a difficult and potentially stressful task, objects that we would otherwise likely see actually go unnoticed. As Pammer et al (2017) noted: *"When we are driving, there is a huge amount of sensory information that our brain must deal with. We can't attend to everything, because this would consume enormous cognitive resources and take too much time."*

New section introduction

It's actually more complicated than that. They continue: *"So our brain has to decide what information is most important. The frequency of LBFTS crashes suggests to us a connection with how the brain filters out information."*

The team recruited fifty-six adults and asked them to examine a series of photographs depicting routine driving situations taken from the driver's perspective. The respondents were to determine whether the image represented a safe or unsafe driving environment. In the final photograph, the researchers manipulated the image to include an unexpected object, either a motorcycle or a taxi, and asked participants if they noticed either object. A total of 48% of all participants failed to notice ANY additional object. But significantly more failed to detect the motorcycle (65%) than didn't spot the taxi (31%).

Classic inattentional blindness research

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. Take a look at this YouTube video – you may have seen it before:

https://youtu.be/vJG698U2Mvo

The task the viewer is required to perform is moderately complex, involving focusing our eyes carefully on the ball, whilst adding up in our head. This has become a classic experiment, and it turns out round 50% of people are taken by surprise by the events. Now, if you are amongst that 50% (and for what it's worth I was the first time I saw it!), you might begin to find it a little easier to believe that a driver performing the complex task of monitoring the movements of other vehicles whilst deciding if there is a safe gap to turn into, might fail to spot a motorcycle approaching a junction. (It's also worth mentioning that some of the subjects, on being told what they had missed and viewing the video a second time, were convinced that it was a trick and that the object they missed had been added to the second video. They had as much difficulty believing they'd been fooled as the motorcyclist who refuses to believe that a driver could 'look but fail to see'.)

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. In short, we simply don't have the brain power to spare. (The term itself dates back to 1992 and a book by the same name which might more usefully have called it 'attentional blindness'.)

In an article on the University College London website, researchers under Professor Nilli Lavie of the UCL Institute of Cognitive Neuroscience, looking at just why our brain becomes 'blind' under high load. Lavie says: *"Engaging attention on a high load task has a strong effect on the brain's response to the rest of the world. It reduces both the level and precision, or 'tuning', of neural response to anything else around us that is not part of the task. These effects of load on neural response explain inattentional blindness. Although our environment hasn't changed, the change in our brain response under load leads to inability to perceive otherwise perfectly visible stimuli outside our focus of attention."*

So, I did a second video. The task is the same. Even though I KNEW there would be some kind of new event happening in the video - after all, I had been mentally primed to be on the alert after seeing the first one, I still failed! That's because there's even more going on, and even more of a cognitive load on my brain. Even though I knew I needed to pay attention to the big picture, my brain STILL shut down any visual input it thought was irrelevant to the task in hand. And because I was looking so hard for the other events, I miscounted the passes.

Back to Lavie: *"When we perform a task which demands processing a high information load, it takes up most or all of our brain capacity for perception of any other information, so our processing becomes selective. We're able to continue attending to the relevant task, but our brain no longer responds to irrelevant information. These effects of load are beneficial when it comes to distraction; we can ignore irrelevant distractions more effectively under high load. But it also leads to inattentional blindness, where we can't perceive unattended stimuli that are not part of the task – even in cases when it's quite important to perceive them – for example, an animal on the road while we're driving."*

One theory is that our eye movements are controlled by two processing centres that are in constant competition. Crundall (2008) explains: *"The fixate centre keeps the eyes in one place, and continues to process the current stimulus, while the move centre continually places demands on the oculomotor system for the eyes to move to a new area of interest. These two centres* *actively inhibit each other, so if the information at the point of fixation is extremely important the fixate centre will inhibit the move centre. However, if the move centre is more active, then the eyes will be dragged away from the point of fixation, potentially before the viewer has finished processing what they were looking at."*

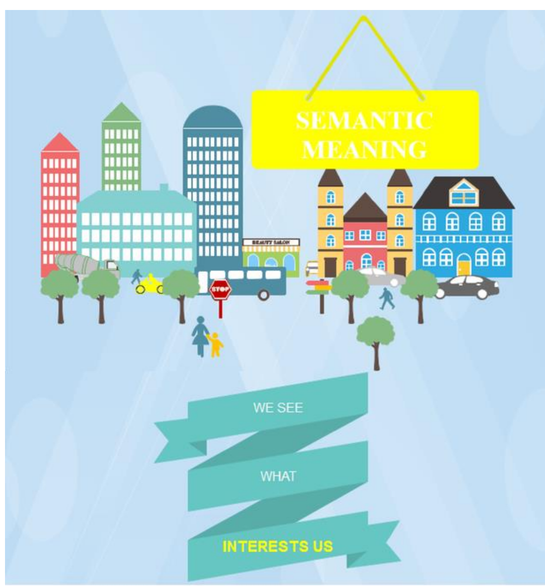
Summary

In other words, 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. Instead, we should recognise that the human brain was never designed for driving and the only way ALL road users (motorcyclists included) can make the best use of the human brain's limited attentional and/or processing capacity is to be selective in where to concentrate attention.

Our visual environment is cluttered with objects. Our visual attention tends to be drawn towards the objects with which we have most connection. Motorcyclists tend to spot other motorcycles but other road users with no interest in motorcycles are less likely to see them.

The previous three sections have discussed aspects of cognitive conspicuity; how the 'prevalence effect' predisposes us to detect objects that are more common than other objects which don't appear so regularly, how the complexity of the task spreads our attention, and how focusing on a particularly difficult job can blind us to other, necessary tasks.

But there is a yet more subtle problem. Humans, like other animals, need to be able to detect objects of interest in that visually cluttered environment. We could be looking for potential prey, possible predators, or even mates. What is that helps us make the right decision on how to focus our attention?



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New section introduction

I previously introduced the concept of ‘visual salience’, whereby some objects have a distinct perceptual quality which draws our eyes and grabs our attention. Only at that point we become aware of whatever the visual system has detected. I pointed out that this is the fundamental concept underpinning the conspicuity aids proposed for use by motorcyclists. In a paper published in the journal ‘Nature’ in 2017, Professor Henderson and fellow postdoctoral researcher Taylor Hayes call this visual salience explanation the ‘magpie theory’, because it often assumes that our attention is drawn, just like a magpie, to bright objects. However, it may not be correct.

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. Henderson and Hayes set up a study which*: “…contrasted the degree to which the spatial distributions of meaning and salience predict viewers’ overt attention within scenes. The results showed that both meaning and salience predicted the distribution of attention, but that when the relationship between meaning and salience was controlled, only meaning accounted for unique variance in attention. This pattern of results was apparent from the very earliest time-point in scene viewing.”*

They accounted for the results in terms of the observer’s field of interest: *“When viewing a photograph or scene observers most commonly fixate on the most physically salient regions first, but if the observers have relevant content expertise (for example, a history student viewing a photograph of artefacts from the US Civil War) then they focus less on physically salient areas and more on semantically meaningful areas.”*

Semantic richness would explain something I have previously written about as the ‘Classic Car Effect’. Start to drive something a bit unusual - an original 2CV perhaps - and suddenly old 2CVs will jump out of the scenery in a way we have never experienced before, despite being surrounded by other, considerably larger, vehicles. That’s not because the 2CVs have suddenly become more visible (visual salience) or that there are a lot more of them around (the prevalence effect), it’s because our new purchase has subconsciously primed us to be more aware of the 2CV - the classic Citroen suddenly holds semantic meaning.

