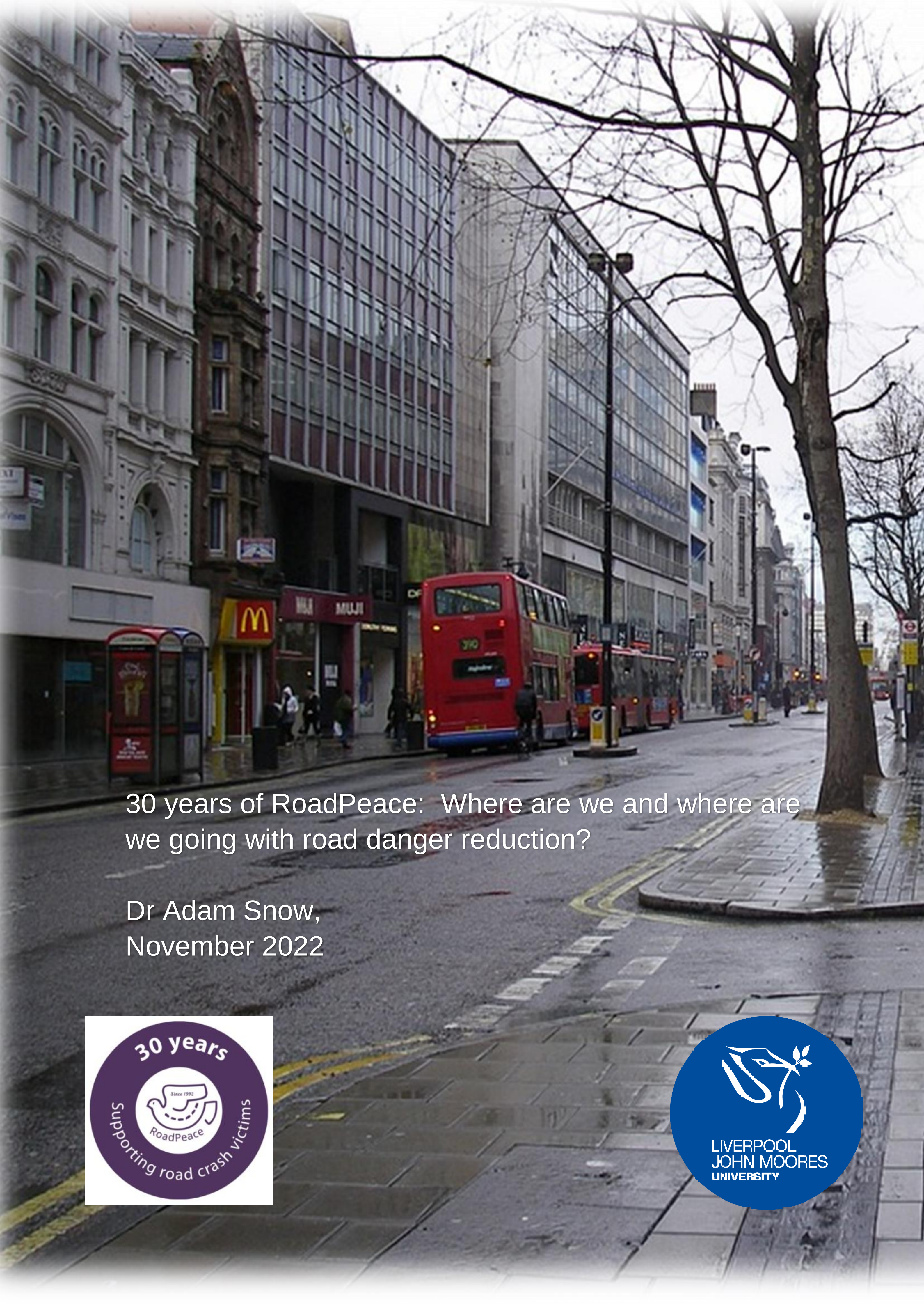

30 years of RoadPeace: Where are we and where are we going with road danger reduction?

Dr Adam Snow,
November 2022

30 years
Since 1992
RoadPeace
Supporting road crash victims

LIVERPOOL
JOHN MOORES
UNIVERSITY

RoadPeace is the national charity for road crash victims in the UK. We provide information and support services to people bereaved or seriously injured in road crashes and engage in evidence based policy and campaigning work to fight for justice for victims and reduce road danger.

Founded in 1992 by Brigitte Chaudhry MBE (MBE awarded in 2003 for her pioneering work for road crash victims), a bereaved mother whose son was killed by a red light offender, we are a membership organisation whose work is informed by the needs and experiences of road crash victims. RoadPeace is governed by a board of trustees, has a small staff team and a network of active members and volunteers.

Our vision is for a world where road danger is not tolerated and where road crash victims receive justice and compassion.

"RoadPeace has helped me so much. I'm glad there's a place to go when you feel so isolated and alone." – Bereaved Daughter

RoadPeace

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30 Years of RoadPeace – Where are we and where are we going with road danger reduction?

Dr Adam Snow

November 2022

About the author

Dr Adam Snow is a senior lecturer in law at Liverpool John Moores University where he has worked since 2017, prior to this he was a lecturer in criminology at Liverpool Hope University and completed his PhD from Keele Univeristy in 2015 on the subject of out of court disposals, including road traffic fixed penalty notices. His research specialises in road policing, road risk reduction and the criminal law. He is a member of the Roads Police Academic Network (RPAN).

Acknowledgements

I would like to thank RoadPeace for commissioning this research and in particular Chair of RoadPeace Trustees Petra Kendall-Raynor and RoadPeace CEO Nick Simmons for their support and guidance during this project.

I would also like to thank Professor Danny Dorling who came up with the genesis of this idea, and Dr Majida Ismael for her help in sifting the volumes of academic research.

This report is dedicated to the tireless work that RoadPeace has done in the last 30 years supporting those who have lost, or had family who have suffered serious injury, sons, daughters, parents, siblings, uncles, aunties, nieces, nephews, grandparents, wives, husbands, partners, friends and colleagues. Most of all this report is dedicated to the memory of the **81,315** people in Great Britain who have died since the foundation year of RoadPeace 30 years ago.

And finally this work is also dedicated to Joseph Berry, my step-son and our beloved Joe. An inspirational human being taken far too soon, whose memory inspires me every day.

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Abbreviations

AADT	**Annual Average Daily Traffic**
AV	**Autonomous Vehicle**
DfT	**Department for Transport**
FTE	**Full Time Equivalent**
GDP	**Gross Domestic Product**
HGV	**Heavy Goods Vehicle**
KSI	**Killed and Seriously Injured**
LGV	**Light Goods Vehicle**
NSCP	**National Safety Camera Partnership**
NTS	**National Transport Survey**
OECD	**Organization for Economic Cooperation and Development**
ONS	**Office for National Statistics**
PACTS	**Parliamentary Advisory Council for Transport Safety**
PCSO	**Police Community Support Officer**
RTC	**Road Traffic Collision**

Foreword

Commemorated on the 3rd Sunday of November each year, 20th November 2022 is the World Day of Remembrance for Road Traffic Victims – now a high-profile global event begun by road victims in 1995 and adopted by the United Nations in 2005 - to remember the many millions of people killed and seriously injured on the world's roads and to acknowledge the suffering of all affected victims, families and communities - millions added each year to countless millions already suffering, a truly tremendous cumulative toll.

As the initiator and passionate advocate of this day, it has been wonderful for me to witness the spread of World Day commemorations throughout the world and to know that we victims are linked with each other in remembering our loved ones and in raising awareness of the terrible consequences of crashes, so that they may be reduced and eventually eliminated.

This year is also the 30th anniversary of the foundation of RoadPeace, the first charity for road victims in the UK, which I felt compelled to set up after my son was killed by a red light violator - because no organisation existed and because the official response to road deaths and injuries was offensively trivial and inappropriate to a loss of life or quality of life.

To commemorate this year's World Day of Remembrance and the 30th anniversary of RoadPeace, Dr Adam Snow of Liverpool John Moores University has been asked to compile a report highlighting the dangers on our roads and the resulting numbers of people killed and injured during the 30 years since RoadPeace was founded.

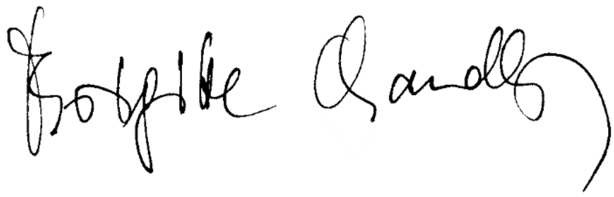
Dr Snow's research found that **81,315** people were killed on British roads between the start of 1992 and the end of 2021, **1,245,833** people have been seriously injured and a further **6 million** have suffered minor injury. This represents over **7 deaths every single day during 30 years.**

If serious injury is included, then every **12 minutes** someone is killed or seriously injured as a result of a road traffic collision.

Road deaths and injuries are sudden, violent, traumatic events, their impact is long-lasting, often permanent. Without this impact being taken into account, the cost to the country of road death and injury amounts to **£11 billion a year** according to Dr Snow's study. This is a permanent huge annual cost since the fatality rates have stayed more or less static at around 1750 from 2012 onwards, after a gradual fall until then from 4229 in 1992.

We are very grateful to Dr Snow for reminding us not only that much campaigning work remains to be done by RoadPeace, but that we have to redouble our efforts, including through examining all causes and all possible actions if we want to see the static road death and injury count reduced to near zero in future years.

Brigitte Chaudrhy MBE



RoadPeace Founder and President

Executive Summary

RoadPeace was founded in 1992 by the vision of Brigitte Chaudhry MBE who had experienced first-hand the devastation a road traffic collision can cause. Determined to represent and support those who have been affected by road crash victims, RoadPeace's vision is for a world where road danger is not tolerated and where road crash victims receive justice and compassion.[1]

Since the foundation of RoadPeace in 1992 there have been 81,315 deaths as a result of a road traffic collision in Great Britain.[2] There have also been 1,245,833 serious injuries caused and over 6 million less serious injuries as a result of road traffic crashes.

The cost of death, serious and slight injury on the road is staggering. In Great Britain since 2010 £132.54 billion is the estimated loss of all road traffic collisions. Each year an average of £11 billion is lost as a result of medical expenditure, loss of output, police costs, insurance and property damage. Each year we spend / loose the equivalent of the whole of the Ministry of Justice spending on road traffic collisions involving injury.

- Each fatal collision in 2021 cost on average £2,340,614
- Each serious collision in 2021 cost on average £252,894
- Each slight collision in 2021 cost on average £85,317

There will of course be wide variation in these figures, particularly in the category serious collision depending on the level of injury. This financial cost should in no way be taken as an attempt to put a monetary value on human tragedy. None of these costs are justified and they can be reduced by focusing on driver behaviour.

The issue with figures of this magnitude is that humans are not good at interpreting them.[3] We become inured to the scale of the issue; 81,315 deaths represents just under 7.5 deaths every single day since 1992 because of an RTC. If we include serious injuries, that represents nearly 114 serious injuries per day[4]. That scale of death and serious injury is

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[1] https://www.roadpeace.org/about-roadpeace/
[2] This is a significant improvement on the 30 years before the foundation of RoadPeace, in which 193,530 had died
[3] Hasak, L & Toomarian, E. 2022 *Brains are bad at big numbers…* reterived from https://theconversation.com/brains-are-bad-at-big-numbers-making-it-impossible-to-grasp-what-a-million-covid-19-deaths-really-means-179081 accessed on 10/11/22
[4] Given the uncertainty over serious injuries in the data this may well be an underestimate.

hard to fathom, but the stark reality is that families, friends and communities have to deal with each of these incidents on a daily basis.

In a fatal road traffic collision a wife, husband, child, sibling, parent, grandparent, partner or friend is having to negotiate the post-crash world of loss, grief, inquests, police investigations, court appearances, sentencing hearings, legal action, dealing with all of the administrative matters that are inevitable when someone dies. Having to relive the moment and its build up multiple times as the police, family liaison officers, coroners' officers, lawyers, insurance companies, family, friends and colleagues ask questions about the collision and the deceased, which adds to the trauma experienced.

In serious injury collisions, the injured party and their family, friends and colleagues are likewise engaged in a process of grief for who the injured party was (and what their life was like) and who the injured party is now. Years of trauma, medical intervention, an inability to continue with ones favourite activities is again incredibly traumatic.

All of these consequences are experienced 121[5] times a day by different people. It is heart breaking and shaming that we seemingly accept this level of trauma and horror with a shrug until such time as it unexpectedly lands at our door. Drivers are the main cause of this and we need to do better. The loss of one person is sometimes described as having a ripple effect, in that the grief and trauma ripples outwards causing more and more disturbance across a person's social network. What these figures demonstrate is not so much a ripple as a colossal wave, a tsunami of grief, regret and horror devouring our society.

If we expand our vision to the global stage, over 1.3 million people die annually as a result of a road traffic collision and millions more suffer severe and debilitating injury. Each loss of life on the road is a tragedy and for the overwhelming majority of fatalities, entirely preventable. The motor car has brought freedom to billions around the globe, it has revolutionised our communities changing us from discrete social groups to much larger communities through travel and the ease of movement of goods and people. With that freedom has come the dark side – a world of pain and misery wrought by poor driving, lax attitudes to safety and, sadly, a general indifferent attitude to the problem from most who have yet to be affected.

The title of this project is - 30 years of RoadPeace: Where are we and where are we going with road danger reduction? In the early phases of the research 'road danger reduction' was referred to as 'road safety', however after a discussion between the CEO of RoadPeace and

[5] Killed and seriously injured

the author it was felt that we needed to address the question of "safety on the roads" as a concept. The ultimate question we asked ourselves was can we really ever have safe roads? Certainly, there has been good progress in the UK and internationally, towards making the roads *safer*, however the idea that they can be made *safe* is far more problematic.

Heavy and fast-moving vehicles will always carry risk regardless of improvements in the design and technology of the vehicles and road infrastructure. Thus, to talk of *safe* roads is something of an oxymoron. We should all strive for *safer* roads but be under no illusion that the roads can never be safe.

A series of policy aspirations and strategies are coalescing, nationally and internationally, that are addressing the safety of our roads. Vision Zero has, as its aim, the complete reduction of death and serious injury on the road, its vision is to reframe the debate about road "safety" to recognise that death is preventable, human failures whilst problematic cannot always be eradicated, that saving lives on the road is not expensive and that a whole systems approach is needed[6]. With plans for active travel, emissions reduction and carbon net zero we are at a unique time to reflect on road transport and the impact it has on our health, wellbeing and environment.

The road to Vision Zero is, unfortunately, a long one at present. As this report set out zero road death days are few and far between, just 43 days have been zero road death days out of the 1,826 days between 2017 and 2021. In other words, a zero road death day happens once every 42 days. Nevertheless, we should have hope since the majority of road traffic collisions are due to human factors, we can make sustained reductions in death and serious injury through a focus on the human element and increase the number of zero days.

For Vision Zero to work there needs to be a sustained commitment to road risk reduction. Unfortunately, over the last decade that commitment has appeared lacking with an underinvestment in policing that can help deliver the vision. The period between 2004 and 2010 in GB represents the best reduction in road death and serious injury of any period since the foundation of RoadPeace. The major reason for that reduction is the growth of the speed camera and the policy of the then government to fund adequately enforcement against speeding. Since 2010 and the adoption of austerity that hit government spending,

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[6] See https://visionzeronetwork.org/

including policing, the position has plateaued, there have still been reductions (although it is expected that this year, 2022, may see an actual increase in the number of deaths).[7]

The plateauing of death and serious injury since 2010 may be explicable from the reduction in dedicated road traffic policing. Since 1996 there has been a 13% reduction in the number of officers available. In the 2010s period of austerity following the ending of the central government funding of speed cameras, dedicated traffic police officers have reduced by nearly 25%. Since 2007 there has been a 40% reduction in dedicated police traffic officers.

There has been an increase in the number of civilian staff dedicated to traffic but not enough to compensate the loss in dedicated traffic police officers.

- Since 2013 police traffic civilian staff have increased by 287, whereas police officers have decreased by 601.
- Road traffic policing accounts for 2.9% of all police officer functions.

Risk on the Road

This report examines risk on the road, what the levels of risk are – as far as such a thing can be measured - and what factors determine our levels of risk. The aim of the report is to examine what has happened with road casualty risk in Great Britain since the foundation of RoadPeace. The findings do not make comfortable reading; far too many die and are seriously injured each year. Nevertheless, there have been some promising developments both nationally and internationally.

In the OECD (Organization for Economic Cooperation and Development) group of members between the years 2000 and 2019 there has been an average reduction of 54% in the number of road deaths per 100,000 population. That equates to nearly 58,000 people who are alive today who otherwise would have perished in a road traffic collision had nothing changed between those years. Of the 38 members of the OECD none increased their death rate over this period.

As we focus in on the shorter-term history the picture becomes less rosy. In the five years between 2015 and 2019 there was a 16% reduction per 100,000 head of population, however, seven states reported higher death rates per 100,000 population than in 2015.

The two key factors that determine risk on the road are driver behaviour and the capacity of the police to enforce road traffic legislation. Poor driver behaviour accounts for 73% of all

[7] This is anecdotal evidence at present from discussions the author has had with road danger reduction professionals and independent of the reductions seen as a result of covid lockdowns in 2020 and 2021.

road traffic collisions. The so-called fatal four (distracted driving, speeding, drink/drug driving and failure to wear a seatbelt) are the leading causes of road fatalities and serious injury. Nearly a third of all fatalities are caused by a car occupant not wearing a seatbelt.

As regards speeding there is reason to believe that this number is underestimated. A review by the Metropolitan Police in 2022 found that speeding, as a contributory cause of collisions, was underestimated by a factor of between 2 and 3.[8]

Despite increasing traffic levels, risk on the road has reduced, but only for certain forms of transport. For professional drivers, those driving an LGV or an HGV, the risk has increased, and hence they expose themselves to a greater level of risk than a professional driver would have nearly three decades ago (based on the number of fatal and serious injury RTCs and the distance travelled each year by this mode of transport).

- An LGV driver exposes themselves to risk 182km before a similar driver in 1994
- A HGV driver exposes themselves to risk 314km before a similar driver in 1994

For pedestrians, if we take the latest statistics that statistics are available (2020) then people aged over 18 can now walk longer before being exposed to the same level of risk as someone walking in 2005, an increase of 21km. However, this was during the Covid19 pandemic in which there was increased pedestrian footfall and a quite large decrease in road traffic volume due to lockdowns. If the 2019 figures are used there has been a smaller increase since 2005 (11km further) but the 2019 fgure represents a decrease in distance when compared to a 2015 pedestrian (-3.5km). Unfortunately it is not possible, at present, to determine the level risk change for those aged under 18 due to the methodology used in this report. What can be said is that since the foundation of RoadPeace 616 child pedestrians under the age of 18 have been killed, 79,001 have been seriously injured (unadjusted) and 302,046 slightly injured (unadjusted).

Those travelling by car, bicycle or motorbike can now go further before being exposed to the same level of risk as those in 1992. Between the period 1994 to 2021

- A cyclist can now travel 36km further before being exposed to the same level of risk.
- A motorcyclist can now travel an extra 4km (whilst a small figure this still represents a 50% increase in distance)
- A car driver can now travel an extra 98km

[8] The Times, 15th May 2022, Speeding causes three times as many road deaths as previously thought retriever from https://www.thetimes.co.uk/article/speeding-causes-three-times-as-many-road-deaths-as-previously-thought- accessed on 10/11/22

This is a positive step and holds out hope for Vision Zero that we can make the roads a safer environment.

As regards road type; A-roads continue to be the riskiest road to travel on with the exception of HGVs. For all forms of motor vehicle transport the motorway is the safest road, offering over double the distance in km travelled to the riskiest road.[9] The evidence for smart motorways is that they are safer than a traditional motorway in terms of hundred vehicle miles travelled[10], however there is a clear public perception that they are unsafe and evidence suggests that drivers ignore the variable speed limits, thus increasing risk.

Themes from the academic literature

Risk on the road is not static; our levels of risk alter dependent on the complex interplay of our behaviour, attitudes, education, parental nurturing / monitoring and many other factors.

Age is the key factor in road risk. Young drivers are far more likely to have a collision and to engage in behaviours that make driving a risk to themselves and others. Being a young male is associated with speeding, drink driving, not wearing a seatbelt and fatigued driving. The only other risk factor that is associated with all four of these behaviours is a sensation-seeking attitude.

Young drivers also 'inherit' driving behaviours from their parents. For some that will result in positive safer driving styles – for those that appreciate risk and develop a habitual cautious attitude to driving. For others, more negative behaviours are learned. If parents are aggressive drivers or there is a distant relationship with the child, this can manifest in riskier driving behaviours. However, it is not just parents where young drivers learn negative driving traits, peer pressure is also a significant indicator of poor driving. This may be reflected in a general attitude of risk acceptance as the price to pay for doing something fun or it may be that presence of a peer in the vehicle with a young driver has a risk magnifying effect.

Parents do have a role in young driver education beyond the formal "learning"[11] stage. They can provide positive instruction / role model for safer driving and also provide control by limiting, or putting conditions on, use of a vehicle.

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[9] With the exception of HGV's where A roads are the riskiest form.

[10] National Highways. 2022. *National Smart Motorways Stocktake* retrieved from https://nationalhighways.co.uk/media/uivj2zem/smart-motorways-stocktake-second-year-2022.pdf accessed 10/11/22

[11] Learning is in inverted commas here to reflect the fact that passing one's driving test is not the end of learning to drive – it may be the end of formal instruction but learning to drive is a continuous lifelong process.

As regards older drivers,[12] age related decline, visual degeneration, medical conditions and failing to yield at junctions have been found to be the leading causes of crashes. On the positive side, however, older drivers perceptions of risk are higher leading to a more cautious driving style. The presence of passengers in older drivers' vehicles have also been found to increase risk, particularly if the passenger is a younger male (16-24).

The evidence on passengers in general is mixed and dependent on the attitudes of the passenger. Passengers can lift the mental demand on drivers by engaging in hazard spotting.[13] Passengers can also provide a soothing and calming presence that dampens down the desire to take risk or exhibit risky driving behaviours. Children in a parental vehicle, or travelling with other loved ones, can provide this calming effect as the desire to protect outweighs the desire for a rush / fun.

Regardless of the age of the driver, almost all drivers believe they are better than the average driver. This optimism bias effects young, middle aged and older drivers equally, it does not lessen with experience or age. The effect of optimism is that it aggravates risk, particularly in those who are considered to be the most optimistic. Even those who believe themselves to be cautious drivers can suffer from over optimistic assumptions about the level of risk they pose, or the situation poses, and thus at a greater risk of collision than would otherwise be the case. Tackling optimism is a key challenge for those wanting to address attitudes towards risk on the road.

International studies of driving and driver attitudes suggest a consensus on beliefs about the causes of road traffic collisions and the risks that certain behaviour poses. Nevertheless, most drivers, despite appreciating the risk, continue to engage in behaviours they know to increase their risk of a serious road traffic collision.

As regards the future development of risk, and the risk profile of the road transport system, autonomous vehicles (AV) and electric vehicles (such as E-scooters, E-Bikes and Electric cars) present new challenges. We are still at the very early stages of autonomous vehicles, with full autonomous driving a long way off. Risk and safety are likely to be key factors in the decision to purchase / use an AV. It is not clear yet that full autonomy is wanted by the driving public.

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[12] There is no clear definition in the literature of what constitutes an older driver – some use 65+, others 60+ and others 70+

[13] This is one of the reasons why it will be necessary to ban hands-free use of a mobile phone whilst driving but not conversations in the vehicle.[13] The passenger can act as an extra set of eyes that are not present with hands-free conversations

What effect widespread deployment of AVs will have on risk / casualty reduction is an open question. In GB, the Law Commission has recently reported on the legal framework for regulating AVs, which suggests some far reaching changes to the current “driver as responsible for risk” approach. Furthermore, the Law Commission does not see regulations as removing risk from the roads but does recommend a positive risk balance from AVs.

As regards e-scooters, the signs are worrying in relation to injury for both riders and pedestrians. The desire for e-scooters and the ease they provide for short journeys suggest that they are here to stay as a transport mode – the effect they will have on casualty figures is still unclear. If the e-scooter represents a modal shift away from other more riskier forms of driving then its negative effect may be negligible. However, if they represent a modal shift away from walking then it is likely the casualty figures increase.

Electric vehicles, regardless of type, can also pose increased danger due to the silent running of the vehicle and the increased acceleration capacity offered by an electric motor. The evidence for safety of e-vehicle counterparts is still in its nascent stage, undoubtedly there are extra risks posed to pedestrians, however for riders / drivers the evidence suggests (at present) that the level of risk is the same[14].