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Humphrey and Underwood (2009) found that when inspecting a scene that was highly relevant to the subject – for example, engineers viewing an engineering scene – specialists looked at semantically-interesting features that were in line with their specialty, rather than at more-highly salient but non-specialist features. They found their eye movements responded more closely to the areas of high meaning which related to interest and less to those with high saliency. They went on to construct an experiment which compared car drivers to road users with a specialist interest in motorcycles, by tracking the eye movements of volunteers as they looked at scenes which had been constructed to have both meaning and salience. Not surprisingly, the same holds true for motorcyclists – we tend to look at other motorcyclists. Humphrey and Underwood stated*: "This conclusion has important implications for current theories of attention across diverse disciplines that have been influenced by image salience theory".*

You will also recall the work done by Lenné et al (2013) which I mentioned earlier, where they investigated how subjects responded to streams of vehicles seeded with buses or motorcycles. They also suggested that the way we detect an object depends on context. By increasing the numbers, they gave those buses or bikes added semantic meaning. The researchers suggested that our prior experience changes the way we search a scene.

<u>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. Dual drivers' eyes are drawn not just to the motorcycles themselves, but to the areas they expect to see motorcycles because they are the 'semantically meaningful areas.'</u> And so semantic meaning is likely to affect our response. Underwood et al (2011) found: *"It is possible that the expertise and familiarity riders had with motorcycles affected the way they processed the scene. When riders fixated a motorcycle (especially a high saliency one), it was semantically meaningful to them, and thus they processed it as a hazard, decreasing the likelihood of a ''safe-to-pull-out'' response. However, when drivers fixated a motorcycle, they failed to process it as a hazard, due to their lack of expertise, and thus were more likely to declare a ''safe'' response, when it was not necessarily safe to pull out (an LBFTS error)."* They further found that: *"When a vehicle was clearly visible (high saliency), riders were quicker to respond (giving a more cautious ''unsafe'' decision), whereas with low saliency vehicles, riders took longer to make a decision."*

Two quick observations. Firstly, being visible is not the same as being conspicuous. Something can be conspicuous and at the same time not visible, or vice versa. The two terms are not interchangeable. I assume that ALL the motorcycles in the study were visible. If not, then it's hardly a test of the effect of salience.

In any case, the study appears to show that riders saw both the high AND low salience vehicles. However, I think the researchers have totally misinterpreted the meaning of the response time.

Because the dual drivers took LONGER to make a decision having seen a low salience vehicle, I would suggest that provided they were not actually committing a ROWV, the longer pause whilst considering their decision means that they were MORE cautious, not less as implied in the study. I would argue that a QUICKER decision is less cautious.

I would further suggest that semantic meaning is also at least a partial explanation for anecdotal claims that motorcyclists (and road safety proponents) who promote the use of conspicuity aids by saying that they find it easier to see other motorcyclists wearing hi-vis clothing and using day-riding lights.

It would be an interesting study to see if motorcyclists who claim to see hi-vis and DRLs more readily also responded more readily to conspicuity aids used by, say, roadside workers. If they didn't, it would cast doubt on the visual salience theory and support the role of semantic meaning.

In any case, it should be clear there is a danger in using our own perceptions of other motorcyclists to make the intellectual leap which concludes that "other road users will also see motorcyclists using conspicuity aids more easily". As other road users do not find semantic meaning in motorcycles or conspicuity aids, any visual salience benefits are likely to be more limited than commonly believed.

The 'cognitive guidance' theory suggests that finding meaning within our visual world is, to quote Henderson, *"the driving force guiding attention through real-world scenes".* 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' 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.

Summary

With experience we tend to use more rapid 'pre-programmed' search patterns at intersections. These search patterns are based on prior experience and expectation. Experienced drivers search for gaps at a predetermined distance from the junction. Failure to search 'backwards' towards their vehicle can lead to detection failures when there are vehicles closer than the observed gap. The failures are rare, which leads us to believe our strategy is a good one.

Next section introduction:
We know that different objects in the visual scene will compete to attract attention. 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.

Crundall et all (2008) found that: *"If a motorcycle and a car are within close proximity, then a saccade made by a driver waiting to pull out at a T-junction is likely to land closer to the car. If the two objects are [further apart] from each other… the eyes will be more likely to land directly upon the larger object."*

Durations of gaze were also analyzed. Experienced drivers made significantly longer 'first gazes' at cars than motorcycles. It is argued that shorter first gazes may reflect easier processing of the object, but may also reflect failure to fully process the motorcycle.

But it seems we tend to take visual short-cuts too. Langham (199?) observed*: "with experience, drivers may develop shorter search times at junctions and may extract from complex traffic*

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scenes only a minimal amount of information, based on prior expectancies about what they are likely to see." Langham (199?) found that when viewing video clips of approaching traffic: *"…experienced drivers appear to use 'pre-programmed' search patterns directed towards areas of the road environment which are informationally rich; there was little evidence of these in the eye-movements of inexperienced drivers. Experienced drivers appeared to start their search at a midpoint in the scene whist inexperienced drivers started their search nearby. One consequence of this was that experienced drivers took longer to detect motorcyclists who were nearby. (i.e., to the left of the initial point of fixation.)"*
The implication is that if the experienced driver fails to move his point of fixation (i.e., the cone of focused, clear, colour vision) back along the road towards his own vehicle, the driver may fail to detect the nearby motorcyclist. Believing the road to be clear, the driver makes the 'looked but failed to see' error and commit a ROWV. So, it's possible the error is at least partly the result of a poor search strategy.

Crundall et al (2012) also captured eye-gazes of participants and analyzed differences between novice, experienced and dual drivers (holding both car and motorcycle license) as the vehicle in which the subject was seated approached and came to a halt at a junction. When a motorcycle 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. This is likely to apply as much to driving as any other task and experienced drivers failed to search back along the road towards their vehicle.

The authors suggest this may point towards an 'over-learned strategy' of experienced car drivers, *"encouraging drivers to search beyond a motorcycle once it has been spotted". They further argue this over-learned strategy may "reduce chances of spotting the motorcycle at all". By contrast, dual drivers "showed longer fixation durations on the vehicle than drivers, perhaps suggesting greater depth of processing".*

If motorcyclists have developed better strategies in terms of detecting other motorcyclists than drivers, this does not represent ‘careless behaviour’ on the part of the driver or an indication that the driver is ‘not looking properly’. Whilst studies report the absolute number of collisions that occur between motorcycles and other vehicles, or make assessments of the numbers of crashes that would be prevented were a particular preventative measure to be introduced, what is virtually never mentioned is the rate at which these collisions happen within the whole riding environment. In fact, the search strategy only very rarely breaks down for experienced drivers. When counted in terms of the percentage of potential collisions and the number of ACTUAL right-of-way violations, the proportion of near-misses and collisions is tiny compared with correct decisions not to pull out. What may be rather more useful to know is that some studies show that motorcyclists are more at risk from young, inexperienced drivers.

Summary

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) are unlikely to have any significant effect on the SMIDSY collision.