Conclusions

Whatever the mode of transport and whoever the driver there will always be risk on the roads. Driver / rider behaviours and attitudes are the leading cause of road traffic collisions and thus they are something we can all do something about. This report makes sobering reading as regards the risk of this everyday activity. We have become somewhat inured to the extent of death and serious injury on the road until such time as it lands at our door. It is time to have a renewed focus on grasping the problem. It will not be easy and will involve behavioural change, however it can be done providing the will exists. The period of the national safety camera partnerships and central government focus on road danger reduction from 2004 to 2010 demonstrate things can be done (regardless of its political acceptability amongst hostile driver groups).

This is the first part of a larger study looking at the impact of RTCs. This part examines the risk of the road. The ongoing second part of this study will focus on individuals navigating the post-crash system. It will examine the experiences of those who have lost loved ones, or had loved ones seriously injured, on the road. In particular, it will examine the role of the justice system and how it affects those caught up in it. The experience of investigations

[14] See pg. 82 below

(both police and coroners), prosecutions, sentencing and expectations of justice will be examined. However, this report focuses on the risk to everyone on the road and hopefully will lead to a debate about how best to achieve Vision Zero.

1.Introduction

Risk on the road is an ever-changing dynamic, what is a terrifying risk for one might be an enjoyable pastime for another. This report subjects road danger to a risk analysis. Using publicly available statistics it analyses multiple factors involved in determining ones risk on the road, whether as a driver / rider, passenger or pedestrian.

Globally 1.3 million people die as a result of a road traffic collision (hereafter RTC) and such injuries are the leading cause of death amongst those aged 5-29 years old.[15] In addition to the human misery and trauma that such a colossal loss of life causes the financial implications are also high, costing an average of 3% of GDP for most countries.[16]

[15] WHO. 2022. Road Traffic Injuries. Retrieved from https://www.who.int/news-room/fact-sheets/detail/road-traffic-injuries accessed on 01/11/22
[16] ibid

In the United Kingdom progress has been made over recent years to stem the flow of slaughter on our roads. The focus on speeding between the years 2004-2010 will go down as the greatest period for reduction in road death and serious injury since statistics began. However since 2011 progress has stalled, with only small reductions in road casualties that have left the UK lagging behind the leading countries in the OECD.

RoadPeace was established in 1992 after founding member Brigitte Chaudhry MBE worked tirelessly to fight the injustice of the legal system that, at the time, seemed to have a rather casual attitude to road tragedy. RoadPeace's mission was to represent the interests of those killed and seriously injured on the road, to provide support to those who lost loved ones or who were living with the consequences of RTC serious injury and to campaign for road danger reduction.

Since the foundation of RoadPeace there has been something of a transformation in official attitudes to road collisions. Road danger reduction is now a high policy agenda item globally, regionally and nationally. International collaboration through activities such as Project EDWARD (Every Day Without A Road Death), organisations such as FEVR[17] and policy aims such as Vision Zero, as well as national and international policy maker, campaigner academic collaboration have road danger reduction as a key priority for humanity.

This report analyses the statistics on road risk in the OECD (Organisation for Economic Cooperation and Development)[18] and Great Britain to determine various categories of risk based on a multitude of factors. The next chapter begins by analysing road death in the OECD since 2000 and then moves on to consider the position in Great Britain since the foundation of RoadPeace in 1992. Various statistics are produced that seek to convey the risks involved in road transport to drivers / riders, passengers and pedestrians. It will be seen that risk of fatal injury because of an RTC in GB is reducing, although that reduction has plateaued since 2011. It will be seen that across all modes of transport the number miles travelled has increased but the risk of being involved in a fatality or serious injury has decreased. In others words people can now drive, walk, ride or be conveyed for further distances before their risk increases. However, behind this seemingly rosy picture of success lies the immense scale of the challenge remaining. In 2021 nearly 5 people were

[17] https://fevr.org

[18] The OECD is a cooperative international organisation that aims to increase effective decision making by using evidence based policy and solutions to a range of economic, social and environmental challenges. It is made up of 38 member states from North, Central and South America, Europe, Asia and Australasia. At present there are no African states although there is an African Partnership with various African States (Egypt, Morocco, Tunisia and South Africa) see https://www.oecd.org

killed per day on GB roads. As discussed below actual zero road death days (the key idea behind Project Edward and Vision Zero) are sadly rare, with some days even contributing 14 fatal road traffic collisions in a period of 24 hours.[19]

Internationally, as Chapter 2 discusses, some states have slipped backwards quite significantly in combating road death. Most notably the Central American states of Mexico and Costa Rica have seen increases in road deaths during the period 2000-2019, whereas the trend across the whole OECD is a 46% decrease.

As regards GB, since the foundation of RoadPeace there have been 81,315 deaths caused by road traffic collisions. The Department for Transport produce statistics each year on the number of people killed, seriously injured and slightly injured as a result of a road traffic collision. Since 1992 there have been 7,357,315 road traffic collisions leading to injury. This is likely to be an underestimation of the extent of the problem mostly in the minor injury category as the statistics depend upon police presence at the collision for it to be recorded.

The human cost of this is immeasurable; the financial cost however is possible to measure. Chapter 2 examines the financial cost of each road traffic collision by severity and in total. As shall be seen, £11.35 billion is the financial cost of road traffic collisions in GB, roughly 2% of GDP in 2021[20].

Risk and road danger is not equally distributed; age, gender, mode of transport, type of road, traffic volume, attitudes, behaviour and many other variables increase or decrease ones risk. In Chapter 3, the relevant academic literature on road danger and risk is reviewed. Starting with a discussion of risk as a social theory it then examines whether in car and on road improvements are capable of improving actual road risk. After rejecting the pessimistic view of risk as homeostatic Chapter 3 then proceeds to survey the leading risk factors that alter an individual's risk on the road. The discussion examines age, risk taking, intergenerational risk, cross cultural / international risk, and the attitudes and behaviours of drivers. It ends with a discussion of automated vehicles and the likely impact they will have on experienced risk and attitudes to risk on the road.

A note on terminology

Throughout the report the term "road traffic collision" is used, not "road traffic accident". RoadPeace has campaigned tirelessly for a change in nomenclature as regards road danger

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[19] See pg. 17
[20] ONS. 2021. Gross Domestic Product at market prices: Current price: Seasonally adjusted £m. retrieved from https://www.ons.gov.uk/economy/grossdomesticproductgdp/timeseries/ybha/ukea accessed 01/11/22

reduction. *Accident* 'suggests something unintentional and beyond control'[21], whereas words such as collision or crash make no assumptions about the cause of the incident, they are factual statements. Thankfully official statements and statistics by the UK government now adopt collision rather than accident. However, there is still some way to go, for example, the Crown Prosecution Service in its Road Traffic – Charging legal guidance mandate that 'collision not accident' is used in all communications at court, in correspondence and meetings.[22] Although rather unhelpfully they use the term accident interchangeably throughout most of the rest of guidance. The Road Traffic Act 1988 is not helpful either in this regard as it uses "accident" rather than collision.

[21] RoadPeace . n.d. *Briefing Sheet: It's a crash not an accident. Ending the Language of Denial* Retreived from https://www.roadpeace.org/wp-content/uploads/2022/02/RP_Crash_not_Accident_Briefing_Sheet.pdf accessed on 1/11/22
[22] CPS. 2022. Road Traffic – Charging. Legal Guidance. Retreived from https://www.cps.gov.uk/legal-guidance/road-traffic-charging accessed 1/11/22

2. Road Risk

Introduction

In this chapter statistics produced by the OECD, Department for Transport (DfT) and Home Office are analysed across a range of factors that affect road risk. The methodological approach is detailed in the next section followed by a preliminary discussion of the international situation on road death.

Following discussion of the international dimension, the report then focuses on the situation in Great Britain. Unfortunately, due to the different reporting mechanisms of the various statistical releases it has not been possible to include Northern Ireland in the analysis at this time. The GB section examines various policy / risk factors that affect road danger including the mode of transport (car, motorbike, HGV, LGV, cycling and walking), traffic volume, road type and road behaviours. In addition, the provision of road policing and associated costs of road traffic collisions are examined.

The section on mode of transport, traffic volume and road type calculates micromort (hereafter µmort) of these factors. A µmort, as explained below, is a calculation that presents risk based on a 1 in a million chance of death (traditionally), although in what follows the 1 in a million chance of serious injury is also reported (hereafter $\mu mort_{seriousinjury}$).

A note on methodology

Throughout the report, the main sources of data for the statistics below are as follows:

- OECD Estimated Road Deaths Per 100k population and the OECD population (mid-year) statistics.
- Department for Transport
  - GB Reported Road Casualties data series (1979-2021)
  - GB Reported Road Accidents data series (1979-2021)
  - GB Road Traffic Estimates data series 1992- Present
  - British National Transport Survey
- Home Office
  - Police Workforce England and Wales[23] - Police Officer Functions as at 31st March in relevant year
- Department for Transport and Vehicle Licensing Agency – Licensed Vehicles at end of quarter March

There are caveats with each source of data and the main ones relevant for the analysis are noted in the relevant sections below.

Serious / Slight Injury Definition methods

The Department for Transport produce statistics each year on the number of people killed, serious injured and slightly injured because of a road traffic collision. Since 1992 there have been 7,357,315 road traffic collisions leading to injury. This is likely to be an underestimation of the extent of the problem mostly in the minor injury category as the statistics depend upon police presence at the collision for it to be recorded. Furthermore, reporting practices that distinguish between serious injury and slight injury had a major review in 2015, meaning that reported figures for both categories are not directly comparable with previous years. Police forces had adopted varying practices for recording injury and generally operated on a subjective approach to assessment. The development of CRASH (Collision Recording and Sharing system) for police forces to standardise the data was rolled

[23] Unfortunately Police Scotland do not break down office function in their statistical releases

out nationally in 2015 and early 2016[24], although the process of adoption has taken much longer with West Yorkshire and Greater Manchester Police (GMP) being the last adopting forces, in 2021.[25,26] CRASH has a list of specific injuries / conditions that determine whether an injury is "slight" or "serious" rather than relying on subjective assessments of police officers at the scene.[27]

The ONS, in 2018, developed a methodology for converting previous serious / slight injuries into the new adjusted format.[28] The DfT has begun the process of adjusting casualty rates and now reports two sets of statistics for slight and serious: adjusted and non-adjusted. Non- adjusted figures tended to under report serious injury. The mean underreport difference between the serious adjusted and unadjusted statistics between 2004 -2015 was 11,427 serious casualties.

Pedestrians

Assessing pedestrian traffic is more difficult and thus has its own dedicated section since the statistics on distance travelled are not directly comparable to those used for the other modes of transport. Pedestrian distance travelled is calculated using the National Transport Survey (hereafter NTS) as this mode of transport is not included in the road traffic estimates issued by the DfT annually. Furthermore, as the NTS is a survey, respondents are aged 18 and over, yet RTC fatalities occur at all ages. Thus, analysis of RTC fatalities in this section are limited to those fatalities where the person was aged 18 and over.

The international picture - OECD Road Traffic Collisions

Before we examine the picture in Great Britain, it is important to get an international perspective on road risk. The international picture is more difficult to assess given the differences in law, regulation, culture and statistical collection between the various states. However, the OECD do maintain a record of road risk data across its organisational members. In this section, the data from the OECD on road traffic collisions per 100,000 population is used to compare performance across the OECD. The data relies on estimated road deaths per 100,000[29] and presents the figure with upper and lower confidence intervals.

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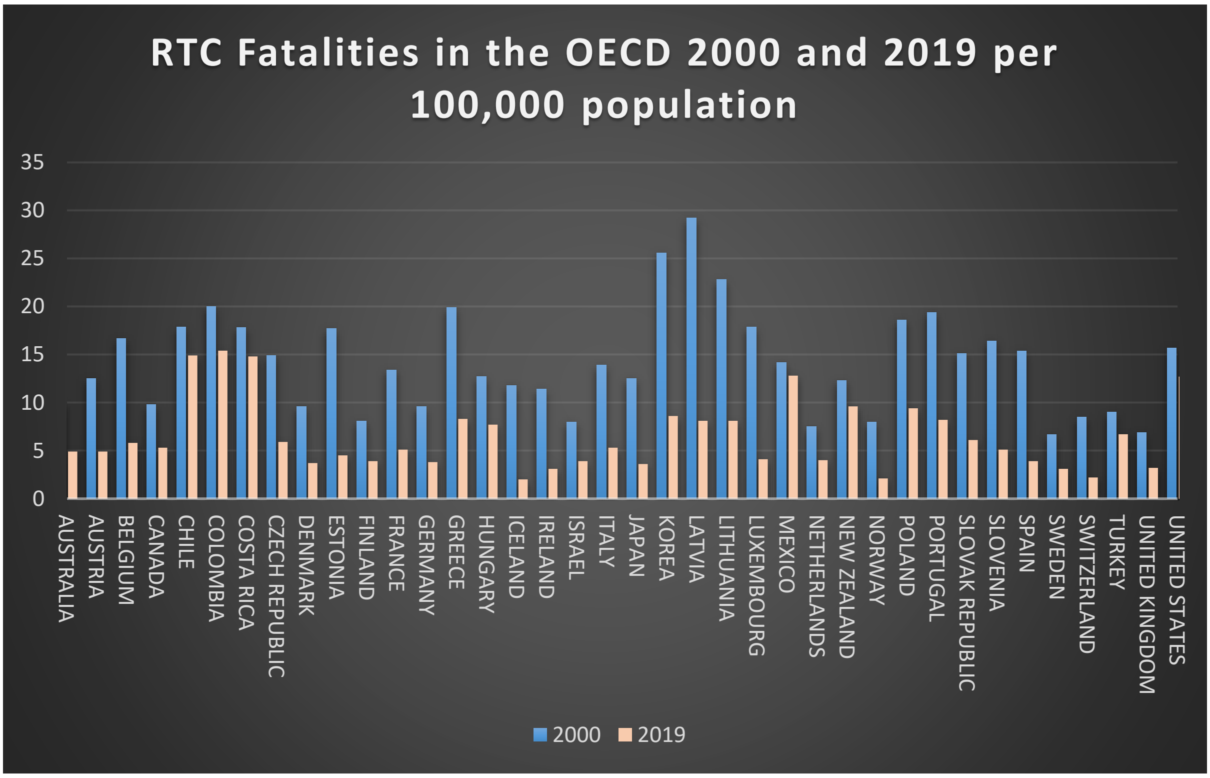
[24] Dft. 2021. *Guide to severity adjustments for reported road casualties Great Britain* London, UK
[25] Ibid
[26] Athough the Metropolitan Police use COPA (Case Overview Preparation Application) instead of Crash, a similar system.
[27] Ibid
[28] ONS. 2018. *Estimating and adjusting for changes in the method of severity reporting for road accidents and casualty data: final report.* London, UK
[29] They are estimated due to inherent uncertainty surround population statistics

For example, the UK's RTC death rate per 100,000 population in 2019[30] was 3.2 persons per 100,000 head of population, with upper and lower confidence intervals of 3 and 3.4. In the analysis that follows the headline figure is used, not the upper and lower confidence intervals.

The data for 2019 is presented in Figure 1 below

Figure 1 RTC Fatalities per 100,000 population OECD Members 2019-2020



Over the period 2000-2019 there was a mean reduction of 54% in the number of RTC road deaths per 100,000 head of population across the OECD. The standard deviation was 19.5% with the largest decrease (83%) in Iceland (from 11.8 deaths per 100,000 to 2 per 100,000 in 2019) and the smallest decrease in Mexico (10%) (from 14.2 deaths per 100,000 in 2000 to 12.8 in 2019). None of the countries in the OECD exhibited a growth in road deaths over this period. In the UK there was a reduction of 54% in deaths from road traffic collisions, from 6.9 deaths per 100,000 to 3.2 in 2019.

If we look at the last 10 years then the picture is less promising with a mean reduction of 21.6% across the OECD and a standard deviation of 16%. The largest reduction was seen in Norway of 52% (from 4.4 per 100,000 in 2000 to 2.1 in 2019). Five countries exhibited a

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[30] The latest date for which data was available at the time of writing.

growth in road deaths – New Zealand (+3%) from 9.3 to 9.6, Sweden (+3.3%) from 3 to 3.1, Costa Rica (+5.7%) 14 to 14.8, the United States (+8.5%) 11.7 to 12.7 and Chile (+19.2%) from 12.5 to 14.9.

Finally, if we look at the five-year period (2015-2019) seven OECD nations are on an upwards trajectory for road traffic collision deaths per 100,000 population. The mean average for all OECD nations is an 11% reduction, if those whose rates increased during this period are excluded, then the mean average decrease is a 16% reduction in RTC deaths per 100,000 population. The best performing OECD nation over the five-year period was Iceland with a reduction of 58% (from 4.8 to 2) and the worst performing nation was New Zealand an increase of 25% (from 7.7 to 9.6). The UK's performance over this period was a 10% increase on the number of fatal RTC's per 100,000 population, from 2.9 to 3.2.

In Table 1 the top 5 and bottom 5 performing nations[31] in 2000 across the OECD are listed. In Table 2 the top 5 and bottom 5 nations in 2019 are reported.

Table 1 OECD top and bottom 5 performing states in RTC fatalities in 2000 per 100,000 population

Position	Country	2000 RTC Fatalities per 100,000	Estimated Deaths (based on population estimates)
1	Sweden	6.7	479
2	United Kingdom	6.9	4063
3	Netherlands	7.5	1194
4	Israel	8	503
5	Norway	8	359
34	Greece	19.9	2150
35	Columbia	20	8059
36	Lithuania	22.8	611
37	Korea	25.6	12,034
38	Latvia	29.2	691

These statistics are based on estimated of population size across the OECD

Table 2 OECD top and bottom 5 performing states in 2019 in RTC fatalities per 100,000 population

[31] Those with the highest and lowest per 100,000 population RTC fatality rate

Position	Country	2019 RTC Fatalities per 100,000	Estimated Deaths (based on population estimates)	Total Fatality change since 2000
1	Iceland	2	153	-26
2	Norway	2.1	112	-247
3	Switzerland	2.2	189	-422
4	Sweden	3.1	319	-276
5	Ireland	3.1	153	-279
6	**United Kingdom**	**3.2**	**2137**[32]	**-1,926**
34	United States	12.7	41,698	-2,602
35	Mexico	12.8	16,202	+2,174
36	Costa Rica	14.8	749	+59
37	Chile	14.9	2847	+101
38	Columbia	15.4	7758	-301

It is welcome that even in the poorest performing countries of the OECD the fatality rate is significantly lower than the 2000 figures.

Over the period 2000-2019, assuming no change in the comparative RTC fatality rates there are a total 57,932 people who are alive that otherwise would not have been had road risk stayed the same[33], from approximately 211,843 road deaths in the OECD in 2000 to 153,910 in 2019. There were four nations where the number of deaths increased, New Zealand (+4), Mexico (+2174), Chile (+101) and Costa Rica (+59).

If we examine the 10 most populous nations in the OECD then collectively they account for 82% of all road deaths in the OECD. Over the period 2000-2019 there was an average decrease of 36% across these countries (with only Mexico having more fatalities in 2019 than in 2000). The most improved states, in terms of total RTC fatalities (weighted by population size) were Iceland (58% reduction with 26 fewer deaths), Luxembourg (77% reduction and 53 fewer deaths), Spain (a 75% reduction and 4,408 fewer deaths) and

[32] The actual figure for the UK in 2019 was 1,808. The reason for the difference indicates the inherent uncertainty in relying on estimated population size. Even using the OECD lower confidence interval of 3 deaths per 100,000 population this would suggest a death statistic of 2,004.
[33] In Chapter 3 there is a discussion of risk homeostasis theory which posits that risk does not change it adapts. It is safe to say that this is not born out by the OECD figures.

Estonia (75% reduction and 188 fewer deaths). The UK was the 24th most improved nation with 1,926 lives saved.

Table 3 reports the 2019 population size (and rank compared to all other OECD members where 1 is the largest and 38 is the smallest), and the 2019 RTC fatalities (and rank against OECD members, where 1 is the largest number of fatalities and 38 is the smallest OECD members).

Table 3 OECD Members ranked by RTC Fatalities and Population Size 2019

State	2019 Population	2019 Population rank	2019 RTC Fatalities per 100,000	2019 RTC rank	Rank Difference (Pop rank minus RTC rank)
AUSTRALIA	25,365,745	14	4.9	23	9
AUSTRIA	8,877,637	24	4.9	22	-2
BELGIUM	11,462,023	17	5.8	17	0
CANADA	37,601,230	13	5.3	19	6
CHILE	19,107,216	15	14.9	2	-13
COLOMBIA	50,374,478	10	15.4	1	-9
COSTA RICA	5,058,007	30	14.8	3	-27
CZECH REPUBLIC	10,669,324	19	5.9	16	-3
DENMARK	5,814,461	26	3.7	31	5

State	2019 Population	2019 Population rank	2019 RTC Fatalities per 100,000	2019 RTC rank	Rank Difference (Pop rank minus RTC rank)
ESTONIA	1,326,855	36	4.5	24	-12
FINLAND	5,521,605	27	3.9	29	2
FRANCE	67,356,050	6	5.1	21	15
GERMANY	83,092,958	4	3.8	30	26
GREECE	10,721,584	18	8.3	9	-9
HUNGARY	9,771,142	22	7.7	13	-9
ICELAND	360,558	38	2	38	0
IRELAND	4,921,496	32	3.1	35	3
ISRAEL	9,054,026	23	3.9	28	5
ITALY	59,729,077	8	5.3	18	10
JAPAN	126,166,948	3	3.6	32	29
KOREA	51,764,822	9	8.6	8	-1
LATVIA	1,913,826	35	8.1	12	-23
LITHUANIA	2,794,135	33	8.1	11	-22
LUXEMBOURG	620,003	37	4.1	25	-12
MEXICO	126,577,691	2	12.8	4	2
NETHERLANDS	17,344,876	16	4	26	10

State	2019 Population	2019 Population rank	2019 RTC Fatalities per 100,000	2019 RTC rank	Rank Difference (Pop rank minus RTC rank)
NEW ZEALAND	4,979,200	31	9.6	6	-25
NORWAY	5,347,893	29	2.1	37	8
POLAND	38,386,476	12	9.4	7	-5
PORTUGAL	10,286,263	20	8.2	10	-10
SLOVAK REPUBLIC	5,454,147	28	6.1	15	-13
SLOVENIA	2,089,310	34	5.1	20	-14
SPAIN	47,105,358	11	3.9	27	16
SWEDEN	10,278,888	21	3.1	34	13
SWITZERLAND	8,575,280	25	2.2	36	11
TURKEY	82,579,448	5	6.7	14	9
UNITED KINGDOM	66,796,807	7	3.2	33	26
UNITED STATES	328,329,953	1	12.7	5	4

Table 3 the green shaded boxes represent states that have outperformed their population size in terms of road deaths per 100,000 population. The data analysis assumes a uniform distribution of RTC fatalities across the OECD dependent on population size. This is not a realistic assumption as states will vary in their desire, ability and willingness to promote and enforce road danger reduction. Furthermore, the accuracy of population estimates as discussed above makes such an analysis inherently uncertain. Nevertheless, it can give an indication of which states are underperforming and over performing as regards fatal RTCs.

Table 3 the UK is the seventh most populous nation but has the 33rd least number of RTC fatalities per 100,000 of population. The UK therefore has an increased performance factor of 26, i.e. it is 26 times better than its population size would suggest. We also see that Japan outperforms its population size the most[34] by a factor of 29, and the UK and Germany close behind on 25-factor improvement. The worst performing nations are Latvia, Costa Rica and New Zealand have the worst factor scores.

Road Risk in Great Britain - The General Picture

Now that we have a picture of road danger across the OECD we can begin to look at the position in Great Britain. Statistics in GB are released annually by the Department for Transport on road risk and break it down into a multitude of factors. In what follows those statistics have been collated and analysed to examine the leading factors of road traffic collisions in Great Britain.

As stated above, since the foundation of RoadPeace there have been 81,315 deaths caused by road traffic collisions. As regards serious and slight (adjusted) injury, there have been 1,245,833 serious injuries and at least 6,030,167 slight injuries since the year of RoadPeace's foundation. The overwhelming majority of these deaths are male (59,838 male fatalities and 21,459 female) and between the ages of 16-40.

To see how these statistics have changed over the years, Figure 2 reports the five-yearly reduction in the relevant category on a rolling basis from 1992 to 2021. As can be seen from Figure 2 the biggest reductions came in the period 2006 – 2011. Since that point there have been reductions however the statistics on those killed have plateaued. The 2017-2021 statistics must be interpreted with some caution since the 2021 figures include a period of national lockdown effecting road traffic casualties[35] and increased numbers of people working from home.[36] In Figure 3 the dates during which the Road Safety Camera

[34] Whether this is as a result of road danger or the fact that Japan has good public transport and very populous cities that are well served by public transport is unknown at present.
[35] Dft, 2021. *The impact of lockdown on reported road casualties Great Britain, final results: 2020*, London UK
[36] ONS. 2022. *Is hybrid working here to stay?* London, UK

Partnerships were first rolled out nationally[37] and the date in which central government funding for speed camera enforcement was ended.[38] Between 2003 and 2010, there was a 47% reduction in RTC fatalities. In the following eight years the reduction was 6%. The area-shaded red on Figure 3 graphically presents the extent of the reductions during the National Safety Camera Partnership period. Figure 3 also suggests that reductions in serious injury and slight injury – although reducing, have also suffered a similar plateau. Research consistently shows that reducing speed reduces collisions and injury (of all severity).[39,40, 41] The statistics presented in Figure 3 certainly support this.

There are three main types of road user that may be killed in an RTC; a driver/rider, a passenger or a pedestrian. The statistics on road deaths attributed to these three categories are in Figure 3. As can be seen across that user types there was a consistent reduction between 2010 and thereafter something of a plateau as regards fatal injury.

In the next section the factors that might help to explain the difference in road risk based on these statistics are analysed.

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[37] This allowed for the hypothecation of speed camera fines to be spent by safety camera partnerships on funding more cameras
[38] House of Commons Library, 2013. *Roads: Speed Cameras* SN350,
[39] Box, E and Bayliss, D (2012) *Speed Limits, A review of evidence*, RAC Foundation, London
[40] Elvik, R., Christensen, P. and Amundsen, A. (2004). *Speed and road accidents. An evaluation of the Power Model*. TØI report, 740, p.2004.
[41] Pilkington, P. and Kinra, S., 2005. Effectiveness of speed cameras in preventing road traffic collisions and related casualties: systematic review. *BMJ*, 330(7487), pp.331-334.

Figure 2 5-year % change in Fatal, Serious (adjusted) and Slight (adjusted) 1992-2021

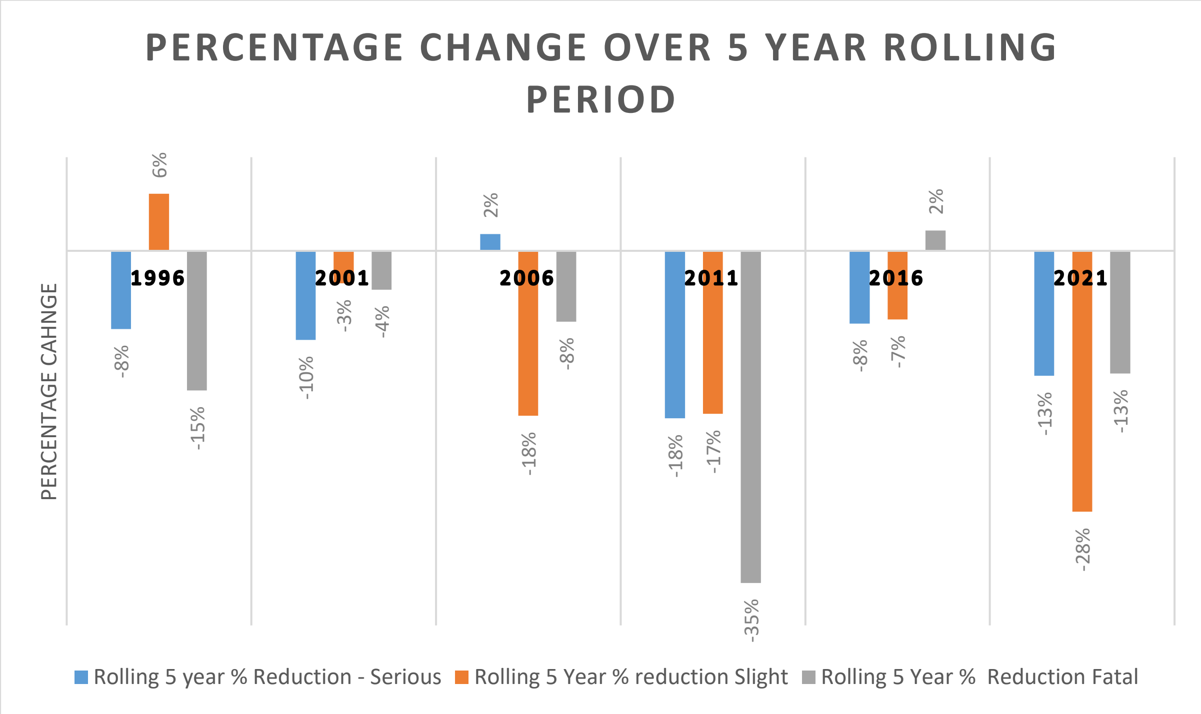
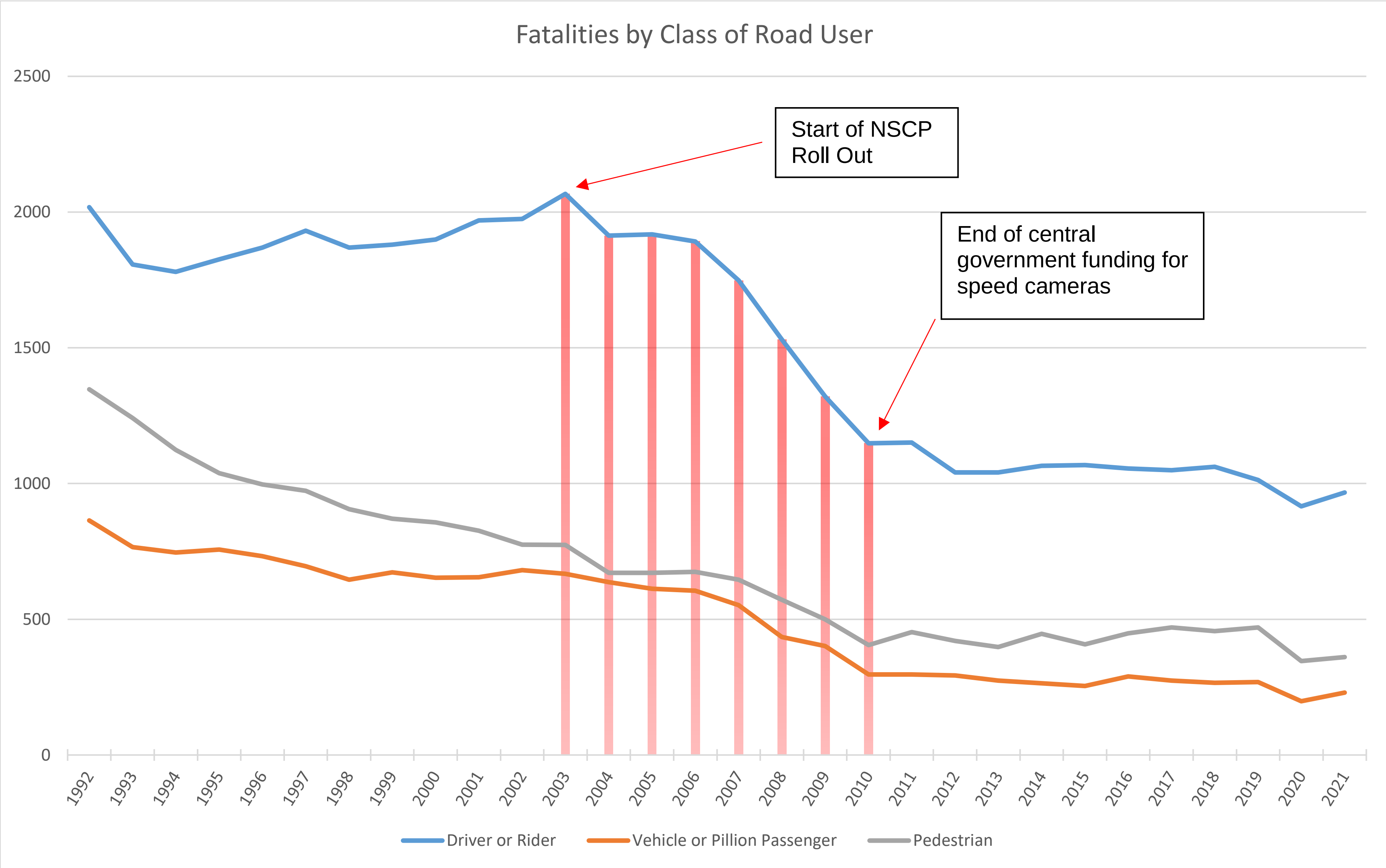


Figure 3 Fatalities by Casualty Class 1992-2021



Zero Road Deaths

A key strategic priority for road risk reduction is Vision Zero. Vision Zero was a policy proposal that started life in Sweden[42] and has been effective in reducing (although not eradicating) death and serious injury on the road.[43]

Vision Zero has, as its aim, the complete reduction of death and serious injury on the road, its vision is to reframe the debate about road "safety" to recognise that death is preventable, human failures whilst problematic cannot always be eradicated, that saving lives on the road is not expensive and that a whole systems approach is needed.[44] In this section the success (or not) of Great Britain towards zero road deaths is discussed.

In what follows, the statistics on road traffic collisions (vehicles) GB are used since these represent the days in which fatalities were caused (rather than the days in which the fatalities occurred.). Unfortunately, data is not available on the date and time of casualty fatalities. In what follows therefore, the figures are an underestimation of actual death since any one road collision can cause multiple fatalities. In 2021 there were 1,558 fatalities caused by 1,474 road traffic collisions, an average of 1.05 deaths per collision (a figure that is relatively static across the previous 5 years).

Focusing solely on the average death rate however misses the fluctuations that do occur over the years in road fatalities. Table 4 below sets out the number of days on GB roads without a road traffic collision (RTC) causing death.

Table 4 Days without an RTC fatal collision 2017-2021

Year	**Days without RTC causing a Road Death**
2017	9
2018	5
2019	4
2020	13
2021	12
Total	43

[42] Belin, M.Å., Tillgren, P. and Vedung, E., 2012. Vision Zero–a road safety policy innovation. *International journal of injury control and safety promotion*, *19*(2), pp.171-179.
[43] Johansson, R., 2009. Vision Zero–Implementing a policy for traffic safety. *Safety science*, *47*(6), pp.826-831.
[44] See https://visionzeronetwork.org/

The 8th of February has twice been a day without road traffic collision causing a road death (8th Feb 2021 and 8th Feb 2018) otherwise there have been no repeated days in the last 5 years. The longest period between days without a fatal RTC was from 15th June 2018 until 21st May 2019. There were 340 consecutive days of fatal RTCs, totalling 1,639 fatal collisions (an average of nearly 5 fatal RTCs per day). The second longest period was 143 days from 16th July 2021 to 7th December 2021 resulting in 709 fatal collisions (5 fatal collisions per day) and the third longest period was between 18th June 2019 and 6th November 2019 with 140 days with 672 fatal collisions (4.8 fatal collisions per day). It should be remembered that these represent the number of collisions; the actual number of deaths will be higher.

There have been no consecutive days without a fatal RTC over the previous 5 years, although in 2021 there was one period where only 1 day split the zero fatal RTC days – 23rd May 2021 and 25th May 2021, on the 22nd there were two fatal collisions. This is a shocking statistic, although in the context of the amount death on the road it is, sadly, not surprising.

As regards the distribution of zero RTC fatalities across the days of the week, they are as follows.

Table 5 Number of zero fatal collision days by days of the week

Days of the week	**RTC Fatal Incidents 2017-21**	**Number of zero RTC Fatal Incident days 2017-2021**
Monday	1060	9
Tuesday	1002	8
Wednesday	1063	8
Thursday	1080	7
Friday	1160	7
Saturday	1286	2
Sunday	1219	2

Saturday and Sunday are the days least likely to have zero road death day and the most likely to have a road death. Average traffic volume on Saturdays and Sundays are below the average across the week[45] thus more fatal collisions seem to be occurring on the days in which there is less traffic. Potential reasons for this include reduced volume of traffic allows

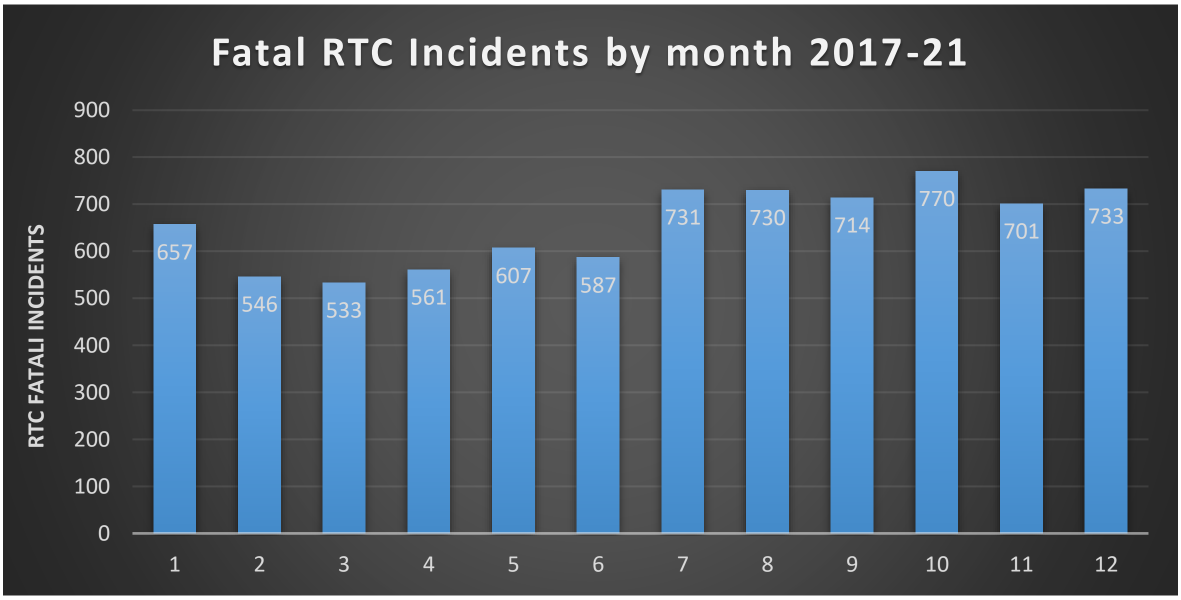
45 DfT. 2022. Average traffic distribution by day of the week, Great Britain 2021

for greater speed (A factor seen during the Covid19 pandemic where excessive speed was an issue in the first lockdown)[46]. Further potential factors include increased recreational pedestrian footfall, increased obstructions on the road from parked vehicles, potential reduced road policing enforcement at the weekend and the type of driver driving at a weekend (a social / fun young driver rather than a commuter / professional). A final factor may be related to medical treatment post-crash and the so called "weekend effect" in hospital treatment[47], although the evidence for that effect is contested.[48] Further analysis is needed to see if the serious and slight injury statistics are the reverse of the fatality statistics for days of the week. That would indicate that the "weekend effect" may have some truth as regards RTCs.

Project EDWARD and zero fatal RTCs

Project Edward is an event that relies on the Vision Zero ethos and is a week-long event in GB that showcases the importance of road danger reduction and new and innovative, as well as traditional, policing as a means of reducing deaths on the road.[49]

Figure 4 Fatal RTC incidents by month 2017-2021



Project Edward has, for the past two years run as a week (working week) long event; prior to

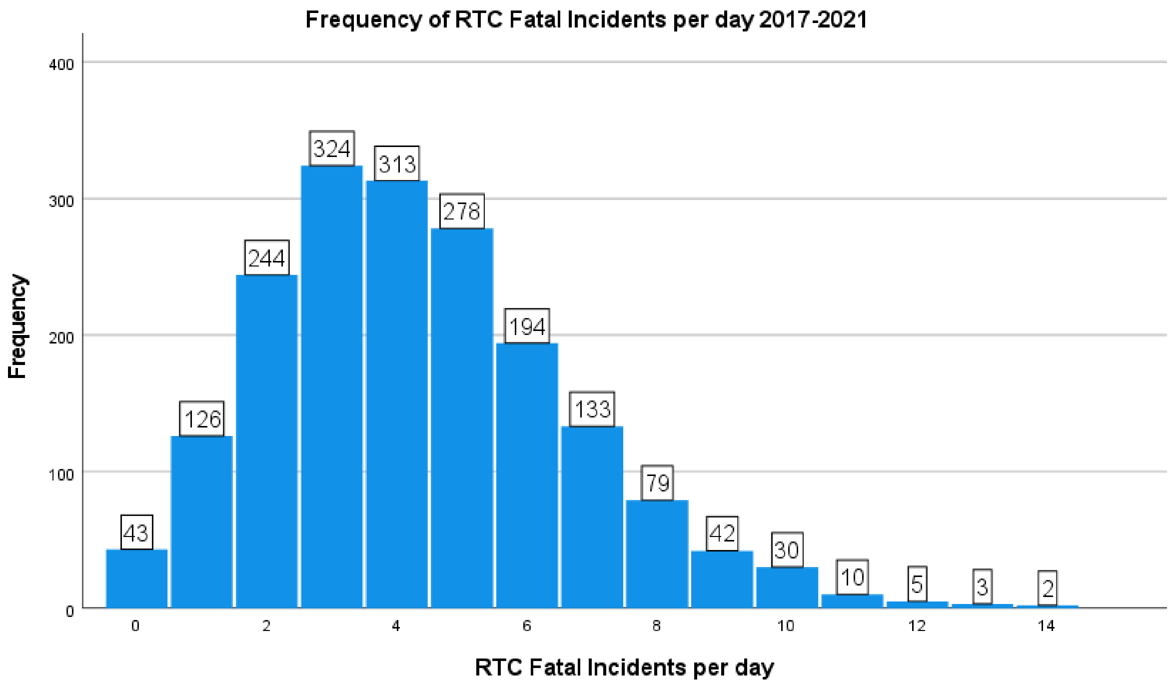
[46] DfT. 2021. Vehicle speed compliance statistics for Great Britain: 2020
[47] Pauls LA, Johnson-Paben R, McGready J, et al. The Weekend Effect in Hospitalized Patients: A Meta-Analysis. *Journal of Hospital Medicine*. 2017 Sep;12(9):760-766. DOI: 10.12788/jhm.2815. PMID: 28914284.
[48] Bion J, Aldridge C, Beet C, Boyal A, Chen YF, Clancy M, *et al.* Increasing specialist intensity at weekends to improve outcomes for patients undergoing emergency hospital admission: the HiSLAC two-phase mixed-methods study. *Health Serv Deliv Res* 2021;9(13)
[49] See https://projectedward.org/

2020 Project Edward was a single day event. Project Edward runs in September (with the exception of this year). September is the month with the 5th most fatal RTCs (714). Unfortunately, there have been no zero fatal collision days during Project EDWARD operations. The number of fatal RTC Collisions are noted in table 2.

Table 6 Project Edward RTC Fatalities

Project Edward Dates	RTC Deaths
13-17th September 2021	24
14 – 18th September 2020	19
26th September 2019	3
19th September 2018	4
19th September 2017	7

Figure 5 Frequency of fatal RTC incidents per day 2017-2021



The average number of RTC fatal collisions per day in 2021 was 4.3, however the average figure masks the variation across the year in the number of RTC fatalities per day. Between 1st January 2017 and 31st December 2021 there were 8347 fatal RTCs over 1826 days, giving an average of 4.6 per day. The actual number of fatal RTCs per day on the road ranged from 0 deaths to 14.

The worst days, in the previous 5 years, have been 7th January 2019 and the 20th September 2020, in which there were 14 fatal RTCs on each day. The frequency table below demonstrates the spread of lives lost during the period 2017-2020.

There were 50 days between 1st January 2017 and 31st December 2021 in which there were 10, or more, fatal RTCs per day and 43 days in which there were zero fatal RTCs. Vision Zero is still a work in progress. In 2017 there were 9 days without a road death, 2018 there were 5, 2019 4 days but in 2020 there were 13 and in 2021, 12 days without a road death. We can only hope that the trend from 2020 and 2021 continues. The signs are promising in that the zero days in 2020 and 2021 occurred throughout the year with 12 zero road death days in lockdown and the other 13 days outside lockdown.

Factors impacting on road risk GB

Many factors impact on road risk, the time of day, the road conditions, the amount of traffic, the driver, the car and many other variables. It is not possible to disentangle the full causes of road mortality or serious injury, although correlations between speed, not wearing ones seatbelt, distracted driving and drink / drug driving and death or serious injury are clear. These factors do influence the risk on our roads, both the risk of being seriously injured or killed in a vehicle and the risk of serious injury or being killed *by* a vehicle. In the sections that follow, the available statistics are analysed to examine the changing risk dynamic when using roads in the Great Britain. It should be noted that statistics for 1992 – the year that RoadPeace was founded - are unfortunately not directly comparable (or even available in some cases). Instead, a decision has been made to use the best reliable statistic for the longest period possible to get a sense of trend.

In what follows, a number of vulnerability factors are analysed for various road user types to examine the risk of traffic volume, mode of transport and distance travelled on road traffic fatalities. The DfT in its Annual Travel Survey[50] does include pedestrian as a mode of transport but this is different data to that used in its traffic estimates and road casualty / accident statistics – for which it does not include pedestrian distances.

Traffic Volume

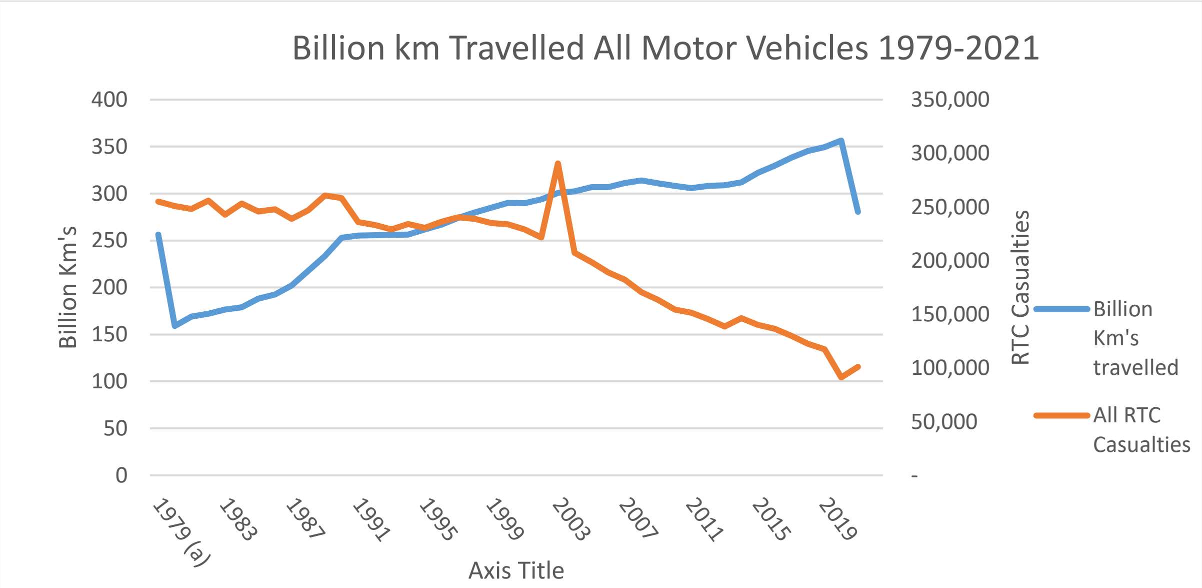
One longitudinal factor affecting road risk and road traffic collisions is the amount of traffic on the road. In Great Britain the DfT produces estimated road traffic statistics, the number of billion vehicle kilometres travelled each year is plotted in Figure 6 alongside the number of

[50] https://www.gov.uk/government/collections/national-travel-survey-statistics

RTC casualties. What is apparent from this chart is just how much safer the roads have become despite increasing traffic, although as shall be discussed below this is only true for certain modes of transport, HGV and LGV drivers have seen their risk increase.