New section introduction

Sometimes the driver sees the motorcycle but miscalculates ‘time to collision. The rider may make it difficult for the driver to judge speed and distance by travelling faster than surrounding traffic. The size-arrival effect means smaller, nearer objects are incorrectly judged to arrive LATER than larger, more distant objects. Compared with cars and vans, the ‘time to arrival’ of motorcycles is estimated to be significantly later. Riders exceeding speed limits are more likely to be killed in a collision.

You’ll remember that the SMIDSY collision involves a cascade of potential issues:

does the driver look at the motorcyclist?
does the driver realise that it is a motorcyclist?
does the driver correctly decide whether the motorcyclist poses a hazard?

We’ve worked through the likely causes of the first two parts of the problem so now it’s time to look at the third. 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. The driver may then make an inappropriate and unsafe manoeuvre when the motorcyclist fully expects to be seen and for the driver to give way.

What goes wrong?
The simplest explanation is that motorcycles don't perform like cars, and motorcyclists don't ride motorcycles like drivers drive cars. As we'll see, we do tend to ride faster than the vehicles around us and we don't always don't consider that the majority of drivers are not familiar with a motorcycle's performance and agility characteristics, nor will they be fully aware of the decision-making processes of a motorcyclist. The authors of the report 'Improving Safety for Motorcycle, Scooter and Moped Riders' state*: "PTW riders' behaviour can also indirectly contribute to the fact that they are not easily perceivable. PTWs can surprise other road users by deviating from behavioural standards with their manoeuvres, for example by their positioning (e.g., riding in the blind spots of cars), speeds and acceleration capacity and confound the perceptual strategies of car drivers."*

In other words, 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. It shouldn't be surprising to a motorcyclist but it IS something that we need to consider.

But sometimes the motorcyclist is travelling in a stream of traffic and not doing anything unusual and the ROWV still results? Why?

To begin to understand, we need to answer a question. How does a road user - rider or driver - determine whether there is a safe gap in which to turn, one that enables the manoeuvre to be completed without putting anyone at risk?

The necessary distance depends on how fast the vehicle is approaching, how far away it is, and how much time the turning vehicle needs to clear its path. If we think we have enough time, we'll turn. If we don't think we have sufficient time, we'll stay put - this is termed 'gap acceptance'.

To be able to accept a safe gap and reject an unsafe gap, we rely on our perception of depth. Depth allows us to locate our own position relative to that of the target object. The rate of change of our relative positions thus allows us to estimate speed and distance. And once we know that, we can calculate a 'time to collision' figure which gives us a window of opportunity to avoid contact. So, the crux of the issue when we decide whether or not to accept a gap is our estimation of 'time to collision'.

One of the first trials of gap acceptance that I can find was carried out by Fulton et al (1980) for the Transport and Road Research Laboratory (TRRL). The gap acceptance behaviour of motorists towards a motorcycle in three conditions (control, dipped headlight and fluorescent jacket) was measured. Here's how they carried it out:

"An experimental motorcycle was introduced into the traffic flow and a study made of responses to controlled gaps which were presented. It was apparent that to achieve an adequate data collection rate the motorcycle would have to make very frequent passes across the junction under study. A rapid circuit was achieved by conducting the trials at a large roundabout. The roundabout had a circumference of approximately 530 metres (1/3 mile).

"Two video recorders were secured on a 3.6 metre (12 feet) high platform in the centre of the roundabout. The recorders were each positioned to film one of two junctions selected for observation.

"The 250-cc motorcycle followed a lead car, which was necessary to stop vehicles at the junctions and to enable the following motorcyclist to control the presented gap. The speed of the car and motorcycle was approximately 25 mile/h. Gaps between 1.5 and 5.0 seconds were used in the trials. The options were changed at half-hourly intervals with the order of presentation being varied between days. A total 1,854 passes were recorded… From the 1,854 passes (927 circuits) taped a total of 352 acceptances and 922 rejections were recorded."

The motorcycle passed four roads (the two being surveyed by the camera plus two others) making a total of 3708 passes for the 927 circuits. The results might surprise you*: "...during this time there were no conflicts between the motorcycle and other vehicles."*

In other words, not a single vehicle pulled out into the motorcycle's path. Moreover, when the data was analysed, comparing the control (no lights or hi-vis) with the motorcycle using either dipped headlight or fluorescent clothing, the results*: "...showed that the use of fluorescent clothing or a dipped headlight on the experimental motorcycle had no significant effect on the sizes of gaps accepted."*

However, thanks to the total absence of right-of-way violations, it wasn't actually possible to test the theory that conspicuity aids reduced the risk of drivers choosing to make an unsafe manoeuvre. The authors concluded: *"The true effectiveness of these aids will only be realised when all motorcyclists use them and their effect can be observed in the national accident statistics."*

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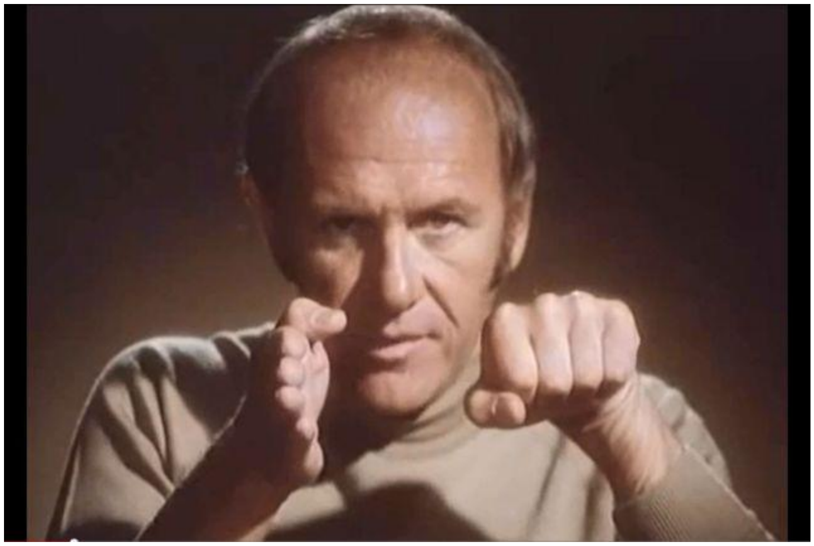
Although this might help us accept the fact that ROWVs aren't as common as motorcyclists typically believe, it is true that motorcycles are particularly vulnerable to gap acceptance errors and the study results don't explain what happens when drivers see bikes then get their mental sums wrong.

Quite obviously, when we are estimating speed, distance and time to collision, we're not doing this with a sophisticated range finder and a calculator. We have to make use of the brain's perceptual abilities. By now you should be getting a hint of the problem. As we have already seen in other ways, the brain isn't infallible.

How does the brain make this 'time to collision' judgement? It was originally thought that we used motion-based cues. In other words, we would assess movement by measuring the rate at which the apparent size of an object changes with time.

Headlight in shade

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. For example, we know roughly how big a locomotive is, so by observing the apparent size of the locomotive, we gain a sense of its distance. We only need a quick glimpse of the locomotive to assess this. 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.



Above is a still snapped from the original 1970s 'Think Once, Think Twice, THINK BIKE' public information film. The presenter is making the point that a motorcycle is a third of the width of a car.

And that gives us an indication of the problem. 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. It's been studied in a number of papers; for example, DeLucia (1991). Horswill et al (2005) investigated whether the size-arrival effect might potentially contribute to the high accident risk of motorcyclists:

It's been studied in a number of papers; for example, DeLucia (1991). Horswill et al (2005) investigated whether the size-arrival effect might potentially contribute to the high accident risk of motorcyclists*:* *"Drivers adopt smaller safety margins when pulling out in front of motorcycles compared with cars."* This could partly account for why the most common motorcycle/car accident involves a car violating a motorcyclist's right of way. One possible explanation is the size-arrival effect in which smaller objects are perceived to arrive later than larger objects. That is, drivers may estimate the time to arrival of motorcycles to be later than cars because motorcycles are smaller.

"Even when a driver has detected an oncoming vehicle, he or she must then judge whether there is sufficient time to pull out safely in front of it. To do this requires drivers to estimate the oncoming vehicle's time-to-arrival. If the strategies used by the driver to judge the time-to-arrival of oncoming vehicles yield a different estimate for motorcycles compared with cars, then this may also help explain the smaller time gap."

Horswill et al performed a fairly simple experiment where subjects were shown video footage of oncoming vehicles and had to press a response button when they judged that vehicles would reach them. The results indicated that when compared with larger vehicles (a car and a van), the 'time to arrival' of motorcycles "was estimated to be significantly later than for different approach speeds and viewing times".

The results confirmed previous experiments carried out by Caird and Hancock in 1994 which also found that time-to-arrival estimates were later for smaller vehicles (motorcycles or small cars) than larger vehicles (large cars or vans) consistent with the size-arrival illusion. Caird and Hancock had used computer-generated stimuli in which different vehicles approached participants at a road junction, but the experiments were criticised for a lack of realism, specifically a lack of detail such as textures, curbstones, or familiar geometric features which are necessary to work out scaling.

Horswill et al (2005) concluded: *"These findings suggest that perhaps drivers should be made aware that they are subject to an illusion when judging whether to pull into the path of an oncoming vehicle and that this illusion may lead them to choose smaller gaps in front of smaller vehicles such as motorcycles."*

Summary

To sum up, here's the sequence of events: looking at an approaching motorcycle, drivers perceive the motorcycle to be further off than it really is

- thus, miscalculating time-to-collision…
- mistakenly selecting an inadequate gap…
- leaving insufficient time to clear the motorcycle's path…
- creating the ROWV and
- setting up the circumstances in which the subsequent collision can occur

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.

There is one other factor to consider. Non-motorcyclists often accuse motorcyclists of riding too fast. Is this true?

The 'Science Of Being Seen' - explaining the SMIDSY
An original presentation CREATED BY Kevin Williams / Survival Skills Rider Training
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Most motorcycles are capable of accelerating faster than most cars and vans from a standing start. My personal observation is that most of us riders use this ability at traffic lights and other intersections to get clear of other traffic thus making subsequent manoeuvres – such as lane changes – easier. In a typical urban environment with many intersections, it's likely that from a side-by-side position, the motorcycle will be first to arrive at the next junction, often well before cars and vans. If this is the case – and I've yet to see a study on the issue – it would not be surprising if PTWs were over-represented in collisions at intersections – the bike would be the first vehicle to arrive.

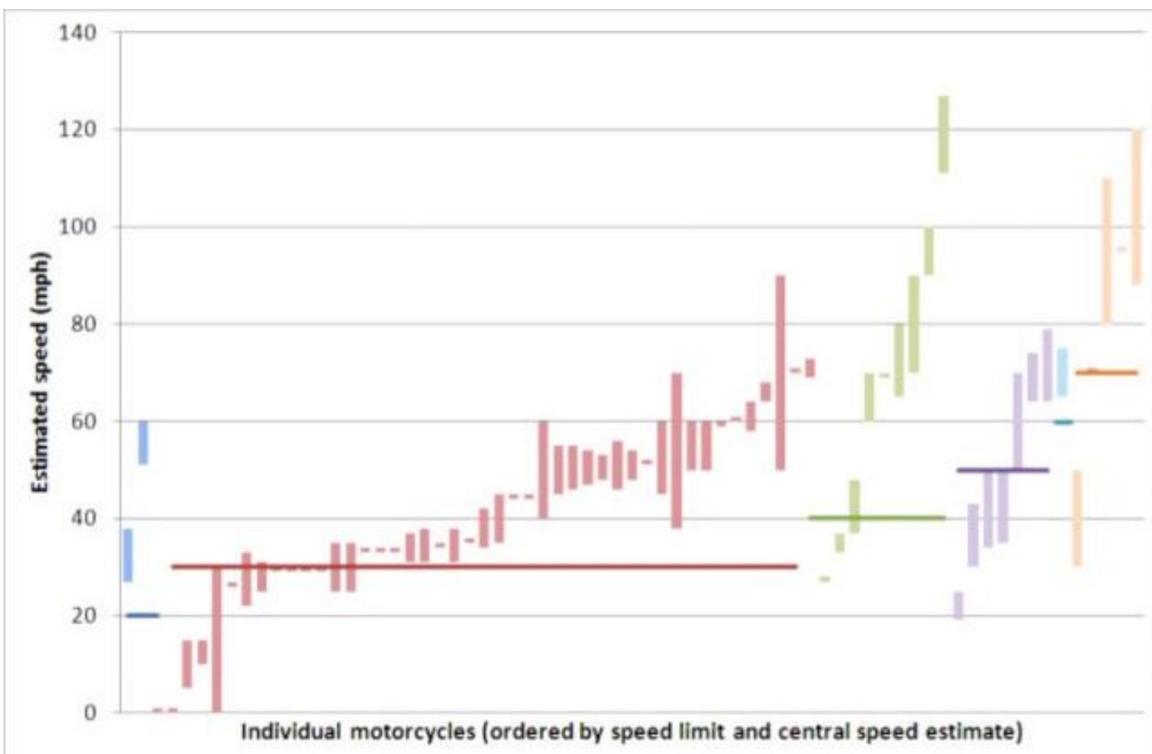
But having reached a 'cruising speed', do motorcyclists then exceed the speed limit whilst travelling between junctions? A study in Wellington, New Zealand found that motorcycles were moving around 10% faster than the other traffic, but they were not necessarily exceeding the speed limit. 10% sounds a lot, but where the average speed of cars was 35 kph, the motorcycles were travelling on average just 3.3 kph faster than cars. But Walton and Buchanan also found that although most motorcycles were travelling within the speed limit, a motorcycle was 3.4

times more likely to be exceeding the speed limit than a car. A similar study from Melbourne, Australia, found that motorcycles were 3.3 times more likely to be exceeding the speed limit than cars.

But perhaps motorcyclists are the victims of other speeding road users. Smith et al (2013) looked at police data from London, and found: *"There were three collisions where another vehicle in the collision was recorded as 'exceeding speed limit'. This is a much smaller group than the motorcycles that were exceeding the speed limit [45 out of a total of 93 fatalities], suggesting that speed-related collisions are mainly due to the speed of the motorcycle rather than the other vehicle."*

In other words, 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 and not the other driver. So just how fast were the motorcyclists who were involved in fatal accidents travelling?