A key concept in the next section is a micromort (or µmort). This was developed by Ronald Howard[51] in 1979 when examining risks from common medical practices and procedures. Howard's insight was that humans are very poor at understanding small (or micro) forms of measurement. Howard gives the example of measuring a rug in miles (0.00170 x 0.00227 miles)[52]. The µmort is a measure equalizing all measurements on a similar scale that has a clearer interpretive meaning. A µmort represents a risk based calculation that equalizes any activity to a 1 in a million chance (of death typically - or whatever metric one is examining). In other words, one can compare completely different activities on a unified scale – that being a 1 in a million chance of death (or other outcome).[53] For our purposes, we can examine how far one has to travel before a fatal road traffic collision occurs by simply dividing the number of fatalities by the distance travelled in a year of all traffic in a similar category. We can then equalise that risk to a 1 in a million chance by multiplying the result by 1,000,000.

Figure 6 Billion kms Travelled and RTC Injuries (Separate Axis)



[51] Howard RA, "Microrisks for Medical Decision Analysis" (1989) 5 International Journal of Technology Assessment in Health Care 357
[52] See FN51 p.360
[53] Howard RA, "Microrisks for Medical Decision Analysis" (1989) 5 International Journal of Technology Assessment in Health Care 357

In 1992, the year that RoadPeace was founded, 256.1 billion kilometres were travelled by motorised vehicles and there were 233,104 RTC casualties. That figure for 2021 was estimated at 280.5 billion kilometres travelled, although it should be pointed out that this is in the period in which traffic was recovering from the Covid19 pandemic and the effect of, for example, increased working from home / hybrid working. Covid19 has had an impact on traffic levels, with the latest estimates suggesting traffic is still down 5.9% on pre-pandemic levels.[54]

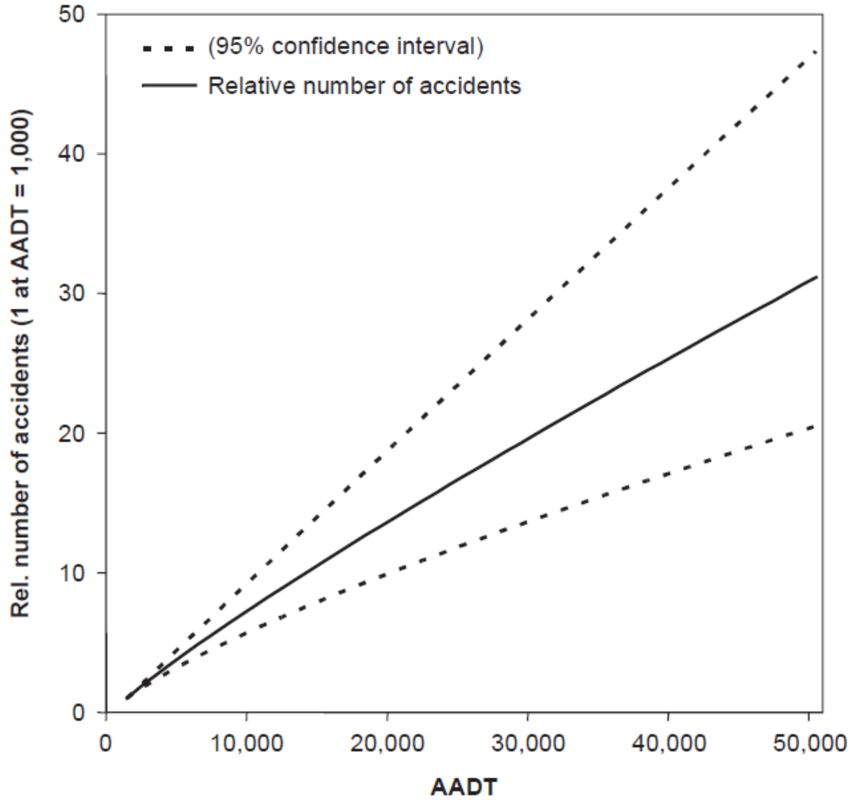
If we look at the figures for 2019 - before the Covid19 pandemic - transport was at 349.5 billion kilometres travelled and there were 101,087 RTC casualties. Thus, there has been a 25% increase in kilometres travelled and yet a 57% decrease in the number of road traffic collision injuries since 1992.

Intuitively it seems logical that with increased traffic come increased collisions, or at the least the capacity for increases. However, Elvik et al[55] point out that relationship is not linear, and that as road traffic volume increases the number of collisions tends to tail off. In Figure 7, reproduced from Elvik et al (2009) the annual average daily traffic (AADT) is plotted against the number of road traffic collisions.

[54] Department for Transport. 2022. *Provisional road traffic estimates Great Britian*, London – retrieved from https://www.gov.uk/government/statistics/provisional-road-traffic-estimates-great-britain-april-2021-to-march-2022/provisional-road-traffic-estimates-great-britain-april-2021-to-march-2022 accessed 28/10/22

[55] Elvik, R., Vaa, T., Hoye, A. and Sorensen, M. eds., 2009. *The handbook of road safety measures*. Emerald Group Publishing.

Figure 7 From Elvik Et al (2009) The relationship between traffic volume (AADT) and the number of road traffic collisions



The dotted lines represent the 95% confidence intervals. At the upper boundary, the relationship is near linear (i.e. for every 10% increase in annual average daily traffic there is a corresponding 10% increase in RTCs) however the lower confidence level indicates that as the volume of traffic increase the number of RTC increase is less. The reasons for the lack of linearity is likely to be related to reduced speed in situations of increased volume, better road danger measures, increased enforcement and increased attention on the road.[56]

It should be noted that Figure 7 is for all collision types. If analysis is limited to fatalities, then average annual daily traffic is not linear. In Great Britain over the last 30 years RTC fatalities occur on days in which road traffic is at its lightest – Saturdays and Sundays. Thus the overall picture on RTCs follows Figure 7, however when the severity of the RTC includes a fatality the relationship is not linear between traffic volume and fatal RTCs.

[56] ibid

Table 7 Distribution of RTC Fatalities across the week

Days of the week	RTC Fatal Incidents 1992-2021	RTC (all severities 1992-2021)	RTC Fatal Incidents 2017-21
Monday	9,753	776,168	1,060
Tuesday	9,509	800,729	1,002
Wednesday	9,826	810,682	1,063
Thursday	10,290	823,055	1,080
Friday	11,928	906,892	1,160
Saturday	12,442	744,551	1,286
Sunday	11,232	600,898	1,219

Potential reasons for this include reduced volume of traffic allows for greater speed (a factor seen during the Covid19 pandemic where excessive speed was an issue in the first lockdown)[57]. Further potential factors include increased recreational pedestrian footfall, increased obstructions on the road from parked vehicles, potential reduced road policing enforcement at the weekend and the type of driver driving at a weekend (a social / fun young driver rather than a commuter / professional). It may also be that at weekend vehicle occupancy tends to be higher as journeys are for pleasure purposes rather than single commuter journeys. A final factor may be related to medical treatment post-crash and the so called "weekend effect" in hospital treatment[58], although the evidence for that effect is contested[59]. Further analysis is needed to see if the serious and slight injury statistics are the reverse of the fatality statistics for days of the week. That would indicate that the "weekend effect" might have some truth as regards RTCs.

Mode of Transport

Not all road users are equally as likely to suffer an RTC related injury. In their meta-review of road transport safety Elvik et al[60] estimate the relative rate of injury for mode of transport, where car occupancy represents 1. They found that across Europe the relative rates were as follows – moped riders – 65.4 times more likely per km travelled to have a collision than a motor car. Motorcyclists were 12 times more likely than a car to have a collision, cyclists 9.4

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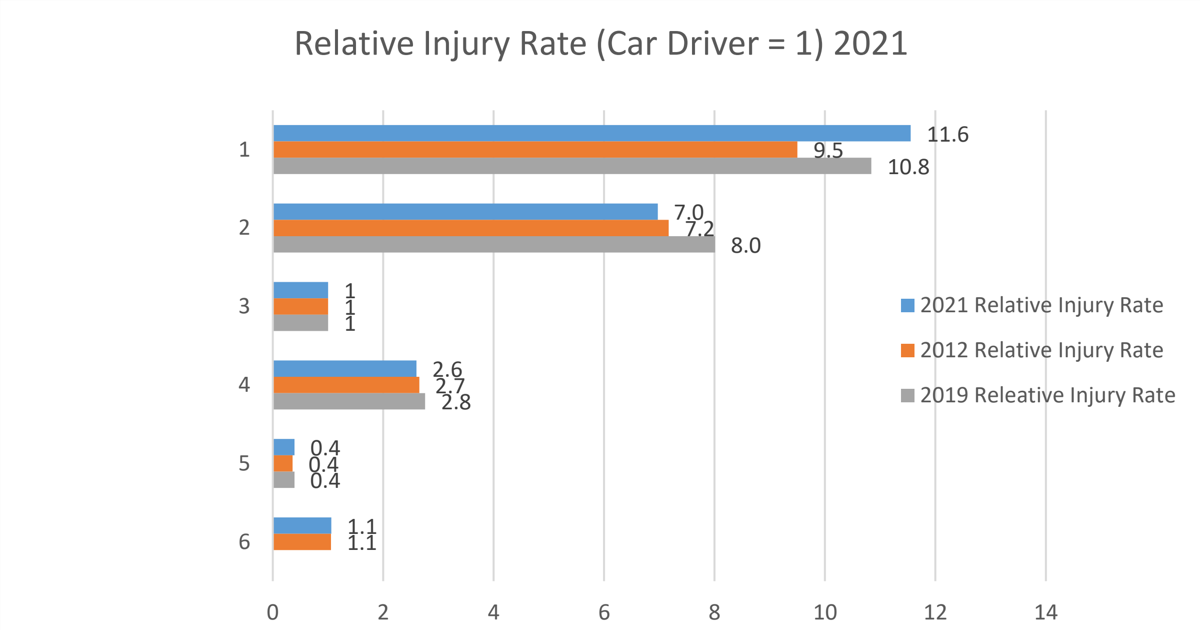
[57] Department for Transport. 2021 Vehicle Speed Compliance Statistics for Great Britain: 2020
[58] Pauls LA, Johnson-Paben R, McGready J, et al. The Weekend Effect in Hospitalized Patients: A Meta-Analysis. Journal of Hospital Medicine. 2017 Sep;12(9):760-766. DOI: 10.12788/jhm.2815. PMID: 28914284.
[59] Bion J, Aldridge C, Beet C, Boyal A, Chen YF, Clancy M, *et al.* Increasing specialist intensity at weekends to improve outcomes for patients undergoing emergency hospital admission: the HiSLAC two-phase mixed-methods study. *Health Serv Deliv Res* 2021;9(13)
[60] See FN 55

times, pedestrians 6.7, and bus passengers 0.5 times more likely. Figure 8 below compares the relative rates of traffic collision injury between 2012 (the earliest date for which statistics are available), 2019 to take into account the potential impact of the Covid19 pandemic in 2020 and 2021, the latest date for which statistics are available.

Figure 8 Relative Injury Rate - where car = 1, Great Britain 2021



It should be noted that figures released by the DfT do not break down the difference between motorcycles and mopeds. As can be seen from the above across the categories motorcycle, cyclist and buses there has been an increase in the relative risk of injury. One possible reason for this is advances in motorcar safety systems which protect the occupants from injury that are absent for cyclists and motorcyclists, a further explanation might be developments in emergency medicine which also impacts on survivability and exposure to serious or slight injury. Nevertheless, travelling by motorcycle remains the most dangerous form of transport.

Risk of casualty and Traffic Volume

Relative injury is a brute way of analysing the difference between the different forms of travel and ones exposure to risk. The micromort (or µmort) provides an easier to interpret comparative analysis unit since all vehicles start at 0 and are not compared to constant vehicle rate (the motor car). We can use the µmort to plot the relative risk of death based on the number of miles one has to travel by various modes of transport before being exposed to a one in a million chance of death (or serious injury, or slight injury). The results of that analysis are in Table 8 below. This shows the µmort for the various forms of travel over 4 periods – the average yearly rate between 1994-98[61,62] and the actual values for 2002, 2012, 2021[63].

Following Table 8 a series of charts (figures 9-12) graphically presents the changing level of μmorts for the various types of road transport.

[61] Depart for Transport, 2010 Review of progress towards the 2010 casualty reduction targets, National Archives
[62] The average rate between 1994-98 is used due to lack of reporting of similar statistics across the period. Reported Road Casualty statistics are available from 2002 onwards and during this period the 1994-98 average was reported and used as a bench mark to assess performance.
[63] At time of writing the latest date for which statistics are available

Table 8 Distances travelled per micromort for modes of transport based on constant risk calculation

	Year	km's travelled before µmort - Killed	Miles travelled before µmort - Killed	km's travelled before µmort - Serious	miles travelled before µmort - Serious	km's travelled before µmort - Injury	Miles travelled before µmort - Injury	km's travelled before µmort - KSI	Miles travelled before µmort µmort KSIs - Miles
Car	1994-8 avg	194.0	120.6	15.7	9.8	1.9	1.2	14.5	9.0
	2002	223.2	138.8	23.0	14.3	2.2	1.4	20.8	12.9
	2012	288.0	179.0	13.8	8.6	2.6	1.6	13.1	8.2
	2021	292.9	182.1	17.0	10.5	3.9	2.4	16.0	10.0
Motorbike	1994-8 avg	8.4	5.1	0.6	0.4	0.2	0.1	0.6	0.4
	2002	8.2	5.1	0.7	0.4	0.2	0.1	0.7	0.4
	2012	12.1	7.5	0.6	0.4	0.3	0.2	0.5	0.3
	2021	12.7	7.8	0.9	0.6	0.3	0.2	0.9	0.5
LGVs	1994-8 avg	633.8	393.8	43.4	26.9	6.4	4.0	40.6	25.2
	2002	781.4	485.7	77.0	47.9	8.8	5.5	70.1	43.6
	2012	402.4	250.0	27.0	16.8	4.8	3.0	25.3	15.7
	2021	451.0	280.4	31.4	19.5	7.1	4.4	29.3	18.2
	1994-8 avg	449.1	279.2	45.2	28.1	8.6	5.4	41.1	25.6

	Year	km's travelled before µmort - Killed	Miles travelled before µmort - Killed	km's travelled before µmort - Serious	miles travelled before µmort - Serious	km's travelled before µmort - Injury	Miles travelled before µmort - Injury	km's travelled before µmort - KSI	Miles travelled before µmort µmort KSIs - Miles
HGVs	2002	449.2	279.4	61.4	38.2	10.7	6.6	54.0	33.6
	2012	93.0	57.6	17.2	10.6	3.6	2.2	14.5	9.0
	2021	135.7	84.5	31.6	19.7	8.4	5.3	25.6	16.0
Pedal Cycles(3)	1994-8 avg	21.5	12.9	1.1	0.7	0.2	0.1	1.1	0.6
	2002	33.8	20.8	1.9	1.2	0.3	0.2	1.8	1.1
	2012	43.9	27.6	1.1	0.7	0.4	0.2	1.1	0.7
	2021	58.1	35.9	1.5	0.9	0.5	0.3	1.5	0.9

By far the riskiest form of transport is the motorcycle, although there have been improvements – one only has to travel 12.7km on a motorcycle to be exposed to a one in a million chance of death, or 0.9km for being killed or seriously injured. The data from table 5 is presented in the figures below which chart the forms of transport and the number of km's travel before one is exposed to a one in a million risk of death.

Figure 9 km's travelled before being exposed to 1 µmort

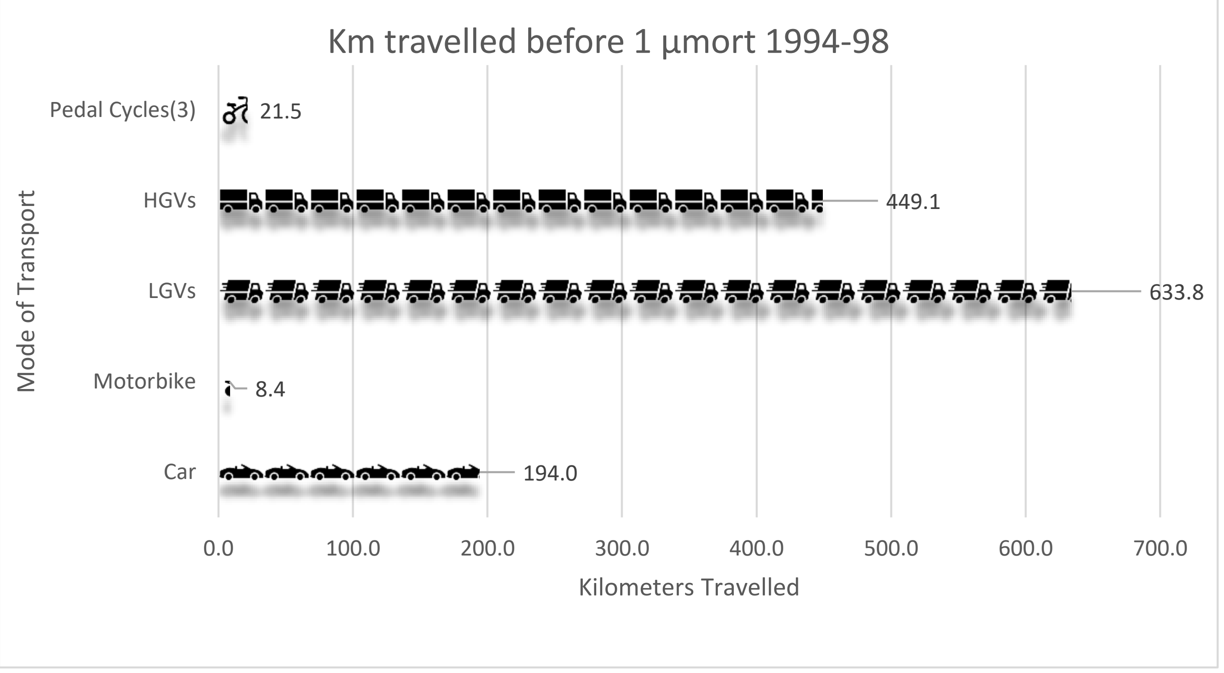


Figure 10 km's travelled before being exposed to 1 µmort

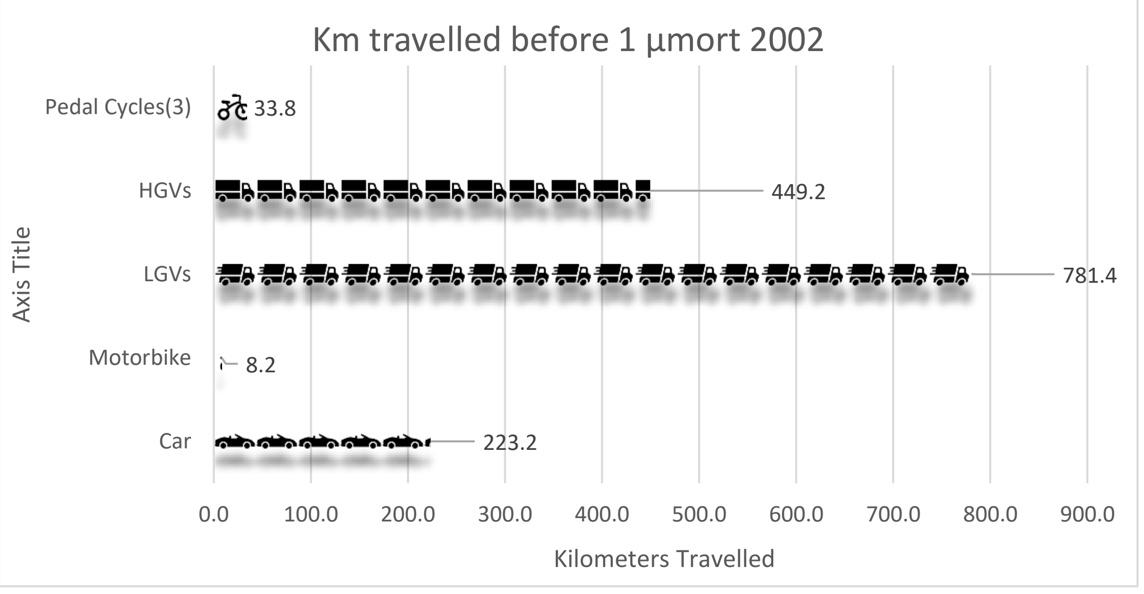


Figure 11 km's travelled before being exposed to 1 µmort

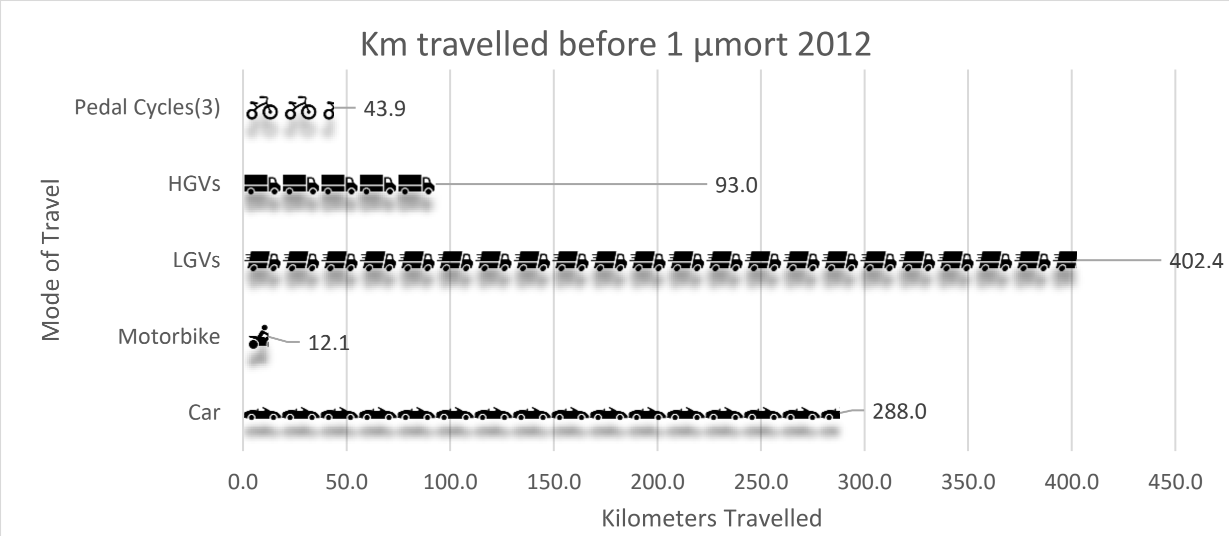
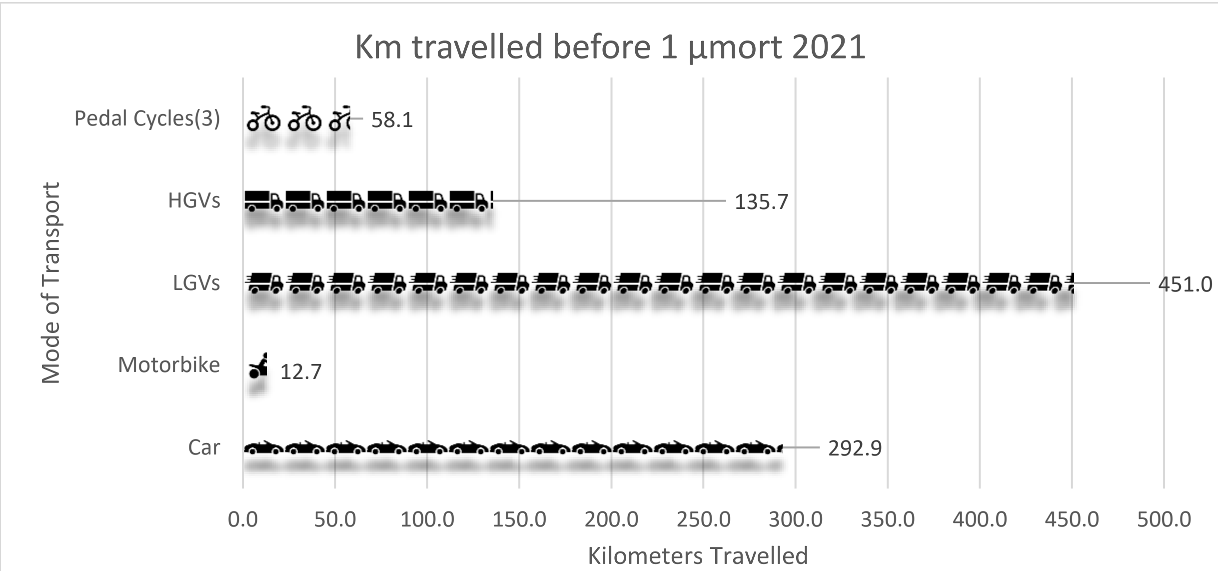


Figure 12 km's travelled before being exposed to 1 µmort



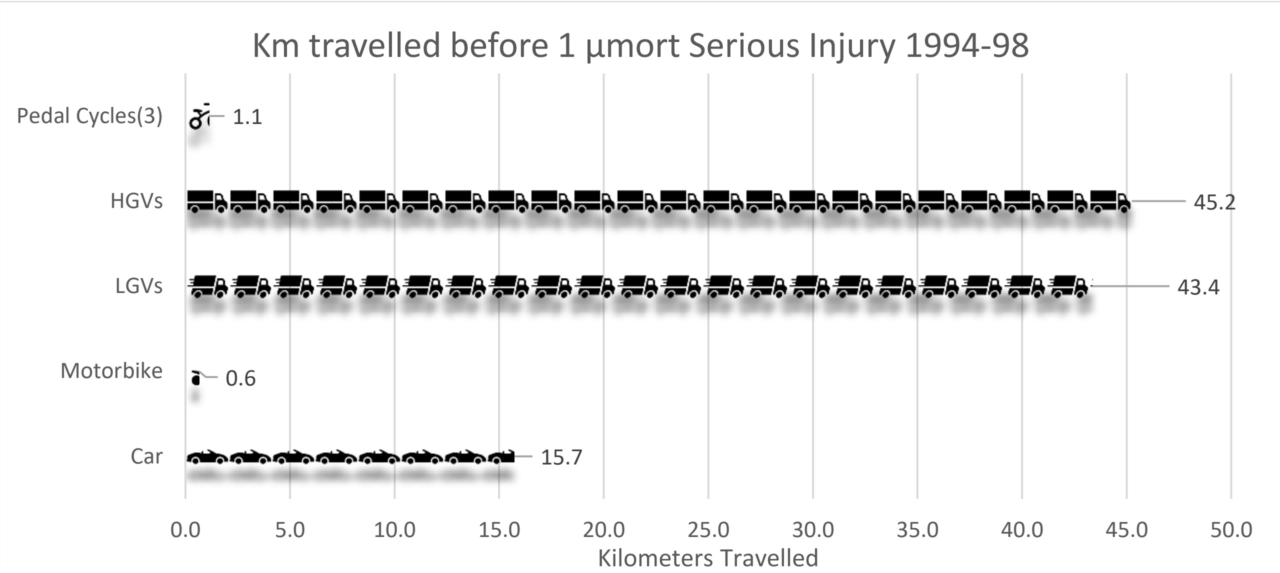
The figures above demonstrate the distance needed to travel before one is exposed to a 1 in a million chance of death. We can see from the charts that LGV drivers have to travel the furthest before they are exposed to a 1 in a million chance of death, although that distance has been decreasing from an average of 633 kilometres between 1994-98[64] to 451km in 2021, a decrease of one third on km's before exposed to 1 µmort of risk. HGVs have also seen a large increase in risk with a one-third reduction in distance before one is exposed to $\mu mort_{death}$ (from 633.8km 94-98 to 451km in 2021). This is indicative of an increasing problem from HGVs being involved in road traffic deaths (from 53 deaths on average per

[64] Depart for Transport, 2010 Review of progress towards the 2010 casualty reduction targets, National Archives

year in 1994-98, to 207 in 2021, the peak year for HGVs was 2015 when 298 drivers and passengers lost their lives)[65].

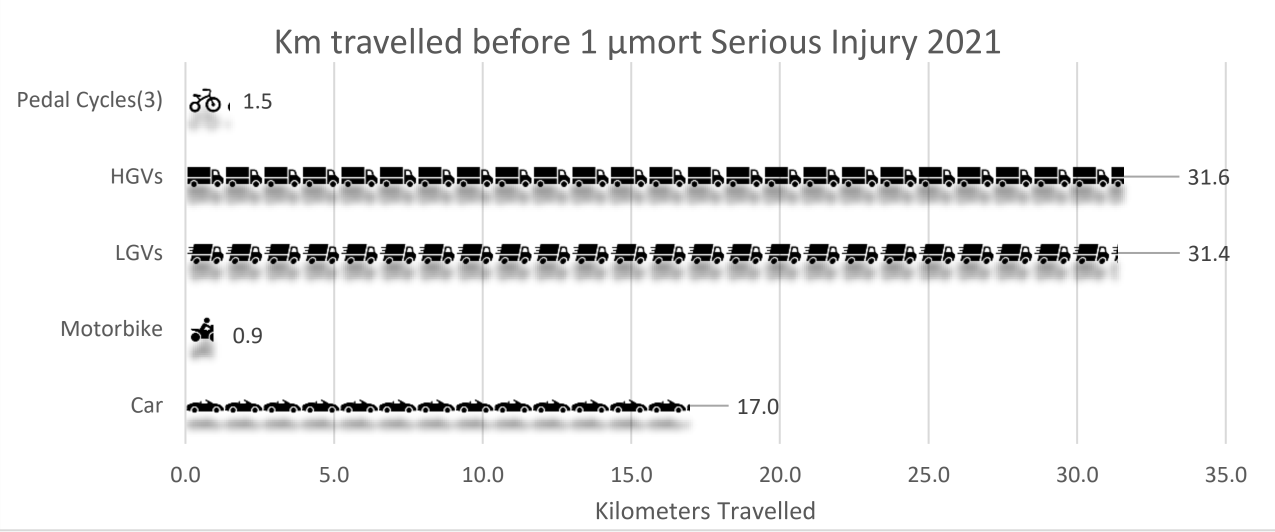
What is particularly welcome is the growth in km travelled per µmort for both bicycles and motorbikes. Between 1994-98 there were an average 467 motorbikes and 186 pedal cyclists killed, by 2021 that has reduced to 322 motorbikes and 117 cyclists but there was an increase of 2.8 billion kms travelled (from 4 billion in 94-98 to 6.8 billion in 2021). However, the picture for cyclists is somewhat clouded by the fact that serious injuries for cyclists have increased, from 3546 (94-98 average) to 4552 (4900 in 2012). There has been little improvement in the µmort of serious injury (that is the distance travelled before one is exposed to a one in a million risk of serious injury), only 0.4km for cyclists and 0.6km for motorcyclists. The $\mu mort_{serious\ injury}$ for HGVs and LGVs has decreased by 13.6km for HGVs and 12km for LGVs see figures 10 and 11.

Figure 13 kms travelled before being exposed to a one in a million chance of serious injury



[65] Dft - RAS0502

Figure 14 kms travelled before being exposed to a one in a million chance of serious injury



Nordfjaern et al[66] examined the attitudes and behaviour of professional and non-professional drivers to compare the rate of crash involvement and speeding incidence in Norway. They found that professional drivers were less likely to wear a seat belt than a non-professional driver, were more likely to speed and be involved in a collision. Furthermore, professional drivers tended to have a less cautious approach to road risk than their non-professional counterparts. Perhaps this explains the increased risk of HGV and LGV fatalities and serious injury.

For car drivers and occupants, the risk of involvement in serious injury or a fatal collision has decreased, with a 53% increase in distance travelled before one is exposed to a $\mu mort_{fatality}$ and an 8% increase in distance for $\mu mort_{serious\ injury}$. Although it should be noted from Table 8 that in 2012 the distance was only 13.8km, in which case the decrease in risk from 2012 – 2021 was a 24% increase in kms travelled before exposure to $\mu mort_{serious\ injury}$.

Pedestrian Traffic

Since the foundation of RoadPeace there have been 20,544 pedestrian deaths, that is one quarter (25%) of all road deaths since 1992. The data on casualty class and fatalities on the road are in Figure 15 below. As a proportion of all road deaths drivers / riders have become increasingly the most common death from an RTC, with pedestrians second and passengers third. As regards overall figures, the trend in all categories is downward (Figure 3) from a high of 1,347 in 1992 to 361 in 2021.

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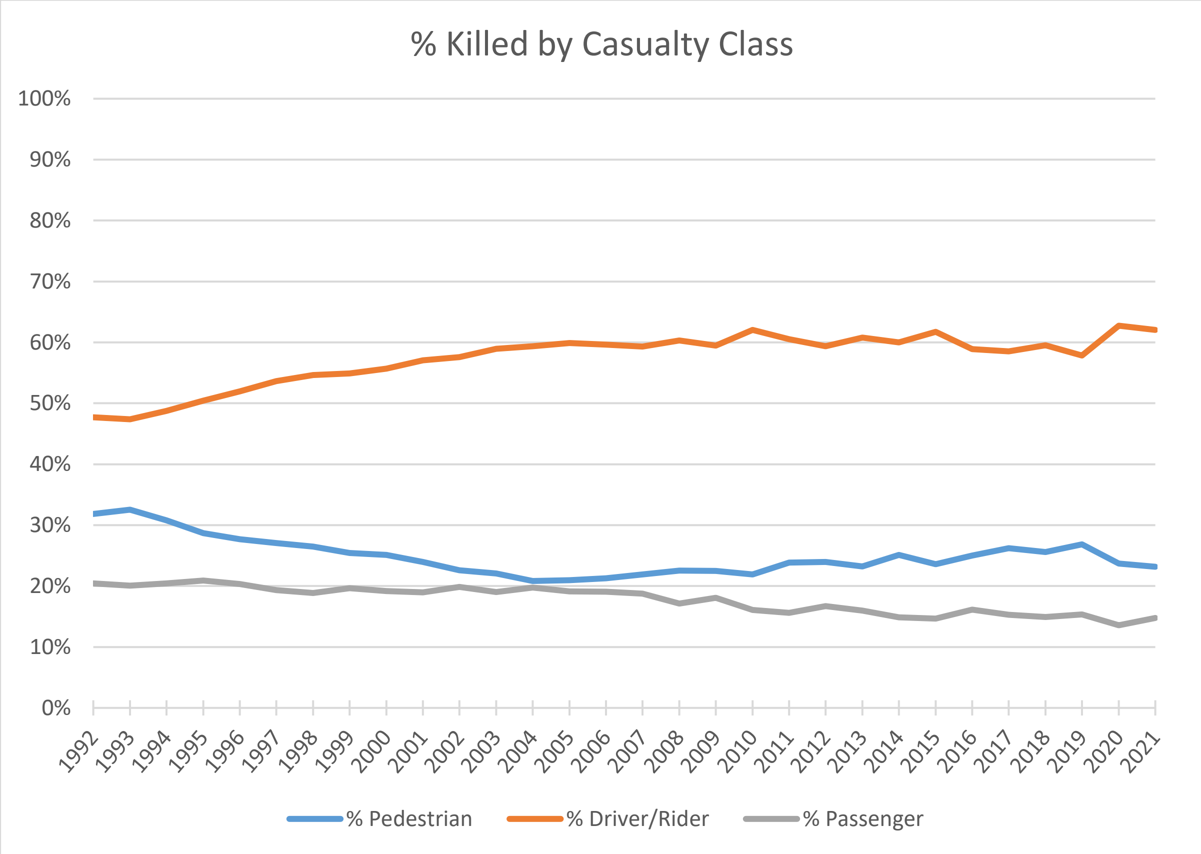
[66] Nordfjærn, T., Jørgensen, S.H. and Rundmo, T., 2012. Safety attitudes, behaviour, anxiety and perceived control among professional and non-professional drivers. *Journal of Risk Research*, *15*(8), pp.875-896.

Figure 15 % of Total Deaths by Casualty Class 1992-2021



Pedestrians Experimental

Assessing the $\mu mort_{fatal}$ and $\mu mort_{serious}$ injury is more problematic since the DfT do not include walking as a transport mode for vehicle kms travelled. Instead, the National Transport Survey (NTS) has been used in the analysis below. To calculate the total miles walked in a year, the NTS on average distance travelled in a year by walking has been multiplied by the population mid-year estimates[67] from the Office of National Statistics[68]. It was decided that as the participants in the NTS will have been 18 and over that would be the age range examined here. Thus in Table 9 below the number of pedestrians killed is the number of pedestrians over the age of 18 killed, and likewise for the other data. There is a discussion below about those under the age of 18 but it is not possible at this time to conduct the μmort analysis.

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[67] Of which 2020 is the latest statistic available – Census Data from 2021 is not yet available that breaks down the individual ages – instead age groups have been reported by the category ranges run to 19 rather than 18 in the data presented here.

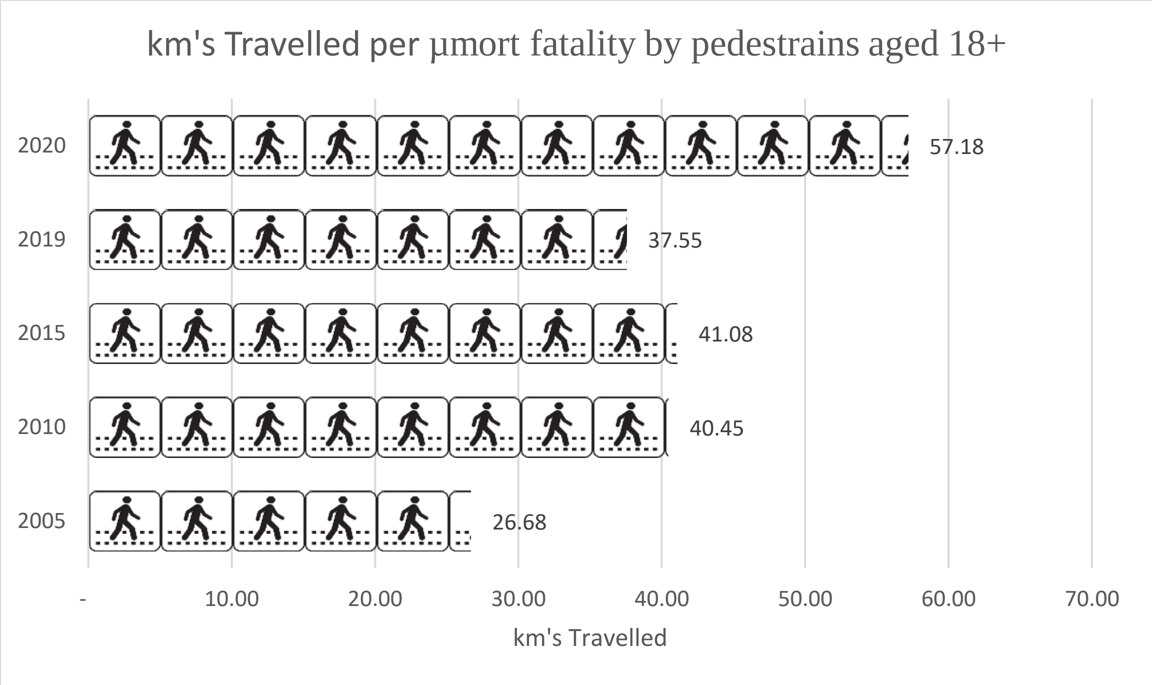
[68] https://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationestimates

Table 9 Distance (km) travelled by aged 18+ pedestrian before µmort fatality exposure

Year	Pedestrians Killed	Pedestrians over 18 Killed	Pedestrian Miles Per Person	Population Mid-Year Estimates	kms Total Walked	km's travelled per death	µmort Fatal
2002	775	677	206	44,796,778	14,880,013,349	21,979,340	21.98
2003	774	677	211	45,089,066	15,313,167,843	22,619,155	22.62
2004	671	572	215	45,410,604	15,712,333,330	27,469,114	27.47
2005	671	579	209	45,866,748	15,448,624,463	26,681,562	26.68
2006	675	582	214	46,277,792	15,933,948,050	27,377,918	27.38
2007	646	566	201	46,710,461	15,136,850,702	26,743,552	26.74
2008	572	496	201	47,150,070	15,278,452,632	30,803,332	30.80
2009	500	449	208	47,546,545	15,893,523,044	35,397,601	35.40
2010	405	369	193	47,996,583	14,927,818,932	40,454,794	40.45
2011	453	406	197	48,455,585	15,385,044,450	37,894,198	37.89
2012	420	394	190	48,788,988	14,943,243,226	37,927,013	37.93
2013	398	363	195	49,104,344	15,447,711,639	42,555,679	42.56
2014	446	406	190	49,502,246	15,106,720,742	37,208,672	37.21
2015	408	376	192	49,921,573	15,446,523,621	41,081,180	41.08
2016	448	405	198	50,340,973	16,055,677,038	39,643,647	39.64

Year	Pedestrians Killed	Pedestrians over 18 Killed	Pedestrian Miles Per Person	Population Mid-Year Estimates	kms Total Walked	km's travelled per death	µmort Fatal
2017	470	443	206	50,644,094	16,786,101,072	37,891,876	37.89
2018	456	421	210	50,940,708	17,190,830,664	40,833,327	40.83
2019	470	449	205	51,220,471	16,859,742,398	37,549,538	37.55
2020	346	318	220	51,435,642	18,182,982,644	57,179,191	57.18

Figure 16 Distance (km) Travelled before exposure to µmort fatality as a pedestrian

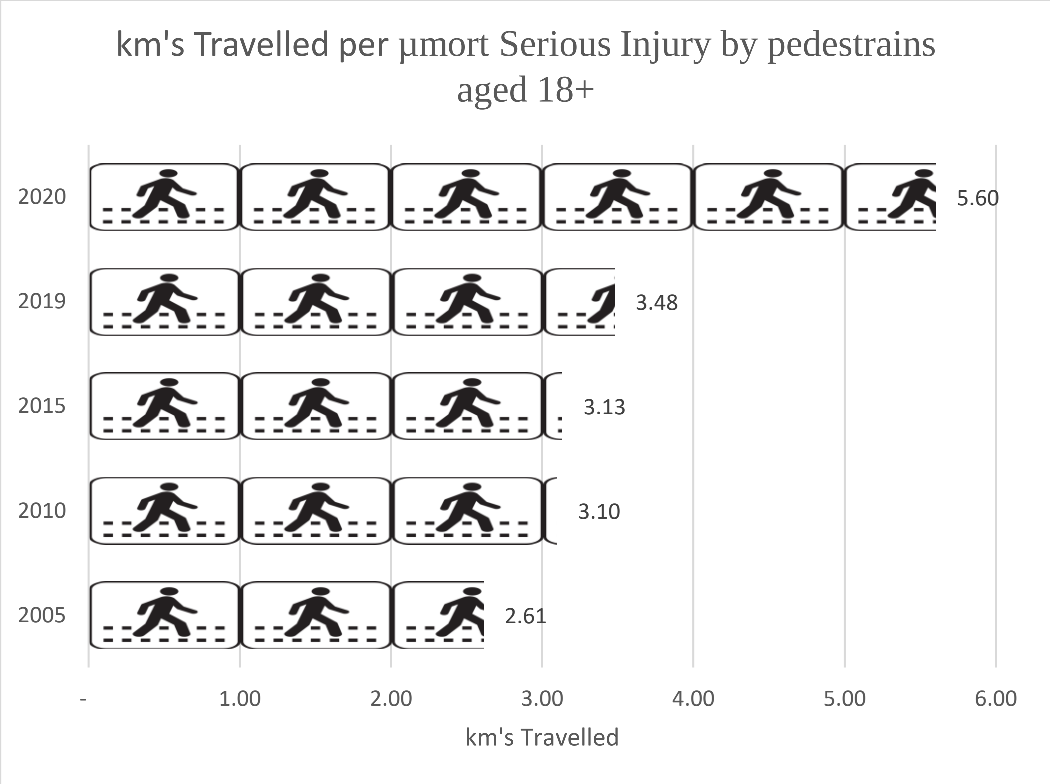


As can be seen from Figure 16 the distance travelled in 2020 is significantly higher than the previous periods. Again, it must be remembered that this is during the Covid19 pandemic reduction in all road traffic. Instead, NTS shows an increase in pedestrian traffic, most likely because of exercise allowed during the strict lockdown periods. If we were to use the 2019 figure instead the picture is somewhat different, with a reduction in distance travelled to 37.55 km's before being exposed to a one in a million chance of death.

The distance travelled by pedestrians over the age of 18 before exposure to a µmort of serious injury are plotted in Figure 17. We can compare these figures to those noted above in relation to the other modes of transport (with the major caveats noted above) and see that as regards serious injury pedestrians are safer than pedal cycles and motorbikes, however they are significantly below the rates for 4-wheel motorised transport. As regards fatalities then walking is more dangerous than cycling but safer than motorcycling. It has to be remembered that the over 18 statistics are experimental relying on multiple data sources that each have their own caveats and noise built into the data.

As discussed above these figures relate to pedestrians aged over 18 due to limitations in the NTS data set. Since 1992 there have been 616 pedestrians aged under 18 who have been killed (365 male and 231 female). There have been 79,001 serious injuries (unadjusted) of under 18s, with 49,734 male and 29,255 females. As regards serious injury and slight injury, since 2004 there have been 45,435 adjusted serious injuries and 115,414 slight injuries. Over the 2004-2021 period there were 241 pedestrians killed aged under 18, 88 of these were female and 153 were male. There were 27,403 male serious injuries under the age of 18 and 16,000 female serious injuries.

Figure 17 km's travelled before exposure to 1μmort of serious injury



Road Type

Not all road types are equal as regards the chances of a death or injury. In the following series of charts the km's travelled before exposure to a $\mu mort_{death}$ are presented for the road and vehicle type in 2021. The data for the figures are presented in Table 10 below. As can be seen from figures 18-21 by far the safest road to travel on is the motorway regardless of vehicle type[69] class. Minor roads are also, generally, safer across all forms of transport - with the exception of HGVs.

[69] Of course bicycles are prohibited from using the motorway and there have been no reported deaths of a cyclist on the motorway since 2016 when there was one death.