Figure 6-3 [the bar graph below] shows the estimated speeds of each motorcycle, where known, compared with the speed limit of the road. Each bar represents one motorcycle and shows the range of the estimate, with each speed limit shown as a different colour. The very small bars are those where only a single figure of speed was given, rather than a range. These generally would be a minimum speed. This shows that on 30mph, a large number of motorcyclists were exceeding the speed limit, some by a large margin. On 40mph roads there was also a large proportion of 'speeders', with one motorcycle estimated to be travelling between 111mph and 127mph.



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The bars represent the estimated travelling speed and impact speed of the motorcycle, based on measurements at the scene, expert opinion or on witness evidence.

The graph indicates that on roads with a 20-mph limit (~30 kph), both riders killed were exceeding the limit, with one riding at between 50 and 60 mph.

In 30 mph limits (~50 kph), although some riders were at or below the limit, most of the motorcyclists were exceeding the speed limit, some by a large margin.

The same general pattern is repeated on 40 mph (~60 kph) roads where there was also a large proportion of ‘speeders’ involved in fatal crashes, with one motorcycle estimated to be travelling between 111mph and 127mph.

So, it does appear that in these speed limits, which are typical of urban environments, where riders speed AND crash, they are more likely to be killed than riders crashing at or below the speed limit. It’s not surprising because the physical impact of a collision increases – mass x velocity.

But on the roads with 50 mph (~80 kph) and 60 limits (~95 kph) the riders involved in fatal collisions are less likely to be speeding, which once again reflects the bigger impact from a crash at the higher speed.

I cannot provide figures for rural environments (I’m looking) but the inference from these figures is that it’s not just the riders travelling at the highest speeds who are most at risk. We need to be aware that ANY junction poses a threat at open road speeds.

From the evidence above, I doubt it’s a coincidence that speeding riders are over-represented in urban junction collisions. The more we behave in a way that is markedly different from other vehicles, the harder it is for a non-riding driver to factor us into their driving plan correctly.

So, if you want to significantly reduce your chances of a fatal collision at a junction:
* don’t speed in urban areas but keep close to the speed of the traffic flow around you
* reduce speed near junctions in rural areas

Remember, it’s the speed at impact that counts.

Summary

Motorcyclists may believe that drivers don’t care about bikes or see them as a source of danger. They further believe the lack of empathy means they don’t look hard enough. This belief does not appear to be founded on any solid evidence, just speculation. Gap acceptance studies show no right-of-way violations in thousands of passes. Statistically, one study indicates that car drivers crash with other cars just as often as with motorcyclists and that they do not crash with motorcycles more often than motorcyclists with other motorcyclists.

New section introduction
Whilst most investigations have focused on perception problems as explanation for why it is that drivers 'look but fail to see' motorcycles, or misjudge their speed and distance resulting in ROWVs, some studies have suggested that there are what might be called 'empathetic' explanations.

Motorcyclists are popularly viewed as a high-risk group and 'thrill seekers', and studies have indicated that car drivers have negative attitudes towards motorcyclists. By extension, it has been suggested - quite seriously - that whilst some car drivers don't care about motorcycles and their riders to 'look hard enough' for them at an intersection, others do not regard motorcycles as a potential danger. Having seen the approaching motorcycle, but cocooned in a car and not feeling threatened, the driver is then postulated to 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 manoeuvre the driver would not be attempted in front of other vehicles.

The earliest expression of the 'threat' aspect of the SMIDSY collision seems to have come from Hurt and Dupont (1977). They wrote (and I've emphased the 'low threat' part of the statement: "*If the approaching motorcycle and rider blend well with the background scene, and if the automobile driver has not developed improved visual search habits which include low-threat targets (such as motorcycles and bicycles, as contrasted with the high-threat targets presented by trucks and buses) the motorcycle will not be recognized as a vehicle and a traffic hazard exists.*"

Not surprisingly, this theory was promptly given some prominence in the motorcycle press, and subsequently picked up by rider action groups who have issued 'calls for action' to address the perceived problem. Equally unsurprisingly, a few motorcyclists believe that they are ONLY put at risk because of a lack of care or though the deliberate actions of other drivers, and also that the perceptual problems previously discussed are just a convenient excuse for 'looked but failed to see' crashes.

How real is this empathetic explanation of the problem?
Is there any factual basis for the belief that drivers deliberately target PTW? I don't know, and I don't think anyone really does. I've only been able to locate two later research papers which suggest something along these lines. In the earlier, Wulf et al (1989) looked into the issues surrounding collisions between cars and PTWs. Whilst suggesting several explanations you should now be familiar with:

* the smaller physical size of the PTW compared with a car makes it less conspicuous
* judging of distance and speed with a small frontal area or with only one headlight is difficult
* because of the low numbers of PTW's in traffic, car drivers do not expect to meet a PTW and are therefore less prepared to notice or recognise a PTW
* because PTW's seem to 'lack relevance' to most car drivers

Wulf also suggested that a car driver is inclined to ignore the presence of a PTW since the impact of a collision with a PTW is less threatening than with a car.

But understand this. Neither Hurt & Dupont nor Wulf ACTUALLY PROVIDED ANY EVIDENCE for their theories that car drivers deliberately put motorcyclists at risk – they only advanced the POSSIBILITY that it could happen. I cannot find any study of junction collisions that has actually produced any kind of statistical figure for a deliberate ROWV as a proportion of the total number of junction collisions, only speculation that deliberate action could be an explanation.

Another popular belief is that drivers are able to tell the difference between a police motorcyclist and an ordinary rider and make decisions accordingly. The source for this is probably a paper by Caird and Hancock (1994) who suggested that compared with the average, some types of rider do not have as many collisions with cars: *"Within the motorcycle population, there is an under-representation of police motorcyclists and – somewhat paradoxically as they represent low contrast – Hell's Angels."*

The implication is that having identified a police motorcycle – or a machine ridden by a Hell's Angel – drivers deliberately hold back from a manoeuvre they would make in front of an 'ordinary' motorcyclist. One possible explanation for the low incidence of collisions involving Hell's Angels is that they ride as a pack. The pack is not only more visible, but only the leading riders in the pack are directly vulnerable.

I did find this statement [and as always, I would welcome new information] which comes from a US-based legal firm, HG. Org, who state: *"Deliberate hostile action by a motorist against a motorcycle rider is a rare accident cause. The most frequent accident configuration is the motorcycle proceeding straight then the automobile makes a left turn in front of the oncoming motorcycle."*

It's unsupported – no reference to original material is provided. But given the source – a US-based legal resources website – and the history of litigation in that country, I would not have expected the article to play down the possibility of 'deliberate hostile action'. In fact, given the role of the business, I would have expected the reverse, that they would play up the ‘deliberate action’ angle.