Table 10 µmort per kilometres travelled by mode of travel on different road types

Vehicle Type	Road Type	Km's travelled (billions)	Killed	kilometres per µmort
Pedal cycles	Motorways	[redacted]	0	-
Pedal cycles	A roads	1.03	52	19.8
Pedal cycles	Other roads	5.73	71	80.7
Pedal cycles	Total	6.76	123	55.0
Motorcycles	Motorways	0.2	10	20.0
Motorcycles	A roads	1.6	191	8.4
Motorcycles	Minor	2.2	140	15.7
Motorcycles	Total	4.1	341	12.0
Cars	Motorways	64.3	118	544.9
Cars	A roads	157.5	880	179.0
Cars	Minor	134.4	645	208.4
Cars	Total	356.2	1,643	216.8
Buses or coaches	Motorways	0.1	0	0
Buses or coaches	A roads	1.2	21	57.1
Buses or coaches	Minor	1.5	13	115.4
Buses or coaches	Total	2.9	34	85.3
Light goods vehicles	Motorways	18.9	12	1575.0
Light goods vehicles	A roads	35.9	114	314.9
Light goods vehicles	Minor	32.7	68	480.9
Light goods vehicles	Total	87.5	194	451.0
Heavy goods vehicles	Motorways	13.4	44	304.5
Heavy goods vehicles	A roads	12.4	141	87.9

Heavy goods vehicles	Minor	2.4	31	77.4
Heavy goods vehicles	Total	28.1	216	130.1

Figure 18 Distance travelled by bicycle in km's before being exposed to a one in a million risk of death by road type

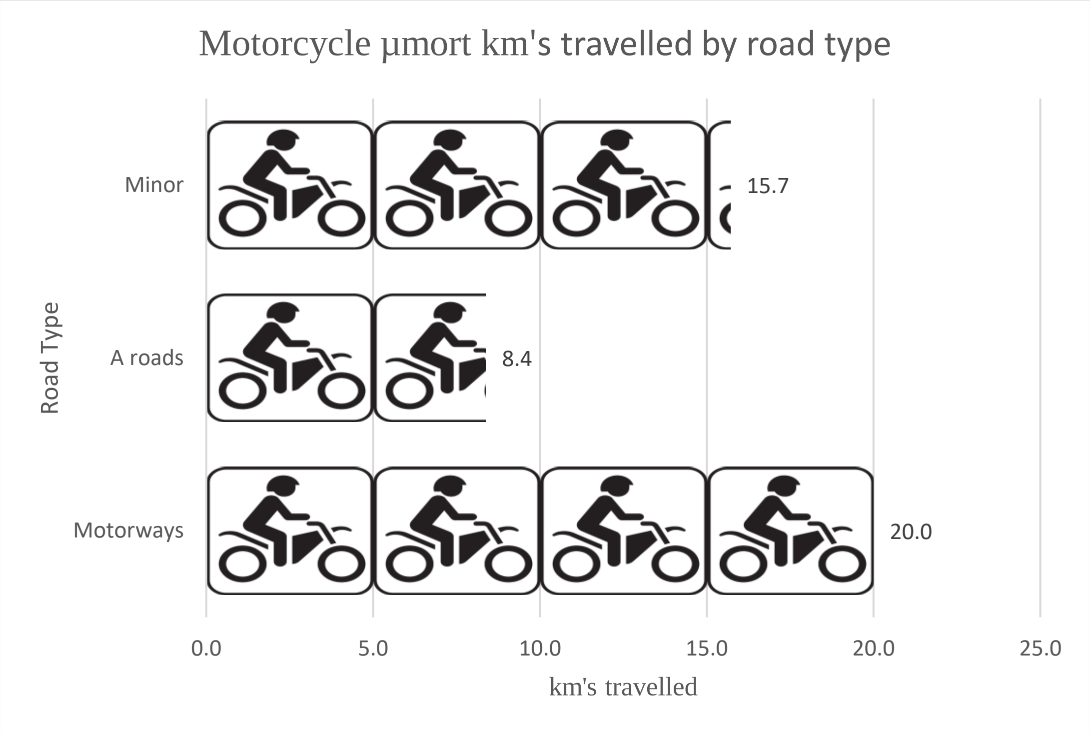


Figure 19 Distance travelled by car in km's before being exposed to a one in a million risk of death by road type

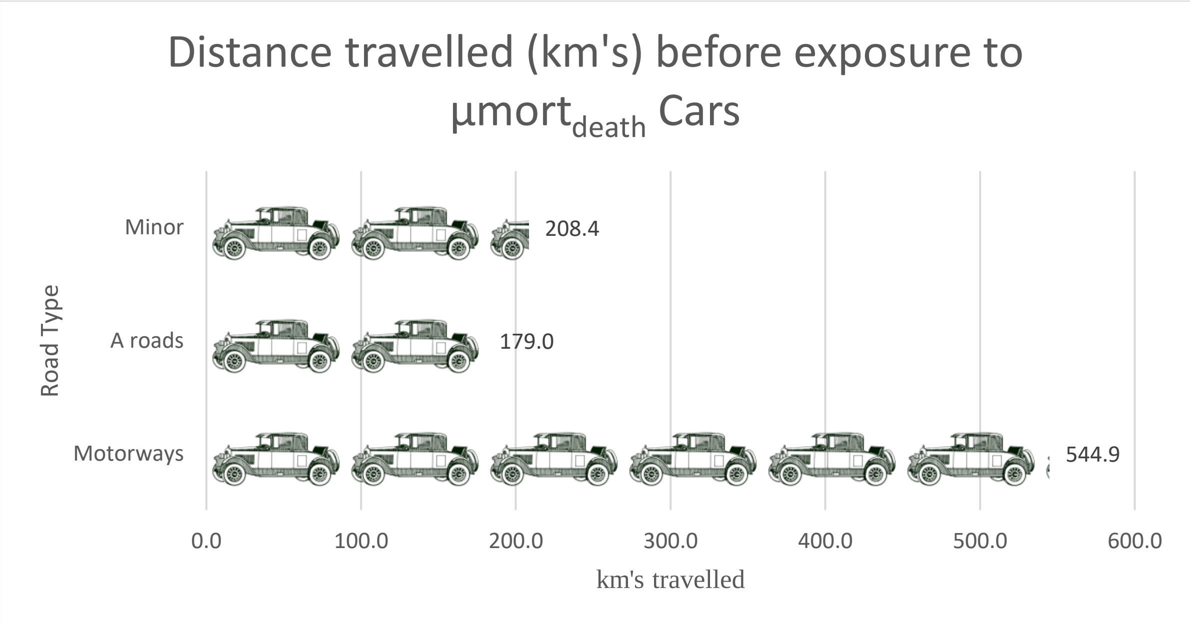


Figure 20 Distance travelled by LGV in km's before being exposed to a one in a million risk of death by road type

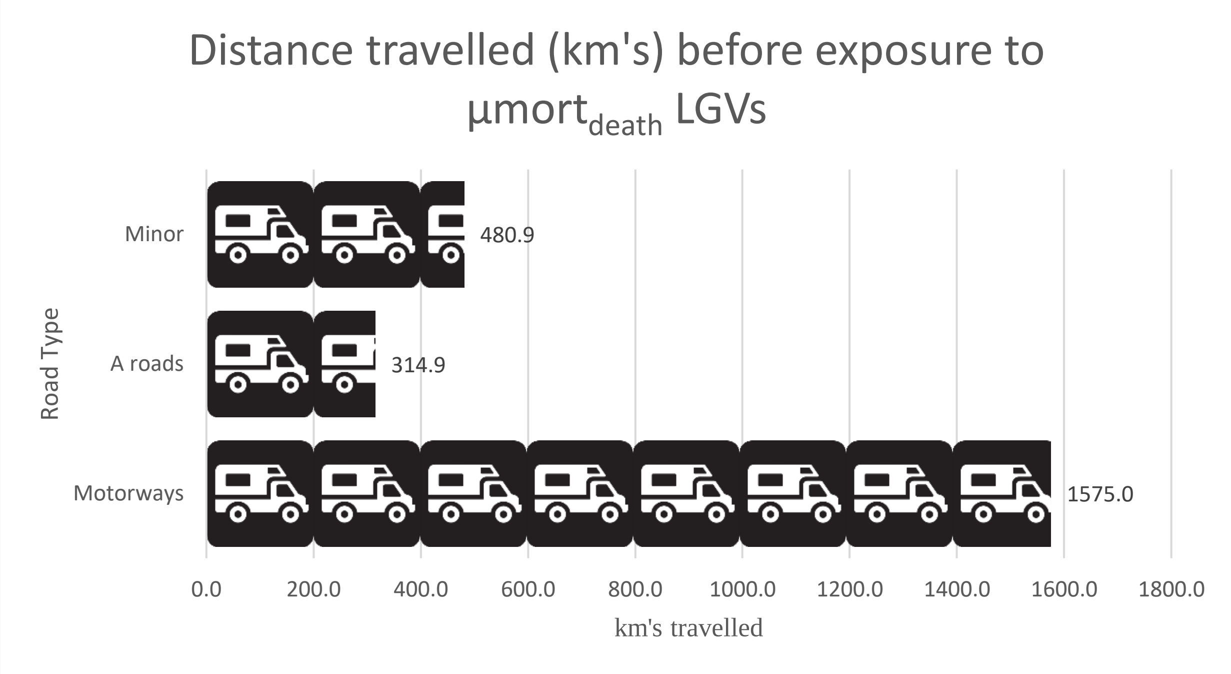
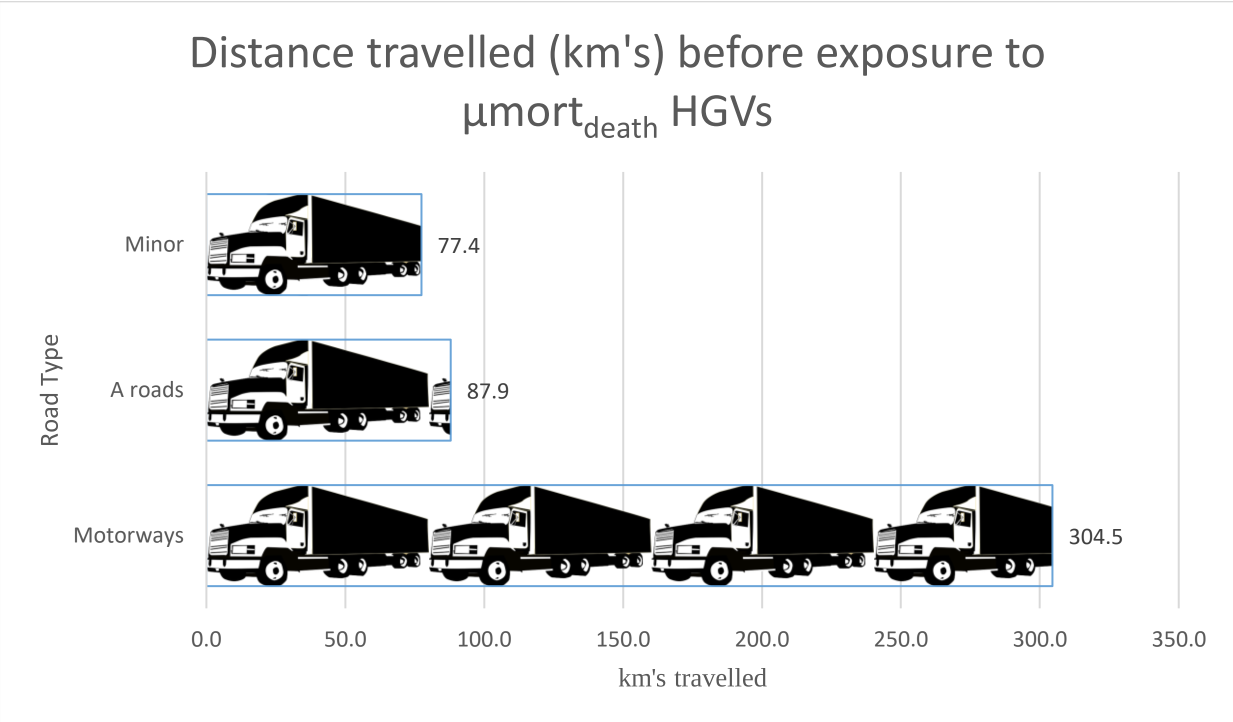


Figure 21 Distance travelled by HGV in km's before being exposed to a one in a million risk of death by road type



We can see from the above figures that the motorway is the safest form of transport across all modes of transport (with the obvious exception of pedal cycles that are prohibited from the motorway)[70]. From Figure 20 (LGVs) we can see that when driving an LGV on a motorway the occupant can travel over 4 times the average distance for all road types.

However the move to smart motorways has somewhat complicated the picture. A smart motorway uses technology to monitor the road and allow use of all lanes of the motorway (ALR motorways) and dynamic use of the hard shoulder when demand necessitates (DHS Motorways). There is clear public concern about the use of smart motorways[71], with most reporting a fear of safety.[72] The evidence collected by National Highways as part of its "Smart Motorways Stocktake" suggests that smart motorways are safer than their non-smart counterparts[73]. The fatality rate for smart motorways is currently 0.07 per hundred vehicle miles, whereas a traditional motorway is currently 0.12 per hundred vehicle mile[74].

Worryingly for smart motorways research from 2017 suggested behavioural attitudes of drivers that increase the risk of a collision and the fail to follow expected behaviours that would deliver on the traffic aims of the system. It found that drivers frequently ignored variable speed limits and failed to use the hard shoulder / inside lane as standard. Following red X warning signs of lane closures were generally followed.[75]

However, following a report by the Transport Select Committee in 2021[76] the government agreed to pause the roll out of all lane running smart motorways until at least 5 years of safety data had been collected in the existing ALR areas.

Travelling by A road is the riskiest road to travel on for motorcycles, cars and LGVs. For HGVs the minor road is the most dangerous road requiring a journey of 77 km before being exposed to a micromort of death.

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[70] Although it should be point out that there have been 2 pedal cycle fatal RTCs on the motorway in the past 10 years (in 2015 and 2016)
[71] See https://yougov.co.uk/topics/travel/articles-reports/2021/01/26/most-britons-oppose-smart-motorways
[72] ibid
[73] National Highways. 2022. *National Smart Motorways Stocktake* retrieved from https://nationalhighways.co.uk/media/uivj2zem/smart-motorways-stocktake-second-year-2022.pdf accessed 10/11/22
[74] Ibid. p. 43
[75] Callaghan, N., Avery, T. and Mulville, M., 2017, September. " SMART" MOTORWAY INNOVATION FOR ACHIEVING GREATER SAFETY AND HARD SHOULDER MANAGEMENT. In *THIRTY-THIRD ANNUAL CONFERENCE* (p. 745).
[76] Transport Select Committee. Third Report of Session – Rollout and safety of smart motorways. HC26

Behaviour

The leading cause of all road traffic collisions in England and Wales is driver behaviour; it accounts for 73% of all road traffic collisions.[77] Road danger reduction is typically focused on the so-called "fatal four", the leading causes in all fatal collisions. Those leading causes are: speeding, distracted driving, drink / drug driving and not wearing ones seatbelt.

It is important to note in the following that it is difficult, if not impossible, to disaggregate the actual cause of the collision / fatality. The DfT presents statistics on the contributory factors to road traffic collisions, but more than one of these factors may be evident in one collision. Thus in what follows the factors are considered *a* cause of an RTC rather than *the* cause of a road traffic collision.

Driver rider or error contributed 61% to all fatal collisions in 2021. In 2017 that figure was 64% so there has been a small reduction. Failing to look or loss of control of the vehicle are the leading factors within this category contributing 27% and 24% respectively of fatal RTCs.

Injudicious action is the next main contributory cause to fatal road collisions, contributing to 29% to all fatal RTCs; this has increased from 26% in 2017. The main form of injudicious action is speeding (18%) or travelling too fast for the conditions (9%). Together both factors were causative in 339 fatalities in 2021; this is slightly down on the 10-year rolling average of 345 fatalities. There is reason to believe that the figures for speeding are a large underestimate. In research conducted by the Metropolitan police, they found that STAT19 reporting of the contributory causes of collisions relied on initial assessments but were not updated following investigations. Carrying out research into its own practices it found that the 17.5% reported collisions caused by speeding in 2019 was actually 49.2 based on final analysis. In 2020 those figures were 19.1% revised up to 46.8%.[78] Thus speeding may be underestimated by a factor or 2 or 3.

Impaired driving is a factor in 27% of all fatal road collisions, the leading impaired factors are 17% drink / drug driving, illness, disability or mental illness 6%, and in vehicle distraction is 5%. In 2020[79] it was estimated that 220 road traffic fatalities were caused by drink or drug driving, this is a reduction on the rolling 10-year average of 232.

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[77] Dft RAS0701 – Reported road collisions and casualties contributory factors by severity and road user type, Great Britain, ten years up to 2021
[78] The Times, 15th May 2022, Speeding causes three times as many road deaths as previously thought retriever from https://www.thetimes.co.uk/article/speeding-causes-three-times-as-many-road-deaths-as-previously-thought- accessed on 10/11/22
[79] The figures for 2021 are not yet available

Behaviour and / or inexperience is the fourth main cause of fatal road traffic collisions in 26% of all fatal RTCs. Carelessness, recklessness or the driver in a hurry contributes 17% to all fatal RTCs under behaviour and / or inexperience.

30% of all RTC fatalities in 2021 involved the driver or occupant not wearing a seatbelt[80], sadly this is an increase of 7% on the previous year and 4% on the rolling 10-year average. Not wearing a seatbelt tends to affect males (34% as opposed to 20% of females) more and the age group 17-29 in which 40% of all RTC fatalities were not wearing a seatbelt. Again, this is a 13% increase on 2020 and a 5% increase on the rolling 10-year average. Not wearing ones seatbelt causing a fatality also tends to affect passengers more than drivers, with 37% of passenger fatalities and 28% of driver fatalities resulting from not wearing ones seatbelt. Thus 401 road traffic fatalities in 2021 were, in part, due to not wearing a seatbelt. It is important to note a caveat with this data – the DfT notes that in a further 48% of car occupant fatalities the seatbelt wearing status is unknown. Thus, the 30% figure is a minimum figure; the true figure could be much higher.

Roads policing as a strategic priority

A further potential factor affecting road risk is the extent to which it is enforced and the extent to which the police have resources available for road policing. Data on the number of police officers dedicated to road traffic was not collected centrally until 2012. However, in a written answer to parliament in 2007 the then Parliamentary Under-Secretary of State for the Home Department stated there were 8084 officers dedicated to "traffic" in 1996 and this number had shrunk to 6511 in 2007. Central statistics were first collected in 2012, Table 11 below sets out the number of officers in a dedicated "traffic"[81] role in England and Wales. There is an important caveat to the data below, some forces, such as Lincolnshire Constabulary, include armed response units in the "traffic" category and so there is some uncertainty in the amount actually dedicated solely to road traffic / safety.

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[80] RAS0711 – Proportion of car occupant fatalities not wearing a seatbelt: Great Britain, from 2013

[81] Traffic officers are defined as those who are involved predominantly involved in:

- Motorcycle or patrol vehicles for policing of motorway or traffic related duties – including accident investigation, vehicle examination and radar.
- Staff who support that function
- Includes those working with hazardous chemicals and those admin staff predominantly serving the needs of traffic function.

Table 11 Police Traffic Dedicated FTE Officers and Staff – Source: Police Service Strength - Supplementary Tables (Home Office)

Year	Dedicated FTE “Traffic” officers	FTE Police – CRP (casualty reduction partnership)	FTE Police – Road Police Command	Total FTE Police Officers – Traffic Function	Dedicated Police Support Staff	Total Police Strength Road Traffic
1996	8084			8084		
2007	6511			6511		
2012	4868			4868	823	5691
2013	4675			4675	811	5486
2014	4356			4356	866	5222
2015***	5220			5220	838	6058
2016	5005	186	43	5234	411* (+467 in CRP) (878)	6112
2017	4650	210	32	4892	930	5822
2018	4352	238	59	4649	1048	5697
2019	4276	93	33	4402	1059	5461
2020	4435	85	85**	4520	1051	5571
2021	3850	122	92	4064	1098	5162
2022	3886	119	69	4074	1137	5211

* The sudden drop in 2016 of police ***staff*** support is most likely caused by a change in reporting practice – in 2015 for police staff the relevant figure was just “police staff – traffic”, however in 2016 staff working in a casualty reduction partnership were separately accounted. Therefore, the combined figure of “traffic” and “CRP” is given post 2016 in Table 11 (above). Also in the police officer FTE statistics post 2016 the figures were similarly broken down into “traffic”, “CRP” and “Command Team” – the statistics on vehicle recovery have not been included in the analysis since this is not a frontline role.

** The sudden increase in Command Team Officers arises because of Avon and Somerset increase from 5 in 2019 to 55 in 2020. At first, it was assumed this might have been a data entry input error; however in 2020 there were 56 command officers, suggesting this is the correct figure not a data entry error and may reflect the inclusion of officers responsible for armed response vehicle commanders.

*** The sudden jump in road traffic officers from 2014 to 2015 is likely to be an artefact of recording practice rather than an actual increase in officers – see PACTS (2020)[82]

Figure 22 Total Police FTE and Police Staff dedicated to Traffic Function

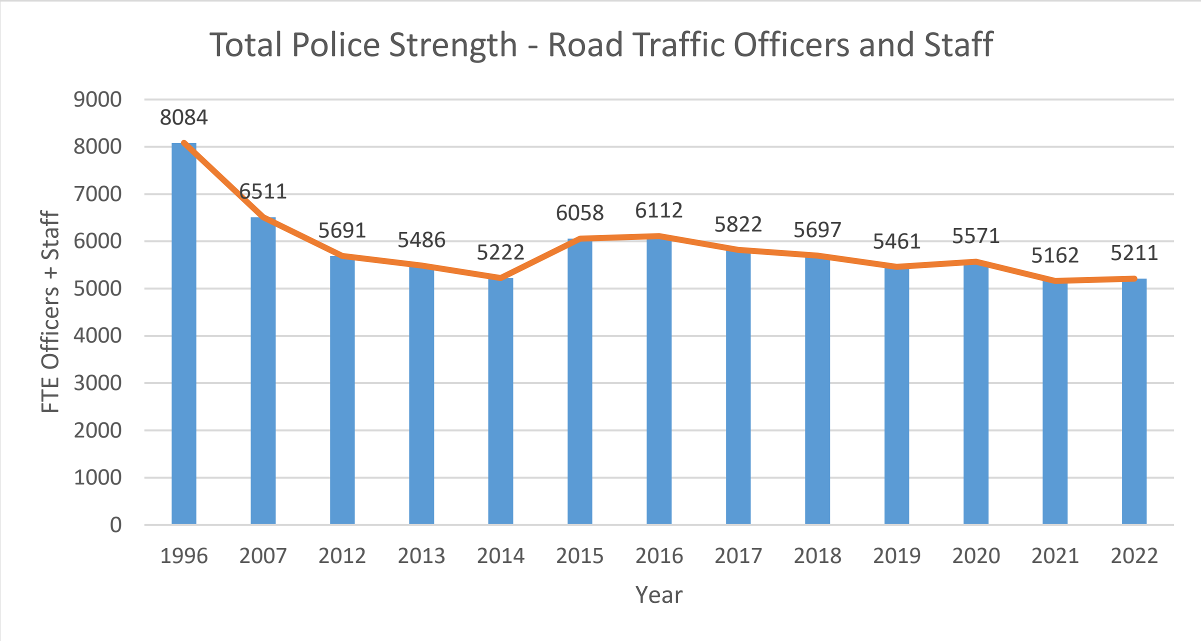
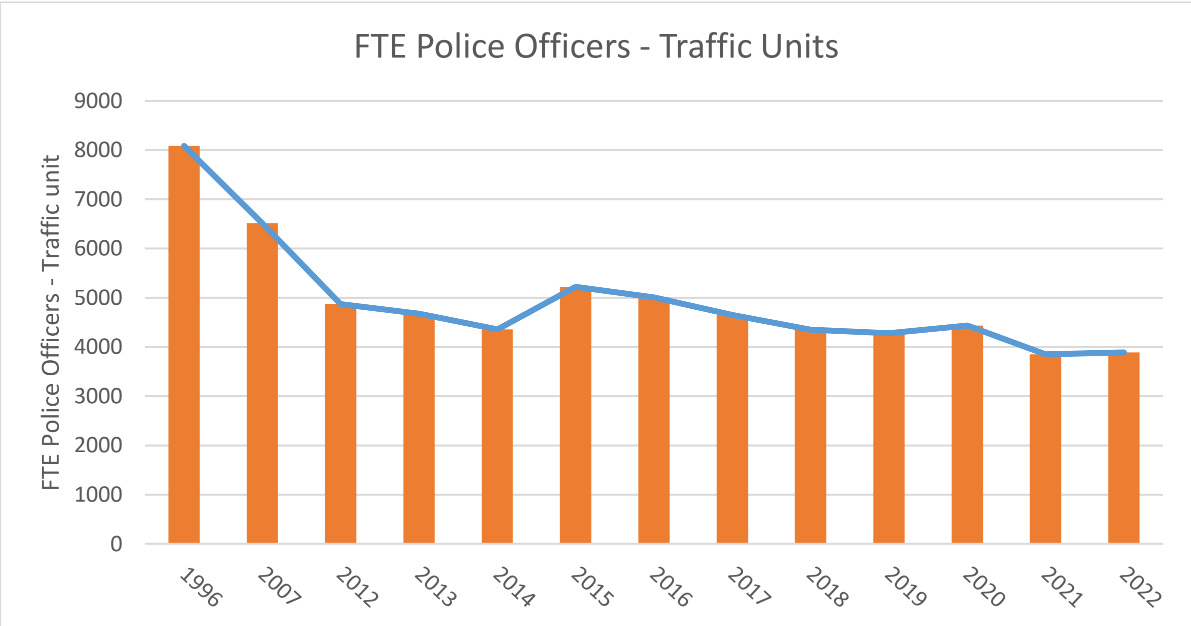


Figure 23 FTE Police Officers dedicated to traffic



[82] PACTS, 2019 Roads policing and its contribution to road safety retrieved from https://www.pacts.org.uk/wp-content/uploads/Roads-Policing-Report-FinalV1-merged-1.pdf last accessed 11/10/2022

Since 2016 the number of dedicated frontline road traffic officers have decreased from 5005 to 3850 in 2021, a 13% reduction. If we factor in officers involved in casualty reduction partnerships and those involved in road police command then the reduction is 12% - but that 1% difference is driven solely by the increase in command officers. Such officers are now commanding less police officer assets.

It is interesting to compare the relative importance (in terms of officers dedicated to road traffic) and those available for all policing (the total FTE officers available in England and Wales). That data is reported in Table 12 below

Table 12 The number of police officers dedicated to road policing (Source Supplementary Tables for Police Workforce, Home Office)[83]

	Road Traffic	All FTE Offices	
2013	4675	129584	3.6%
2014	4356	127909	3.4%
2015	5220	126818	4.1%
2016	5234	127808	4.1%
2017	4892	123113	4.0%
2018	4649	122407	3.8%
2019	4402	123171	3.6%
2020	4520	129110	3.5%
2021	4064	135301	3.0%
2022	4074	140228	2.9%

There was a change in accounting in 2015 that means the statistics before this date may not be directly comparable. Nevertheless, we can see that since 2016 the number of officers

[83] Police Workforce in England and Wales 2021

dedicated to road traffic has been decreasing from 4.1% of the officer workforce in 2016 to 2.9% in 2022[84]. This latter figure is in the context of increasing police numbers – one possible explanation for this (not related to road traffic priorities) may be the increase in recruiting police officers from 2020. A significant proportion of the extra circa 11,000 officers may be still be on their probationary / training period and may not yet have been assigned a role.