But car drivers have more crashes with motorcyclists than cars, yes? That’s an article of faith amongst bikers. So, I’ll take the opportunity to remind you about an observation from a recent paper from the Netherlands that I mentioned earlier: *“The majority of motorcycle crashes are crashes with a car. In these crashes, the police register the car driver as first offender more often than the motorcyclist. So, 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. An analysis of different crash causes at intersections indicates that, relatively speaking, car drivers fail to give priority to a motorcycle as often as to a car.”*

Let me highlight the two important statements. Firstly, De Craen and her team found that:

> *“…relatively speaking, car drivers fail to give priority to a motorcycle as often as to a car.”*

That makes it hard to see how drivers could be ‘singling out’ motorcycles at junctions with deliberately risky manoeuvres. They also found that:

> *“…when adjusted for exposure, car drivers do not crash with motorcycles more often than motorcyclists with other motorcyclists.”*

For the vast majority of motorcyclists who believe that they are at risk from car drivers because “drivers don’t look properly for bikes” and that by contrast because they are bikers “we see other bikes” and don’t run into them, that will be a statement that is very hard to digest, but the study is based on police data. And just so you know that I have not misquoted or selectively quoted from the paper, here’s a screenshot of the section from relevant page:

Conclusions

The majority of motorcycle crashes are crashes with a car. In these crashes, the police register the car driver as first offender more often than the motorcyclist. So in absolute numbers, many motorcycle crashes seem to be caused by car drivers (research question 1). However, when adjusted for exposure, car drivers do not crash with motorcycles more often than motorcyclists with other motorcyclists. An analysis of different crash causes at intersections indicates that, relatively speaking, car drivers fail to give priority to a motorcycle as often as to a car.

In one situation 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 type of crash occurs more often when the oncoming vehicle is a motorcycle than when it is a car. The literature

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Nevertheless, in the interests of balance I will point out that this is just one paper, by one team of researchers, using data from one country. It would be useful for the analysis to be repeated with fresh data from beyond the Netherlands.

de Craen et al (2011) went on to point out that motorcyclists are at greater risk ONLY in one scenario - when an oncoming car turns across a motorcycle's path into a side road: *"In one situation 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 type of crash occurs more often when the oncoming vehicle is a motorcycle than when it is a car."*

Their explanation was that 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".

But in the scenario below – the classic SMIDSY with the emerging car – it seems the driver is just as likely to make an error in front of another car as in front of the bike. That's absolutely NOT what most of us would expect to hear. Of course, the consequences for the PTW operator are likely to be far more serious than for a driver of another car. That's what loads the injury statistics, not actual crash rate.

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In any case, the fact is that most ROWVs in front of PTWs will NOT result in a crash. In the majority of incidents recognised by the rider as a ROWV, zero action – or only a trivial change of speed and direction – is required to avoid a collision. Emergency action is relatively rare.

So, the key point then is not so much whether the rider THINKS that the driver should have waited (what we might term 'bad behaviour' because the motorcyclist considers the manoeuvre to be a violation of the traffic code) but whether the manoeuvre poses a GENUINE threat requiring a serious intervention by the rider to avoid a collision. What a rider needs to know is at what point does a ROWV change status. Is the manoevure:

irrelevant?
a mild annoyance?
a potential threat? (if the rider doesn't take some mild defensive action)
a genuine threat? (requiring emergency evasive action)
unavoidable (potentially resulting in injury or death)

The answer is that although there have been a number of 'gap acceptance' studies, which look at the driver's response to a motorcycle and how close to the car the motorcycle can get before the driver rejects the turning manoeuvre, my searches have turned up very little that investigates the SMIDSY from the rider's perspective.

We can turn to a study carried out by Ouellet and Kasantikul (2006) using a methodology similar to Hurt's work in California but this time studying crashes in Los Angeles and Thailand. In both study areas, teams of investigators travelled to an accident scene immediately after a collision and conducted an analysis of the incident independent of the police investigation. In total, 969 collisions involving 1082 riders and 399 passengers in six different regions over a twenty-month period were investigated (including motorcycle – motorcycle collisions – around one-quarter of the total). In Los Angeles, 900 accidents were studied.

One of the key results was a determination of the time from 'precipitating event' (i.e., the moment the collision partner began to turn into the rider's path) to impact. In both Los Angeles and Thailand, the mean (average) time from precipitating event 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.

Given the entirely different driving conditions in the two cities, where there are very different levels of driver skill, traffic rule enforcement and deterrence, it's interesting that the time from the precipitating event to the collision is almost exactly the same. The implication is that the ROWV is not dependent on 'driver behaviour' so much as human error.

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. Similar results come from Germany. In a sample of 502 injury accidents in 2001-2002 (reported in 'SafetyNet (2009) Powered Two Wheelers'), 279 of the motorcyclists had taken action to avoid a collision and 54 eventually lost control.

An important factor is the time it takes for the rider to respond. Most emergency stop measurements start with a rider who is expecting to stop. So, all that's measured is the rider's physical reaction time (the time taken from detecting the signal to stop, to beginning to brake) plus the mechanical stopping distance (how hard the rider brakes, how good the brakes are etc.). But it's by no means guaranteed that in a genuine and unexpected emergency that the rider will PERCEIVE the need to take action instantaneously. In fact, this 'recognition' time can add anything from one to three seconds to the time it takes to stop. The riders in the studies just mentioned took longer to stop than the figures in the UK's 'Highway Code'. If you recall the gap acceptance infographic, you'll note that I labelled five seconds as 'safe' and three seconds as 'at risk'. This is the source of those figures.

The 'Science Of Being Seen' - explaining the SMIDSY
An original presentation CREATED BY Kevin Williams / Survival Skills Rider Training
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The only study I could find that actually asked motorcyclists what they thought was the early 1980 TRRL study I have mentioned before. They sent out a questionnaire to a sample of riders, asking: whether or not they had experienced any accidents involving another vehicle or pedestrian in the last three months, and if so to declare:

a) how many accidents.
b) on how many occasions they were wearing their safety clothing at the time of the accident
c) what were the causes."

They went on to analyse the responses:

"As accidents occur relatively infrequently, it was decided to investigate both accidents and near-misses where the motorcyclist considered that the incident was due to another motorist failing to see them. During the experimental period of one year 33 per cent of the sample suffered at least one such incident/accident or near miss. The distribution of the numbers of incidents reported by each respondent is given in Table 1 (reproduced below)."

Table 1 Frequency of accidents or near misses in last year / Number of incidents

1 – 24.7
2 – 20.0
3 – 16.7
4 – 3.3
5 – 5.3
6 – 5.3
7 – 0.7
8 or more – 19.3
No response – 4.7

In all, 150 responses were analysed, with 84% being reported as near-misses and 16% as accidents. It looks pretty bad, and in fact that authors assumed it was worse than it looked: *"It is quite probable that the situation is even worse than the figures above suggest as it is unlikely that the respondents were able to recall all such incidents which had occurred during the last year."*

A few things caught my eye.

Firstly, the survey asked participants to respond to a loaded question. It's likely that riders who DIDN'T have an incident wouldn't respond. You'll note that there is no record of any motorcyclists who reported zero incidents. Whilst the sample isn't big (just 150 motorcyclists), it does seem just a little unlikely that not one single rider had no crashes and zero near-misses. If every single respondent had at least one incident, that would explain the results, but the results are almost certainly skewed by a lack of reporting from riders who didn't experience a crash or near-miss. I'm surprised that the zero data point is not recorded, all the same.

Secondly, only around 60% of the incidents reported occurred at junctions. The remainder involved overtaking collisions and rear-end shunts.

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Thirdly, all those riders reporting eight or more incidents are lumped together. This gives a very strange shape to the frequency curve – a lot of riders having few incidents, then very few riders having four to seven incidents, then another large group having eight or more. To me, this seems an unlikely distribution. I would have expected the opposite – a 'bell-shaped' curve with relatively few riders at either extreme having either zero/few or many incidents, and the majority in the middle.

The authors didn't seem to be concerned about this, but I'm doubtful that we can draw any valid conclusions from the near-miss reporting. It's easy to tell the difference between a crash and no crash, but how near is a near-miss?

This is, of course, a highly-subjective question. At what point does a driver's decision to pull out in front of a motorcycle change from a being 'well-judged manoeuvre' to what the motorcyclist perceives as a 'near-miss'?

If you asked me, I'd class a near-miss as an incident where I had needed to brake hard or swerve to avoid a collision. Having spent many years in London as a motorcyclist and more lately a driver, I am used to heavy traffic, and tolerant of instances where drivers turn across the path of my vehicles even when I had right-of-way, even where the margin for error is limited. If you think about it, even if the margin for error was limited, it MUST have been adequate. If it had been inadequate, the manoeuvre could not have been completed without a collision, or at least some evasive action on my part.

For a motorcyclist less-experienced in heavy traffic (or one perhaps tolerant of what they see as 'impatient drivers'), it's easy to see how a driver accepting an 'adequate but limited' gap and the resultant proximity of the turning vehicle, could be perceived as a threat, even when the manoeuvre is successfully completed. From there, it's no great leap to see how the motorcyclist could interpret this as either 'careless' or even a deliberate decision to put the motorcyclist at risk, even though that was neither the intent nor the belief of the driver. But does any of this lend any credence to Wulf et al's belief that the less-threatening nature of a collision with PTW means that drivers are likely to ignore the consequences of a collision with one?

Although we have to be careful assuming that laboratory studies accurately reflect real-life events, the evidence from at least one research study actually points the other way. Crundall et al (2012) tested three groups – 25 novice car drivers (mean age 20.6 years and a mean experience level of 1.6 years), 25 experienced car drivers (mean age 33.4 years / mean experience level of 14.8 years) and 24 'dual drivers' with significant experience with both cars and motorcycles (mean age of 44.9 years / mean experience level of 25.7 years with cars and 20.0 years with a motorcycle). The study showed the subjects a number of videos which include ten scenarios with conflicting motorcycles, ten with conflicting cars, and ten with no conflicting vehicles. Another 42 clips were randomly interspersed. The study tracked response times reflecting when the participants thought it was safe to pull out were recorded, and the participants' eye movements.

Although the results indicated that 'dual drivers' were more aware of approaching motorcycles and less likely to violate their right of way, Crundall et al also reported that *"the most immediate finding from the analyses was the greater caution given to conflicting motorcycles than to conflicting cars. Both the percentage of safe responses and the [reaction times] reflect a greater safety margin in responding to motorcycles…"* In other words, rather than taking greater risks, all drivers were more careful around motorcycles than when approaching other cars.

Let's have another look at that "33 per cent of the sample suffered at least one such incident/accident or near miss" figure. It means that 67% of the respondents had ZERO incidents that were worth recalling. And what about those riders who reported incidents – how many miles did they manage to cover without incident?

The fact is that whilst ROWV incidents stick in our minds, the non-incidents vastly outnumber the collisions or even genuine near-misses. I don't know of anyone who has calculated the ratio, but my guess is that it's in the ratio of tens of thousands to one. Do I have any evidence for that claim? The early TRRL study also looked at what they termed 'gap acceptance' by sending a motorcycle around a large roundabout behind a car: *"An experimental motorcycle was introduced into the traffic flow and a study made of responses to controlled gaps which were presented… The 250-cc motorcycle followed a lead car, which was necessary to stop vehicles at the junctions and to enable the following motorcyclist to control the presented gap. The speed of the car and motorcycle was approximately 25 mile/h. Gaps between 1.5 and 5.0 seconds were used in the trials… In total 1,854 passes were recorded."*

What they found was that from a total of 1,854 opportunities, there were a total of 352 acceptances and 922 rejections with NOT ONE SINGLE ROWV during the study. (My emphasis.) What was interesting was that their analsis of the data showed: "*…that the use of fluorescent clothing or a dipped headlight on the experimental motorcycle had no significant effect on the sizes of gaps accepted. The absence of any detectable changes in the gap acceptance behaviour of the motorists joining the traffic stream suggests that if the motorcycle is perceived at the junction when [typo for 'then'?] the use of high visibility aids has no effect on this behaviour."*

I think there is a typo in that sentence, but the implication is that having seen the motorcycle, the conspicuity aids did not affect the driver's subsequent decision-making in terms of accepting a tighter or wider gap.

Unfortunately, although rating none of the gap acceptances as a ROWV, the TRRL study doesn't show which time gaps were accepted and which weren't. The more recent study by Sager et al (2014) looked at motorcycle positioning and how that affected drivers' decision-making. Working from the junction geometry and estimating the likely acceleration by the driver, they calculated that: "*…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."*

These figures have to be treated with some care, as roads clearly vary in width and a safe gap will also vary with speed, but it's a useful starting point, particularly as it seems to fit well with the work already mentioned by Ouellet on his 'lane positioning hypothesis' where he concluded that the 'at risk' zone for motorcyclists begins when they are approximately three seconds from the junction.

From what I can find in the research, in the UK at least, my belief is that collisions resulting from deliberate driver decisions to turn into an unsafe gap are far outnumbered by the perceptual errors that create 'looked but failed to see' problem.

Of course, when confronted with a ROWV that results in a genuine near-miss that requires emergency braking or swerve - and potentially a crash - the shock to the motorcyclist is significant and I'd suggest we are hyper-sensitive to 'near-misses'. That being the case, it's likely that as motorcyclists we are far more likely to recall these incidents, whilst at the same time forgetting just how many times the 'driver looked, saw and did not turn'.

'Looked Saw & Forgot': Crucial new understanding, 'Micro-memory

SMARTER Editor's Note: Kevin wrote the following material in two posts, one when he first discovered this research but he only had a report of the research and not access to the actual paper. He was later able to access the published research and "fleshed out" his original writing. SMARTER has edited and combined his writing on this topic.

The authors of a paper entitled: *"The 'Saw but Forgot' error: A role for short-term memory failures in understanding junction crashes?"* have proposed a mechanism by which some motorcycle collisions which are current classified as 'looked but failed to see' crashes are actually the result of a memory issue. The motorcycle is actually seen and brought to conscious attention, but is then somehow forgotten again in what I suggested might be termed a 'micro-memory lapse'(Robbins, et el, 2019). Access the research report at: https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0222905

In computer terms, this is 'FIFO' memory - first in, first out - and the buffer size is small.

What this means from a practical point of view is that in an environment where there are few vehicles, and assuming that the bike is seen in the first place, drivers (and other bikers incidentally) WILL remember the PTW as they plan their manoeuvre, factoring in the motorcycle. But in a crowded environment, where there are many things to keep track of, there is a risk that a motorcycle, although it HAS been seen, is then forgotten as other vehicles and maybe cycles and pedestrians catch the driver's attention. With many vehicles to keep track of, there is a risk that the motorcycle's presence slips from this short term 'micro-memory' as it's filled with newer data.

The authors believe that the majority of LBFTS errors on real roads may have been misclassified, and thinks that they actually occur due to a memory deficit in the way our short-term memory works and that drivers often forget vehicles - particularly motorbikes - that they saw seconds earlier.