In the context of wider policing, road traffic policing attracts just 2.9% of police FTE officers in 2022. The majority of FTE officers are assigned to local policing (46.1%) and investigations (22.6%). In terms of change over time, road policing has lost 1.1% of its workforce since 2016, whereas local policing has lost 1.7% and investigations[85] have been hit particularly hard with a drop of 7.8%. The beneficiary of these drops has been public protection policing (including domestic violence support) (+1.7%) and police support (1.7%).

Only three police forces in England and Wales have Police Community Support Officers (PCSOs) dedicated to road traffic enforcement – these are Greater Manchester Police (35 officers), the Metropolitan Police (167 officers) and Lincolnshire Police (14). The figure for the Metropolitan police represents a significant drop in officer numbers on previous years. In 2020 there were 517 FTE PCSOs in the Met with a dedicated traffic function.

Family Liaison Officers (FLOs) also play a key role in the aftermath of a fatal road traffic collision. Unfortunately, due to the nature of that role, statistics are not kept on the number of FLOs in police forces. Nor is it possible, at present, to say whether such officers are drawn from the Road Traffic category for fatal road collisions.

As regards strategic priorities of the police it would appear that road policing has been less of a priority over the previous 6 years with a reduction of 1160 officers dedicated to roads policing. As regards police civilian staff the number dedicated to road policing has increased by 36%, from 811 members of staff in 2013 to 1137 in 2022. Although as a proportion of all police staff there is very little difference (1.2% in 2013 – 1.4% in 2022).

[84] Year ending March 2022
[85] That is all police investigations not just road casualty investigations

Table 13 The number of police staff dedicated to road policing (Source Supplementary Tables for Police Workforce, Home Office)

	Police Staff- Road Traffic excl. recovery	**All Police Staff**	**% Dedicated to Road Traffic**
2013	811	69516	1.2%
2014	866	68069	1.3%
2015	838	67688	1.2%
2016	878	67504	1.3%
2017	930	65205	1.4%
2018	1048	66948	1.6%
2019	1059	69121	1.5%
2020	1051	72330	1.5%
2021	1098	75858	1.4%

Perhaps one reason for the fall in police numbers and a climb in police staff dedicated to road policing has been the reliance on automated methods of enforcement to capture speeding behaviour. In analysis for the RAC Foundation in 2016 Snow[86] found that automated enforcement of speeding had become the norm. Based on the latest statistics (year ending March 2020) the number of automated capture of speeding offences was 2,098,108 fixed penalties issued, or 95% of all speeding. In 2013 that figure was 1,722,237 fixed penalties and 90% of all speeding was captured by automated camera. This may explain some of the change in police officer numbers dedicated to road traffic offending, since automated enforcement does not require the same level of officer input and can largely be done by police staff.

Thus, it is not too far of a stretch to suggest that enforcement of road traffic laws is increasingly becoming civilianised. This can partially be seen in the increasing number of civilian police staff (at a time when FTE police officers are falling) employed in a road traffic role. However, local authorities are also becoming more involved in roads policing.

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[86] Snow, A.J., 2017. *Automated Road Traffic Enforcement: Regulation, Governance and Use A review*. RAC Foundation, London retrieved from https://www.racfoundation.org/wp-content/uploads/2017/11/Automated_Road_Traffic_Enforcement_Dr_Adam_Snow_October_2017.pdf accessed 28/10/22

Certainly during the period of National Safety Camera Partnerships[87] local authorities were engaged in partnerships with police forces in addressing speed offending, although enforcement was (and is) still is enforced by the police. However, since July this year, local authorities have had the power to enforce a range of moving traffic violations under s. 73(2)b of the Traffic Management Act 2004 and Schedule 7 Part 4 of the Act.

Since July 2022 local authorities across England and Wales have been given the power, if they choose to adopt it, to enforce against a range of moving traffic violations. The power to issue such penalty notices arose under s. Schedule 73 Traffic Management Act 2004, however the power to issue penalty notices in respect of moving traffic was only brought into force in 2022. Moving traffic enforcement under the act covers two offences – failing to comply with a traffic sign subject to civil enforcement (Sch. 7.para 8(1)a) and failing to comply with a traffic order in so far as it makes provision for a requirement, restriction or prohibition that is conveyed by a traffic sign subject to civil enforcement. (Sch. 7 para 8(1) b). The traffic signs in question are as follows (Sch. 7 Para 8A, Table A):

- Direction indications (e.g. road closed, turn in a specified direction, no U-turns)
- Signs indicating priority for vehicles in the opposite direction
- No entry signs
- No vehicles (or prohibition on certain vehicles)
- Pedestrian zones entry
- Cycle zone entry
- Goods vehicles weights
- Route indications for specified traffic only (e.g. buses, pedal cycles, cars, pedestrians
- With flow and contra flow cycle lanes
- No stopping
- Neglecting box junction markings

All of these offences have a potential road risk impact and thus the civil enforcement of the requirements may contribute to road risk reduction in the future.

[87] Wells, H., 2012. *The fast and the furious: Drivers, speed cameras and control in a risk society*. Ashgate Publishing, Ltd..

Future study could look at the contribution of local authorities to road danger reduction by way of civil traffic enforcement.

Assessing the cost of RTCs

Undoubtedly, as discussed above, the number of deaths on our roads has dramatically decreased since 1992. However, the killed and seriously injured figures have plateaued in recent years, with emerging signs of a worrying increase, certainly in fatalities.

Each road death (and serious injury) represents a personal, familial, cultural and societal tragedy. Even minor injury and collision can have lifelong psychological consequences (e.g. the cyclist may fear ever getting back on) for those who are injured (and those who drove the vehicle). It is hard to quantify the damage done and attempts have generally focused on understanding the financial costs of road traffic collisions at the personal, familial and societal level.[88] Focusing on the financial impact of an RTC should in no way belittle or reduce the suffering to a cost benefit analysis – however, it is important that policymakers in government and the police, understand the impact of road risk on society at a strategic level. Intuitively we may be able to grasp a small portion of the level of hurt and grief caused by road traffic collisions, but we should also understand the societal implications of our decisions when deciding priorities for public policy.

The Department for Transport issues costs estimated each year for the various types of road traffic collision injuries (Killed, Seriously Injured and Slight) and breaks the cost into 6 categories of costs. The figures for 2010-2020 inclusive are reported in Table 14.

We can see from Table 14 that the average amount spent / lost through road traffic collisions resulting in injury is more than is spent on the Ministry of Justice each year. In 2021-22 the Ministry of Justice annual total annual expenditure limit was £10 billion[89], compared to the £11.35 billion cost of RTCs.

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[88] Makaba, T., Doorsamy, W. & Paul, B.S. Bayesian Network-Based Framework for Cost-Implication Assessment of Road Traffic Collisions. *Int. J. ITS Res*. 19, 240–253 (2021). https://doi.org/10.1007/s13177-020-00242-1
[89] HM Treasury. 2022 *Public spending statistics: July 2022* London

Table 14 Financial Cost of RTCs 2010-2021

	KSI	Number of KSIs	Casualty related: Lost output (£ million)	Casualty related: Medical and ambulance (£ million)	Casualty related: Human costs (£ million)	Crash related: Police costs (£ million)	Crash related: Insurance and admin (£ million)	Crash related: Damage to property (£ million)	Total (£ million)	Total All Casualties (£ billion)
2010	Fatal	1,731	1052.08	10	2,070	30	1	19	3,182	
	Serious	22,171	495.09	297	3,370	41	4	103	4,311	
	Slight	32,423	402.19	171	1,916	69	15	395	2,969	£10.46
2011	Fatal	1,797	1116.27	10	2,195	32	1	21	3,374	
	Serious	22,783	520.87	313	3,548	43	4	108	4,537	
	Slight	33,121	403.85	171	1,924	69	15	394	2,977	£10.89
2012	Fatal	1,637	1039.88	9	2,042	29	1	19	3,139	
	Serious	22,533	525.81	315	3,582	44	4	108	4,578	
	Slight	32,518	389.19	165	1,854	67	15	381	2,871	£10.59
2013	Fatal	1,608	1039.46	9	2,044	30	1	19	3,142	
	Serious	21,193	504.26	303	3,436	42	4	104	4,393	
	Slight	30,779	373.68	159	1,781	66	14	372	2,765	£10.3
2014	Fatal	1,658	1134.26	10	2,229	32	1	20	3,427	

	KSI	Number of KSIs	Casualty related: Lost output (£ million)	Casualty related: Medical and ambulance (£ million)	Casualty related: Human costs (£ million)	Crash related: Police costs (£ million)	Crash related: Insurance and admin (£ million)	Crash related: Damage to property (£ million)	Total (£ million)	Total All Casualties (£ billion)
	Serious	22,305	559.52	336	3,812	47	4	116	4,875	
	Slight	32,475	417.75	177	1,991	73	16	412	3,086	£11.39
2015	Fatal	1,616	1073.41	9	2,107	32	1	19	3,241	
	Serious	21,598	528.20	317	3,599	46	4	110	4,604	
	Slight	31,045	387.38	164	1,846	70	15	383	2,865	£10.71
2016	Fatal	1,695	1149.61	11	2,265	34	1	21	3,479	
	Serious	23,173	591.94	355	4,034	51	5	123	5,160	
	Slight	29,841	381.23	162	1,817	69	14	377	2,819	£11.46
2017	Fatal	1,676	1183.06	10	2,322	35	1	21	3,571	
	Serious	24,032	629.71	378	4,293	55	5	129	5,490	
	Slight	28,836	363.82	154	1,734	66	14	360	2,692	£11.75
2018	Fatal	1,671	1215.35	11	2,386	36	1	22	3,670	
	Serious	24,639	668.25	401	4,556	58	5	137	5,825	
	Slight	29,201	344.41	146	1,641	63	13	343	2,551	£12.05
2019	Fatal	1,658	1238.29	12	2,439	37	1	22	3,748	

	KSI	Number of KSIs	Casualty related: Lost output (£ million)	Casualty related: Medical and ambulance (£ million)	Casualty related: Human costs (£ million)	Crash related: Police costs (£ million)	Crash related: Insurance and admin (£ million)	Crash related: Damage to property (£ million)	Total (£ million)	Total All Casualties (£ billion)
	Serious	24,638	702.43	422	4,790	60	5	144	6,124	
	Slight	28,138	334.71	142	1,595	61	13	334	2,480	£12.35
2020	Fatal	1,391	978.99	8	1,916	29	0	18	2,948	
	Serious	19,746	517.55	311	3,533	45	4	107	4,517	
	Slight	22,152	240.23	102	1,145	45	10	242	1,783	£9.25
2021	Fatal	1,474	1144.97	9	2,243	34	1	21	3,450	
	Serious	22,758	659.61	397	4,502	57	5	135	5,755	
	Slight	25,079	287.91	122	1,372	54	11	293	2,140	£11.35
										£132.54

Using the data in Table 14 we can estimate that each road death in 2021 results in £776,776.30 lost opportunity costs (which are a measure of the loss of productive capacity of an individual as a result of an injury in a road collision). £6,280.58 cost lost to the health and ambulance service, £1.52 million in human related costs (these represent the cost of pain and distress of relatives as well as loss of enjoyment of life).[90] A further £22,648 in police costs of dealing with the collision and its aftermath, £387.65 in insurance administration, £14,152.41 in damage to property. Making a total of £2.341 million per fatal injury.

Table 15 below details these figures for killed, seriously injured and slightly injured road traffic collisions from 2010 to 2021.

[90] Of course no monetary figure can ever compensate the loss of a life – these figures are based on Chilton et al (1997) see A valuation of road accidents and casualties Great Britain: Methodology Note, Department of Transport (n.d.) available at https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/995110/rrcgb-valuation-methodology.pdf retrieved on 3rd October 2022

Table 15 Total Cost Per RTC 2010-2021

	KSI	Number of KSIs	Casualty related: Lost output £ per KSI	Casualty related: Medical and ambulance £ per KSI	Casualty related: Human costs £ per KSI	Crash related: Police costs £ per KSI	Crash related: Insurance and admin £ per KSI	Crash related: Damage to property (£ per KSI)	Total (£ Per RTC)
2010	Fatal	1,731	607,789.51	5,588.24	1,195,892.92	17,251.08	299.55	11,235.76	1,838,057.07
	Serious	22,171	22,330.48	13,391.57	152,018.73	1,868.70	171.81	4,654.99	194,436.28
	Slight	32,423	12,404.56	5,262.16	59,106.25	2,137.89	461.67	12,187.54	91,560.06
2011	Fatal	1,797	621,184.99	5,605.93	1,221,397.14	17,660.15	309.39	11,425.09	1,877,582.68
	Serious	22,783	22,862.22	13,719.04	155,738.65	1,905.55	177.30	4,747.74	199,150.50
	Slight	33,121	12,193.16	5,172.49	58,098.99	2,082.15	454.25	11,895.29	89,896.33
2012	Fatal	1,637	635,232.66	5,528.86	1,247,432.63	17,842.64	312.57	11,416.98	1,917,766.33
	Serious	22,533	23,334.95	14,001.50	158,944.73	1,933.69	180.37	4,783.15	203,178.38
	Slight	32,518	11,968.32	5,077.10	57,027.61	2,050.53	446.86	11,722.70	88,293.13

	KSI	Number of KSIs	Casualty related: Lost output £ per KSI	Casualty related: Medical and ambulance £ per KSI	Casualty related: Human costs £ per KSI	Crash related: Police costs £ per KSI	Crash related: Insurance and admin £ per KSI	Crash related: Damage to property (£ per KSI)	Total (£ Per RTC)
2013	Fatal	1,608	646,431.16	5,812.86	1,270,901.39	18,407.77	319.75	11,910.28	1,953,783.21
	Serious	21,193	23,793.66	14,281.19	162,121.10	1,995.42	184.20	4,920.46	207,296.02
	Slight	30,779	12,140.81	5,150.28	57,849.52	2,131.28	460.96	12,093.39	89,826.24
2014	Fatal	1,658	684,115.96	6,078.24	1,344,539.40	19,335.55	336.82	12,325.91	2,066,731.89
	Serious	22,305	25,085.13	15,056.25	170,919.62	2,103.61	194.25	5,211.18	218,570.04
	Slight	32,475	12,863.67	5,456.92	61,293.88	2,235.67	485.92	12,680.92	95,016.99
2015	Fatal	1,616	664,236.81	5,708.47	1,303,840.84	19,501.54	327.19	12,049.40	2,005,664.26
	Serious	21,598	24,456.10	14,679.42	166,642.07	2,120.87	188.86	5,074.37	213,161.69
	Slight	31,045	12,477.92	5,293.29	59,455.84	2,251.73	471.53	12,321.05	92,271.36

	KSI	Number of KSIs	Casualty related: Lost output £ per KSI	Casualty related: Medical and ambulance £ per KSI	Casualty related: Human costs £ per KSI	Crash related: Police costs £ per KSI	Crash related: Insurance and admin £ per KSI	Crash related: Damage to property (£ per KSI)	Total (£ Per RTC)
2016	Fatal	1,695	678,236.25	6,438.33	1,336,340.76	20,116.40	337.59	12,366.34	2,052,602.49
	Serious	23,173	25,544.42	15,335.64	174,092.33	2,212.43	196.99	5,299.10	222,654.12
	Slight	29,841	12,775.35	5,419.46	60,873.05	2,309.35	484.01	12,632.90	94,464.24
2017	Fatal	1,676	705,882.89	6,002.71	1,385,184.51	20,804.46	348.03	12,699.18	2,130,921.78
	Serious	24,032	26,202.85	15,737.34	178,654.35	2,273.83	203.02	5,376.59	228,447.99
	Slight	28,836	12,616.88	5,352.23	60,117.93	2,301.64	482.37	12,483.83	93,354.04
2018	Fatal	1,671	727,321.32	6,288.70	1,428,125.02	21,378.42	359.25	13,061.16	2,196,533.88
	Serious	24,639	27,121.63	16,286.68	184,889.85	2,339.71	210.13	5,567.23	236,415.23
	Slight	29,201	11,794.51	5,003.37	56,199.44	2,158.75	454.64	11,758.66	87,369.37

	KSI	Number of KSIs	Casualty related: Lost output £ per KSI	Casualty related: Medical and ambulance £ per KSI	Casualty related: Human costs £ per KSI	Crash related: Police costs £ per KSI	Crash related: Insurance and admin £ per KSI	Crash related: Damage to property (£ per KSI)	Total (£ Per RTC)
2019	Fatal	1,658	746,855.67	6,986.35	1,470,795.11	22,082.69	372.26	13,541.11	2,260,633.19
	Serious	24,638	28,509.86	17,125.44	194,413.15	2,444.61	220.12	5,825.77	248,538.96
	Slight	28,138	11,895.40	5,046.17	56,680.18	2,180.06	461.82	11,856.66	88,119.52
2020	Fatal	1,391	703,803.52	5,496.81	1,377,188.34	20,965.94	353.86	12,859.83	2,119,144.16
	Serious	19,746	26,210.61	15,760.69	178,924.76	2,271.52	204.76	5,395.09	228,734.46
	Slight	22,152	10,844.68	4,600.45	51,673.64	2,031.57	431.55	10,926.15	80,501.24
2021	Fatal	1,474	776,776.30	6,280.58	1,521,672.78	22,864.88	387.65	14,152.41	2,340,614.44
	Serious	22,758	28,983.61	17,427.03	197,841.78	2,485.58	225.69	5,941.68	252,894.22
	Slight	25,079	11,480.22	4,870.05	54,701.91	2,142.54	457.75	11,673.34	85,317.42

As can be seen from Table 15 for each road death that is prevented there is a saving of £2.3million. The cost per RTC fatality has increased by 27% from 2010 to 2021, slightly under the level of inflation. The cost per serious injury has also increased from £194,436 in 2010 to £252,894 in 2021, a rise of 30% for a rise of 3% in the number of serious injuries.

Conclusions

Risk on the road is subject to a multitude of factors. For the most part, both nationally and internationally road death has been decreasing consistently across the years. Certainly, some states, such as Mexico, Chile, Cost Rica and New Zealand have some work to do, but through shared knowledge with states that are doing well the policies and tools are available to address their problems.

Depending on one's philosophy there is both much to be optimistic and pessimistic about in the GB road risk. Although the 2004-2010 figures may have encouraged a leaning toward optimism around road danger reduction, it is important to be realistic about the plateau that has occurred since. Between 2011 and 2019 there was a reduction of 149 road deaths, however if one looks from 2012 then to 2019 there was only a reduction of two fatalities. One rather obvious potential cause of this has been the political backlash against speed cameras, since the plateauing of fatal collisions has taken place following the removal of central government funding. Added to this has been the reduction in police officer numbers because of austerity. If one is of a pessimistic mindset, one could conclude that doing less (less speed enforcement) with less (fewer officers) is always going to result in a negative outcome.

That being said local authorities are now taking an increasing role in road danger enforcement with the full enactment of Part 6 of the Traffic Management Act, it remains to be seen what the effect of this will be on road risk levels.

Having examined the changing levels of risk on the road this report now turns to examine the academic evidence regarding risk and road danger reduction.

3. Risk – The Academic Domain

Introduction

This report examines risk on the road. In chapter 2, the statistics on road danger reduction were analysed to provide indications of relative road risk across a number of variables, both nationally and internationally. In this chapter, the academic literature on road risk is examined. It starts by tracing the centrality of risk as a means of understanding road danger reduction, and then examines the various risk factors that have been investigated in academic study.

The chapter then moves on to consider the relationship between risk and attitudes in driver behaviour and rejects the risk homeostasis theory that road risk is impervious to safety enhancements. Following this the chapter analyses the key risk factors, both positive and negative, that impact on road danger including risk taking, risk and age, risk and driver attitude. The chapter then considers whether risk is transferred through the generations and the affect parental attitudes, behaviour and presence has on road risk for their children (as drivers).

Throughout the chapter, both national and international research is drawn upon. The penultimate section of the chapter however examines the state of the research on cross cultural / international attitudes to road danger.

The final section examines literature on risk and autonomous vehicles, in particular, driver attitudes towards autonomous vehicles. A question address in this section is how these vehicles will affect risk in the future driver, at both the objective (i.e. crash risk) and subject (i.e. attitudinal) levels.

Risk Theory

Risk has become the predominant means of governing contemporary society[91]. Risk is a concept that arises when we are required to trust in situations where we do not have complete knowledge.[92] As Giddens sates

> "When I go out of the house and get into a car, I enter settings which are thoroughly permeated by expert knowledge-involving the design and construction of automobiles, highways, intersections, traffic lights, and many other items. Everyone knows that driving a car is a dangerous activity, entailing the risk of accident. In choosing to go out in the car, I accept that risk, but rely upon the aforesaid expertise to guarantee that it is minimized as far as possible. I have very little knowledge of how the car works and could only carry out minor repairs upon it myself should it go wrong. I have minimal knowledge about the technicalities of modes of road building, the maintaining of the road surfaces, or the computers which help control the movement of the traffic."[93]

One can also add to this that we don't know how other drivers / pedestrians / cyclists and all other manner of road users will behave, what their views about safe driving practices are or

[91] O'Malley, P., 2010. *Crime and risk*. Sage Publications.
[92] Giddens, A (1990) *The Consequences of Modernity*, Polity Press, Cambridge
[93] See FN 92 p.28

their physical and mental state impinging on those practices. This conception of risk permeates society[94].

Risk on the road is a socially constructed[95], mediated and experienced phenomenon that not only involves what we might call objective risk, i.e. the risk of certain events eventuating but also subjective risk, or assessments of risk that individuals make according to their own metrics of desires, wants, needs and necessities. Burgess argues that understanding risk as a social construction means that 'we hold back from, and treat sceptically, the latest new hazard that is said to be a serious threat'.[96] Beck refers to this as the demonopolisation of expertise[97], the sense in which we become experts in our own determinations of risk (and how we calculate them). Furthermore Beck talks of the democratization of expertise whereby individualised conceptions of risk carry the same (or sometimes more) weight as authoritative scientific expertise[98].

The key emerging theme in road danger and road policing has been risk.[99] Wells (2010)[100] has noted both the democratization and demonopolisation of expertise in road traffic, specifically citizen responses to speed enforcement. Wells found that drivers determine their own risk based on their experience as a driver and this risk is democratised as their personal views about their risk outweigh expert claims about risky driving behaviour. Put simply, views that claim speeding is a risk are subject to individualised assessments that counter the dominant expert narrative.

Altering Risk – are attitudes and risk impervious to road danger developments?

Examining the changing nature of road risks over the last 30 years (and forecasting into the future) requires an understanding of how risk operates in individual driving decisions, and how this determines the levels of objective risk.

This question has been subject to debate in the scientific literature. The debate is between those who favour risk homeostasis theory and its detractors. Risk homeostasis encapsulates the idea that drivers engage in a continuous process of risk assessment such that

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[94] Beck, U (1992), *Risk Society –Towards and New Modernity*, Sage Publications, London
[95] Burgess, A., 2014. Social construction of risk, Chapter 4.In Cho, H, Reimer, T and McComas, K (Eds) *The SAGE handbook of risk communication*, Sage, London. pp.56-68.
[96] Chapter 4
[97] FN94 p.156
[98] Fn94 p.191
[99] PACTS (2005) Policing Road Risk: Enforcement, *Technologies and Road Safety*, PACTS London
[100] Wells, H., 2011. Risk and expertise in the speed limit enforcement debate: Challenges, adaptations and responses. *Criminology & Criminal Justice*, *11*(3), pp.225-241.

> [a]t any moment of time the instantaneously experienced level of risk is compared with the level of risk the individual wishes to take, and decisions to alter ongoing behaviour will be made whenever these two levels are discrepant.[101]

Homeostasis is a theory of zero change equalisation. In other words, drivers continuously monitor their driving for risks to their health and wellbeing and make decisions to alter that risk (e.g. slow down, speed up, turn, stop etc…) whilst maintaining an acceptable overall desired level of risk. Risk homeostasis is a theory of no change in that overall objective risk – in terms of RTCs – does not change as people respond to risk mitigation inputs (i.e. safety improvements) with risk-taking behaviours to compensate, and thus maintain the same level of risk.

Wilde argues that risk homeostasis is an important theory as it explains that most road traffic safety interventions have a temporary nature whilst holding out that long-term effects can only be achieved through altering a driver's risk evaluation of the benefits and risks of their behaviour.

The significance of this theory is that it suggests that most road traffic interventions on safety have nil or very little long-term effect. A simple example of risk homeostasis would be the introduction of seatbelts[102]. According to risk homeostasis theory this will have little effect on safety since drivers will compensate for the lower risk that seatbelts represent by altering their driving to maintain the same level of individual risk calculations. In other words, seatbelts could increase speed since the driver now feels safer at a high speed. The risk system output has stayed the same all that has changed is the behaviour within that system.