The authors start by mentioning conventional explanation. The first is the 'looked but failed to see' phenomenon: *"Typical interpretations of these junction crashes are based on the idea that the driver pulling out of the junction has failed to devote sufficient attention to the traffic on the road he or she is entering, thus, they are often termed 'Look but Fail to See' (LBFTS). It is proposed that the crash is caused by failing to spot an oncoming vehicle. This is consistent with the psychological phenomena of change blindness and inattentional blindness, with explanations suggesting that even when attention is on an object it is not always associated with the detection and processing of this object.*

If you're read any of my work on understanding junction collisions, you'll know I've always been doubtful of the basic premise that the driver "has failed to devote sufficient attention to the traffic" because collisions are actually rare events. As the paper itself explains a moment earlier, this "corresponds to approximately 90 deaths in the UK per annum". If that sounds shocking, put it in context with between one and two million active motorcyclists, travelling several billion miles each year and meeting around 40 million drivers at junctions. Clearly, drivers DO pay sufficient attention on nearly every single occasion, or we bikers wouldn't get much further than the end of our own road. Bear this in mind as you read on.

The authors then mention what I have called the 'looked, saw, and misjudged' error: *"Other previous research has suggested that motorcycle accident risk is inflated due to the size-arrival effect, which suggests that smaller objects are perceived as further away, and to arrive later than larger objects. Due to this perceptual error, drivers may adopt a smaller gap at the junction when a motorcycle is approaching compared to a larger vehicle such as a car or large goods vehicle. Data from both real and experimental simulations have found that crashes do occur when a car pulls into the path of an oncoming motorcycle, with the car driver thinking the motorcycle is further away than it actually is.*

There is of course a third reason for junction collisions which wasn't considered - the 'looked but could not see' issue where the motorcycle simply isn't where the driver can see it, however hard he or she looks. That appears to account for around one-fifth of all junction collisions.

The authors commenced a series of studies. And here's something very important. *"Our study immerses the driver in a realistic driving scenario."* Many of the old studies into driver perception of motorcycles were based on still photos, short video clips, or contrived on-road trials. Using a realistic driving task allows the environment to be manipulated whilst still maintaining realism for the subject. The studies involved what is known as 'gap acceptance' to examine whether drivers were willing to complete a manoeuvre in front of approaching vehicles, and used eye tracking to determine whether drivers had fixated on vehicles before subsequently failing to recall them.

So, what did the paper find? They report that: *"The most striking finding from the first study was...the complete failure to report some vehicles, particularly approaching motorcycles."*

So, the authors propose a fourth mechanism, which we might call 'looked, saw and forgot'.

Essentially, they explain that we use short-term memory for *"the encoding, temporary storage and retrieval of information for complex cognitive tasks"*, including building an awareness of the traffic situation around us. What they suggest is that a driver's ability to create a correct awareness of what's around them "depends not only on [the information] being successfully encoded, but also on the storage of this information and its retrieval from short-term memory, and that the so-called 'looked but failed to see' incidents: *"...might not always be due to a failure in visual attention (encoding), which many previous researchers have suggested, but could sometimes be due to subsequent failures in memory."*

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 behaviour."*

The implication of that is that the current recommendations to look HARDER and LONGER for motorcycles is likely to be ineffective. The authors also noted: *"One of the biggest challenges in this research was that such memory errors were rare - the majority of participants never made any memory errors at all."*

Once again, that's absolutely in line with my contention that drivers DO pay sufficient attention to see approaching motorcycles on nearly every single occasion where it matters. They conceded that: *"Although we cannot say for certain that fixated vehicles have been processed, these findings do suggest that drivers' fixation durations on these motorcycles were sufficiently long for them to be fully processed on other occasions... Previous theories regarding attention and awareness have suggested that awareness will occur when a sufficient amount of attention is allocated to an object, therefore a longer fixation, from which we are inferring more attention, would increase the likelihood that the object will be consciously perceived. If this were the case, it would have been expected that more frequent and longer fixations would be associated with reported, as opposed to unreported objects. We do not find significant evidence for this, with no large differences in the number of, or length of fixations on reported and unreported vehicles."*

That's more or less in line with my thinking that 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 the information.

What might cause that failure?

If you've sat in on one of my Science Of Being Seen presentations or visited the #SOBS website, (or are reading this document complied by SMARTER) you probably know that I talk about the problem of 'workload' and discuss the limitations of the human brain when there is a lot of information to be processed. The authors noticed that: *"...when drivers failed to report a motorcycle, they had made more head movements and waited longer before pulling out after the initial fixation than on occasions where they reported it."*

In their discussion of their results, they state: *"While the explanation of a failure in visual attention may account for at least some report failures,* ***we must also consider the possibility***

that some of these errors may occur due to a failure in visual working memory. *For the current findings, this explanation is particularly compelling as the results suggest that it is drivers' subsequent behaviour which predicts their ability to report vehicles. For this interpretation, information held in visual working memory may be subject to interference by subsequent visual information. Head movements in this situation will provide a LARGE QUANTITY OF NEW VISUAL INFORMATION TO PROCESS AND RETAIN, and there is limited reason to believe that subsequent visual behaviour after fixating on the vehicle would predict earlier attentional errors."* **[my capitals]**

And they also flagged up previous research which has investigated drivers' memory by testing 'working memory load' by changing the number of visible vehicles from three and eight vehicles: ***"It was found that the percentage of vehicles recalled decreased with increases in memory load, with drivers on average, recalling five vehicles when there were eight vehicles present."***

So, to help understand looked but failed to see errors, the authors have created an entirely *"new model of dynamic risky decision making in which the role of short-term memory is emphasised. The model, the Perceive, Retain, Choose (PRC) model, expands on those previously used to provide a much more explicit series of cognitive processing steps that may be involved in the decision to pull out at a junction or make other risky dynamic decisions."*

"It is worth noting here that a common pattern of head movements in our studies involves a head movement towards a motorcyclist, then one to a car coming from the other direction, and a final one on the road ahead before pulling out. This raises the possibility that information from the second or third head movement has overwritten the initial contents of visuospatial memory, and that these were no longer available at the time a decision to pull out was made."

The authors conclude*: "Our results suggest that some junction crashes in which a driver reports being careful and attentive in their visual checks but nonetheless pulls out in front of an oncoming motorcycle, could be misclassified. While previous researchers suggest that this crash is associated with a failure in drivers' visual search for motorcycles - 'Look But Fail To See', the current results highlight the possibility that at least some of these crashes could occur due to a memory deficit - a 'Saw but Forgot' error."*

Final point from me

Final point from me. This “looked but forgot” paper would seem to fill in a crucial hole in our understanding of junction collisions. It explains just how the problems that I had previously highlighted as 'workload issues' could be the result of these 'micro-memory lapses', which thereby cause the breakdown of the seemingly 'simple' task of "looking for a motorcycle".

Although the paper went on to give the suggestion that drivers should ‘see bike, SAY “BIKE” ‘to engage a different pathway in the brain to prevent these memory issues, my own conclusion (once again) is that it is just another reason why motorcyclists should assume first and foremost that they have not been seen, and be ready to take evasive action. The authors suggested a simple psychological technique - saying "bike" out loud when they see one - could help drivers retain the memory of the motorcycle whilst manoeuvering at junctions.

We bikers absolutely have to stop thinking that "drivers don't look properly" or "didn't look hard enough" but to accept that there are limitations to the ability of a careful driver to spot us coming. And those limitations will result in errors.

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