Wilde argues that 'lasting accident reduction [...] cannot be achieved by means of merely providing users with more opportunity to be safe, but that *safety can be enhanced by measures that increase people's desire to be safe*'[103].

Evans[104] disputes the central claims of risk homeostasis theory in road risk stating "there is no convincing evidence supporting it and much evidence refuting it"[105]. Using empirical data on road traffic collisions across a range of variables (including different types of roads, long term trends, short term and long term trends in response to a road dnager input, changing

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[101] Wilde, G.J.S. (1982), The Theory of Risk Homeostasis: Implications for Safety and Health. Risk Analysis, 2: 209-225. https://doi.org/10.1111/j.1539-6924.1982.tb01384.x
[102] Although there is no evidence of this effect following the introduction of seatbelts, in fact the opposite is true, overall risk diminished it was not homeostatic. See FN 104
[103] Ibid, 220
[104] Evans, L. (1986), Risk Homeostasis Theory and Traffic Accident Data. *Risk Analysis, 6: 81-94*. https://doi.org/10.1111/j.1539-6924.1986.tb00196.x
[105] Ibid 81

laws and collision causes) Evans demonstrates that overall objective risk in the system is not static or worsening, it is improving. Thus, homeostasis is not an apposite description for what is occurring.

One need only make a cursory examination of fatality and serious injury statistics over the last 30 years, particularly in Great Britain, to demonstrate the falsity of homeostasis theory.

Wilde does allow for change in the system, but only to the extent that such change represents a change in attitude towards personal risk from the driver. Risk mitigation strategies that arise from any other method (whether technological, social, enforcement related etc…) have no effect on overall risk according to Wilde. However, no evidence has been provided in support of radical changes in risk acceptance from drivers over the years during which objective risk of fatal and serious injury on the road has been falling (and quite significantly so).

Evans is correct to claim that the theory of risk homeostasis is, at its strongest, a trite claim about various road traffic factors influencing individual risk assessments. There may be some intuitive superficial attraction to the claims that people compensate for lowering risk in one dimension but raising it in another[106] to achieve a homeostatic equilibrium, but there is no evidence to substantiate the theory, what evidence exists actually undermines it.

Robertson and Pless make the point that it is ludicrous to assume, as risk homeostasis does, that humans are able to make objective calculations about risk in instantaneous decisions.[107] In support of his theory of risk homeostasis Wilde cites studies that reinforce the view that no safety improvements are maintained whilst ignoring the overall long-term trends identified by Lund et al[108], and fails to cite studies that have been replicated with vastly different results[109].

Furthermore, homeostasis can be explained by other theories that have a more compelling evidence base. In particular optimism bias, the sense in which drivers rate themselves as better than the average driver in responding to risks on the road (see below). Wilde's cited study of air bags[110], as Robertson and Pless point out, has been replicated many times with

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[106] Indeed such arguments are the mainstay of behavioural economics in which people *sometimes* driven by irrational desires (i.e. those that don't accord with traditional economic theory)
[107] Ibid
[108] Lund, A.K. and Ferguson, S.A., 1995. Driver fatalities in 1985-1993 cars with airbags. *Journal of Trauma and Acute Care Surgery*, *38*(4), pp.469-475.
[109] Wilde, G.J., Robertson, L.S. and Pless, I.B., 2002. For and against Does risk homoeostasis theory have implications for road safety For Against. *Bmj*, *324*(7346), pp.1149-1152.
[110] Peterson S, Hoffer G, Millner E. Are drivers of air-bag equipped car more aggressive? A test of the offsetting behavior hypothesis. J Law Economics 1995;37:251-64. Cite in Ibid 1150

findings vastly at odds with the single study cited by Wilde. Furthermore, without an appreciation of driver attitudes as regards optimism, which Peterson and Hoffer did not assess, the findings are suspect. It may be that the drivers in Peterson and Hoffer were overoptimistic about their risk mitigation abilities, particularly in the early stages of the development of air bags. Longitudinal studies, such as that by Lund & Fergusson[111] demonstrated that airbags resulted in a 24% reduction in fatalities, and by 16% reduction in all non-fatal injury crashes between the period 1985-1993. Thus fundamentally undermining Wilde's evidence in support of risk homeostasis.

Risk homeostasis is thus a theory with little empirical support and based on a pessimistic and fatalistic view of the value of road danger developments. It is a theory in search of causation when scientific endeavour in the social sciences can only ever provide correlation. Thus, driving behaviours / attitudes are not impervious to safety developments; the evidence is overwhelmingly in the opposite direction.

Risk as a pleasurable facet of driving

Risk, thus far, has been seen as a negative assessment of risk of crashing or fatality. However, any understanding of risk on the road must also account for the potential positives that arise through risk. Risk is not simply a matter of negative consequences otherwise it would fail as a concept to capture behaviours that are sometimes socially useful (such as entrepreneurship) but also enjoyable for some (although lacking in social utility). O'Malley[112] has charted how the idea of risk is entwined with neo-liberal rationalities with a move away from risk as minimization to embracing risk as a socially useful rationality. The risk as minimization thesis fail to account for, as O'Malley sets out, the 'emotional surge'[113] and a "*positive* pursuit of a rationality in which rewards are not material but emotional".[114]

In the road traffic context risk can be both a technique for understanding danger and harm as well as more socially acceptable pursuits such as fun or emotional release. The extent to which the latter impinges on the former will become clearer in the next section in which the attitudes of drivers to road danger, and the contribution to road danger based on those risks, is examined.

At this juncture it is important to stress that the scales of risk are not equal in this regard. Risk as emotional reward is an individual level assessment, what some might find thrilling,

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[111] FN108
[112] FN91
[113] Ibid p.61
[114] Ibid p.62

others may, no doubt, find quite terrifying. Individual level of risk affects the objective overall level of risk on the road. There is an asymmetry in these risk calculations, one person's positive enjoyment is not equal to one person's increased objective risk. Positive orientations towards personal risk (risky driving) are likely to have a far larger impact on overall risk than on the individual experiencing that positive risk. Thus, we need to understand individual risk characteristics, particularly those that some may find enjoyable, if we are to understand overall level of risk on the roads.

Risk and age

There is widespread acceptance that young drivers are, as a class, more risky than older drivers – and in particular young male drivers.[115] Harre questions whether these descriptions of risk relate to inexperience or whether there is something problematic about youth that affects their judgements or decisions whilst driving.[116]

Harré posits two risk states that are desirable for safer attitudes in younger drivers; these are habitual cautious driving and active risk avoidance. There are further three risk states that are undesirable, they are; reduced risk perception, acceptance of risk as a cost and risk seeking. The psychological states interact with each other, in that drivers may actively seek risk whilst being under the mistaken impression that the risk is low (reduced risk perception). Conversely, they may have a heightened sense of risk, which may manifest itself eventually in habitual cautious driving.

Fernandes et al[117] in a review of the literature on risk factors leading to problematic driving behaviours identify the following factors that influence certain types of road traffic offending for young drivers (see Figure 24)

[115] Harré, N., 2000. Risk evaluation, driving, and adolescents: a typology. *Developmental Review*, 20(2), pp.206-226.
[116] Ibid: 207
[117] Fernandes, R., Hatfield, J. and Job, R.S., 2010. A systematic investigation of the differential predictors for speeding, drink-driving, driving while fatigued, and not wearing a seat belt, among young drivers. *Transportation research part F: traffic psychology and behaviour*, *13*(3), pp.179-196.

Figure 24 From Fernandes et al (2010) - past research demonstrating factors with a relationship with certain type of road traffic offending. "-" for a negative relationship, "+" for a positive relationship "M" for males only

	Speeding	Drink-driving	Driving while fatigued	Not wearing seat belts
Age	(–)	(–)	(–/+)	(–/+)
Gender	M (+)	M (+)	M (+)	M (–/+)
Authority rebellion				
Sensation seeking	(+)	(+)	(+)	(+)
Driver anger	(+)			
Time urgency				
Perceived personal risk (perceived susceptibility)	(–)	(+)	(–)	(–)
Perceived personal risk (perceived severity)		(–)		
Perceived relative risk (illusory invulnerability)	(–)			(–)
Cost – "taking longer to get to destination"	(+)		(+)	
Cost – "miss out on thrill and excitement"	(+)	(+)		
Benefit – "comfort and security"		(+)		(+)
Benefit – "avoiding parental disapproval"	(+)			(+)
Peer influence/approval	(+)	(–/+)		(+)

[M]Indicates the direction of relationships observed for males.

NB. Where a particular factor has been associated with each of the four behaviours (that is, where an entire row in the table is full), these associations were not observed in one study.

We can see from the above that age is negatively associated with speeding compliance, drink driving compliance and seatbelt compliance. Thus, young drivers are more likely to engage in these behaviours.

Examining the positive relationships is interesting in that an increased perception of susceptibility to a risk leads to an increase in drink driving, whereas it decreases the incidence of speeding, drug driving and not wearing ones seatbelt. Young drivers do not drink drive or refrain from wearing a seatbelt in order to get to a destination quicker[118], although they do speed and drive whilst fatigued. Thrill and excitement are positively correlated with drink driving and speeding, but not seatbelt wearing. Perhaps one explanation for this is that the risk perception is so high for not wearing ones seatbelt that it is not a "thrill" that is worth taking.[119]

In their empirical study, Fernandes et al[120] examined risk based on ideas of rebellion, time urgency, sensation seeking and driving anger on the four offences examined above. They found that increased anger and sensation seeking were correlated with intentions to speed. As regards perceived risks of enforcement-based interventions (fines, points, capture) there was an increased risk of speeding amongst those who felt the risk was lowest. Lowered perceptions of risk of crash were also likely to increase speeding intentions.[121]

For drink driving, peer influence was seen as the key factor encouraging this risky behaviour. Lower perceived risk of crashes was also found to contribute to an increased intention to drink drive, although this was only the case for male drivers. For female drivers the test was not statistically significant[122]

For driving whilst fatigued, the relevant risk factors are the perceived costs and benefits of not driving whilst fatigued. Thus those who saw a clear financial cost or time benefit in driving whilst fatigued were more likely to engage in that behaviour. The risk of being caught, being involved in a crash, fined and gaining licence points all dampened the likelihood of not wearing ones seatbelt. Ideas of rebellion against authority were not statistically significant contributory factors in any of the intended offences.

Fernandes et al conclude that '[b]eliefs appear to be the strongest predictors of risky driving, after controlling for the effects of age, gender, and personality factors.'[123] Thus personalised, demonopolised risk assessments seem to be the key factor in most self-reported intention to break road traffic laws. Young drivers perform risk assessments based on their beliefs about a range of factors that are unique to their own situation, rather than

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[118] Instead there are likely to be more social factors that impact on these decisions
[119] ibid
[120] ibid
[121] Ibid Para 4.1.1
[122] Ibid para. 4.1.2
[123] Ibid 4.2

focused on generic / objective risk assessments that focus on actual / relative risk amongst their driving demographic.

Lucidi et al[124] have tested whether age moderates casualty risk, specifically related to risk based attitudes. They found that being anxious and demonstrating attitudes of hostility to others (not solely based on driving) was only statistically significant for older drivers (60 years+) in relation to their attitudes to road danger. Anxiousness was correlated with increased road safer attitudes, whereas hostility was correlated with decreased road safer attitudes.[125] Excitement seeking and normlessness[126] were statistically significant across the age group, thus they were not factors that solely affected young drivers. Altruism[127] was correlated with positive road danger attitudes, although not amongst older drivers.

To see the effect of attitudes on driver behaviour, Lucidi et al tested whether attitudes impacted upon three types of self-reported road safe behaviours (using the Driving Behaviour Questionnaire (DBQ).)[128] These were errors (where the driver reports making an error that is not against the law e.g. underestimating the speed of an oncoming vehicle), lapses (e.g. misreading a sign) and violations (e.g. deliberate disregard of the speed limit). They found that excitement seeking affected violations across all three age groups, but did not affect errors or lapses in older drivers, and did not affect lapses in middle-aged drivers. Anxiety linked with lapses in young and old drivers, and errors with old and mid aged drivers. None of the age groups demonstrated an association with anxiety and violations, suggesting that anxiety leads to more cautious driving and thus less rule violation on the road.[129]

A key issue with the above research is that the data relies on self-report; either self-reported intentions to break a particular road law or self-reported breaking of those laws. The DBQ, which was used by Lucidi et al, and has been used repeatedly in road danger research, has been criticised by Wåhlberg et al[130] for its poor performance in predicting actual collisions. They argue that use of the DBQ is heterogeneous in regards to the number of items assessed, scales used and the methods of factor analysis in interpreting the DBQ. Thus,

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124 Lucidi, F., Girelli, L., Chirico, A., Alivernini, F., Cozzolino, M., Violani, C. and Mallia, L., 2019. Personality traits and attitudes toward traffic safety predict risky behavior across young, adult, and older drivers. *Frontiers in psychology*, *10*, p.536.
125 P.8
126 The idea that negative driving behaviours are needed to obtain important goals (ibid. 4)
127 The sense of being thoughtful and considerate see fn124
128 Lawton, R., Parker, D., Manstead, A.S. and Stradling, S.G., 1997. The role of affect in predicting social behaviors: The case of road traffic violations. *Journal of applied social psychology*, *27*(14), pp.1258-1276.
129 See pp. 7-8
130 af Wåhlberg, A., Dorn, L. and Kline, T., 2011. The Manchester Driver Behaviour Questionnaire as a predictor of road traffic accidents. *Theoretical Issues in Ergonomics Science*, *12*(1), pp.66-86.

one must exercise caution in interpreting results that claim to reinforce similar findings in different studies using the DBQ.

Road Risk Driving Determinants

There are numerous factors that increase risk of an RTC that relate to human behaviours. The key factors found in the research that increase the risk of road collision are as follows:

Excessive speed[131], driving recklessly[132], driving with passengers[133], driving at night[134] particularly in younger drivers. Risk taking[135], alcohol and drugs[136], excessive speed[137] fatigue[138], seatbelt use[139], driver inattention[140] and use of a mobile phone[141] are the key factors in crash causation in all drivers. As regards older drivers failing to yield at

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131 Gonzales, M.M., Dickinson, L.M., DiGuiseppi, L.M., Lowenstein, S.R., 2005. Student drivers: A study of fatal motor vehicle crashes involving 16-year-old drivers. *Ann. Emerg. Med.* 45 (2), 140–146.
132 Lam, L.T., 2003. Factors associated with young drivers' car crash injury: comparisons among learner, provisional, and full licensees. Accid. Anal. Prev. 35 (6), 913–920.
133 bid
134 Clarke, D.D., Ward, P., Bartle, C. and Truman, W., 2006. Young driver accidents in the UK: The influence of age, experience, and time of day. Accident Analysis & Prevention, 38(5), pp.871-878.
135 Rolison, J.J., Hanoch, Y., Wood, S., Pi-Ju, L., 2014. Risk taking differences across the adult lifespan: A question of age and domain. J. *Gerontol. Ser. B: Psychol. Sci. Soc.Sci*. 69, 870–880.
136 Bingham, C.R., Shope, J.T., Zhu, J., 2008. Substance-involved driving: predicting driving after using alcohol, marijuana, and other drugs. Traffic Inj. Prev. 9 (6), 515–526.
137 International Transport Forum. 2020. *Speed and Crash Risk* Paris, retrieved from https://www.itf-oecd.org/sites/default/files/docs/speed-crash-risk.pdf accessed 26/10/22
138 Connor, J., Whitlock, G., Norton, R. and Jackson, R., 2001. The role of driver sleepiness in car crashes: a systematic review of epidemiological studies. *Accident Analysis & Prevention*, *33*(1), pp.31-41.
139 Carpenter, C.S. and Stehr, M., 2008. The effects of mandatory seatbelt laws on seatbelt use, motor vehicle fatalities, and crash-related injuries among youths. *Journal of health economics*, *27*(3), pp.642-662.
140 Klauer, S.G., Neale, V.L., Dingus, T.A., Ramsey, D. and Sudweeks, J., 2005, September. Driver inattention: A contributing factor to crashes and near-crashes. In *Proceedings of the Human Factors and Ergonomics Society Annual Meeting* (Vol. 49, No. 22, pp. 1922-1926). Sage CA: Los Angeles, CA: Sage Publications.
141 Asbridge, M., Brubacher, J.R. and Chan, H., 2013. Cell phone use and traffic crash risk: a culpability analysis. *International journal of epidemiology*, *42*(1), pp.259-267.

junctions[142], age related decline[143], visual degeneration[144] medical conditions[145] and medication use[146] are a further set of causative factors in crash risk.

Petridou and Moustaki[147] in a meta-review of risk of RTC found that human factors are the key determinants of driving behaviour, which are related to crash occurrence and crash injury in both the short term and the long term. The authors posited two ways in which the predictors of crashes influence behaviour, either through reduced capability or through modulating the risk faced by the driver. These categories were further subdivided into those that have long-term and short-term effects. Long term reduced capability involved factors such as inexperience, old age, disease or disability, accident proneness and alcoholism or drug abuse. The short-term effects of capability are drowsiness, acute alcohol intake, binge eating, acute psychological stress and temporary distractions. As regards the modulation of risk long term effects are overestimation of driving ability (so called optimism bias), habitual speeding or disregard for traffic, non-seatbelt use or helmet use, indecent gestures, inappropriate driving position, accident proneness and alcoholism. The short-term effects that modulate risk are drugs, motor vehicle crime, suicidal behaviour and compulsive acts.[148]

As regards attitudes to road risk, Assum[149] found that in Norwegian drivers, the key determinants of risk were demographics, in particular being male, and annual mileage travelled. Attitudes in general were not as strong a predictor of behaviour if accounting for age, gender and annual mileage. Assum acknowledges that this is a difficult finding as regarding the pre-existing literature and it may be that the measure of "attitude" leads to different results.[150] Literature since Assum's work tends to argue the converse, that attitudes do influence crash risk, thus the conceptualisation of attitude may be the key factor here.

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[142] McGwin, G., Brown, D.B., 1999. Characteristics of traffic crashes among young, middleaged, and older drivers. Accid. Anal. Prev. 31 (3), 181–198.
[143] Hu, P. S., Young, J. R., & Lu, An. Highway crash rates and age-related driver limitations: Literature review and evaluation of data bases. United States. https://doi.org/10.2172/10149328
[144] Ball, K., Edwards, J.D., Ross, L.A., McGwin, G., 2010. Cognitive training decreases motor vehicle collision involvement of older drivers. J. Am. Geriatr. Soc. 58 (11), 2107–2113.
[145] McGwin, G., Sims, R.V., Pulley, L., Roseman, J.M., 2000. Relations among chronic medical conditions, medications, and automobile crashes in the elderly: A population- based case-control study. Am. J. Epidemiol. 152 (5), 424–431.
[146] Meuleners, L.B., Duke, J., Lee, A.H., Palamara, P., Hildebrand, J., Ng, J.Q., 2011. Psychoac-tive medications and crash involvement requiring hospitalization for older drivers: a population-based study. J. Am. Geriatr. Soc. 59 (9), 1575–1580.
[147] Petridou, E. and Moustaki, M., 2000. Human factors in the causation of road traffic crashes. *European journal of epidemiology*, *16*(9), pp.819-826.
[148] Ibid pp. 821-823
[149] Assum, T., 1997. Attitudes and road accident risk. Accident Analysis & Prevention, 29(2), pp.153-159.
[150] Ibid p.158

It has long been noted that there is a distinction between driver motivation (attitudes) and driver behaviour and a number of theories have been developed that accept the influence of attitude on behaviour to a greater or lesser extent.[151]

The theory of planned behaviour[152] holds that attitudes and intentions do matter when addressing behaviour but are subject to moderating influences, the key determinant of behaviour is intentions, our actual intentions impact on our driving behaviour, but those intentions are an amalgam of beliefs, attitudes, habit, age, experience and many other variables. The theory of interpersonal behaviour[153] rejects the centrality of intentions and holds that they are but one influence amongst others that influence our behaviour. Feelings of arousal, aggression, anger, thrill seeking all have independent influence on behaviour in addition to intention. Protection motivation theory[154] posits that a complex calculation takes place (a threat appraisal), which trades the benefits and risks of behaviours relating to health promotion and other important attitudes (such as thrill seeking). This calculation then determined behaviour based on the desire to protect one's own health weighed against other important factors to the driver, such as fun or thrill seeking.[155]

In all of these models of human behaviour, attitudes are important dimensions of road danger reduction, and addressing attitudes, particularly in those that are at high risk, are important. Since human behaviours are responsible for nearly three quarters of all road traffic collision injuries the future impact of focusing on attitudes can deliver road risk reduction

Optimism Bias

Road safe attitudes do not arise in a vacuum – they are a complex mix of subjective and objective assessments (as discussed above). The interplay between subjective assessments of risk based on a putative objective standard is mediated by the extent to which the subject knows the risk exists and believes that the risk applies to them. One factor

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[151] Delhomme, P., De Dobbeleer, W., Forward, S. and Simões, A., 2009. Manual for designing, implementing, and evaluating road safety communication campaigns: Part I. *Brussels: Belgian Road Safety Institute*.
[152] Ajzen, I., 1991. The theory of planned behavior. Organizational behavior and human decision processes, 50(2), pp.179-211.
[153] Triandis, H.C. Interpersonal Behavior; Brooks/Cole Publishing: Monterey, CA, USA, 1977; ISSN 081850188X 9780818501883.
[154] Rogers, R. W., & Prentice-Dunn, S. (1997). Protection motivation theory. In D. S. Gochman (Ed.), *Handbook of health behavior research 1: Personal and social determinants* (pp. 113–132). Plenum Press
[155] This is not to suggest that such a calculation is rational or logical – the protection motivation theory allows us to understand irrational decisions and the impact they have on behaviour.

that repeatedly recognised that leads drivers into error as regards their subjective risk on the road (through assessment of objective risk) is optimism bias.

Goselin et al (2010)[156] propose that drivers suffer from comparative optimism. That is 'the tendency of individuals to estimate that they are less susceptible to risks than others' (2010, p.734). There is a wealth of evidence in road danger literature that drivers suffer optimism bias.[157] Sivak et al[158] found that older drivers' perceptions of hazards were significantly different to the younger age groups; they found risks to be more apparent than younger drivers did. Goselin et al[159] (2010) found that, despite Sivak et al's findings, older drivers likewise suffered significantly from optimism bias. Thus regardless of age of the driver a clear belief of being better than the average driver (regardless of the average driver's age) was exhibited, which, as many studies point out, is statistically impossible. Sandroni and Squintani[160] found no evidence that a person's optimism lessens with age or experience. Furthermore, the authors found that those who are considered the most optimistic are most likely to engage in poor choice risk mitigation strategies.

The problem with overoptimistic assessments of ones skill at driving are, as Reason et al[161] found, they are the drivers most likely to be those who report engaging in road traffic violations. The authors suggest two factors may be at work, either the driver considers himself or herself to be so skilful that they can engage in more risky driving or they think of themselves as good drivers because they so frequently 'get away' with violations.

Thus attitudes to road danger, and their link to safe driving behaviour, are mitigated by the extent of optimism in driving skill. What optimism bias research demonstrates is that drivers are typically poor estimators of their own skill compared to other drivers. Thus, a driver with an attitude to risk on the road that is focused on safety may still be a risky driver if their sense of what constitutes risk is underestimated, or their belief in their ability to mitigate risk is overinflated.

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[156] Gosselin, D. et al. (2010) Comparative optimism among drivers: An intergenerational portrait. Accident analysis and prevention. [Online] 42 (2), 734–740.

[157] Harré, N., & Sibley, C. G. (2007). Explicit and implicit self-enhancement biases in drivers and their relationship to driving violations and crash-risk optimism. *Accident Analysis and Prevention, 39*(6), 1155–1161. https://doi.org/10.1016/j.aap.2007.03.001

[158] Sivak, M., Soler, J., Tränkle, U. and Spagnhol, J.M., 1989. Cross-cultural differences in driver risk-perception. *Accident Analysis & Prevention*, *21*(4), pp.355-362.

[159] Fn156

[160] Sandroni, A. and Squintani, F., 2013. Overconfidence and asymmetric information: The case of insurance. *Journal of Economic Behavior & Organization*, *93*, pp.149-165.

[161] JAMES REASON , ANTONY MANSTEAD , STEPHEN STRADLING , JAMES BAXTER & KAREN CAMPBELL (1990) Errors and violations on the roads: a real distinction?, ERGONOMICS, 33:10-11, 1315-1332, DOI: 10.1080/00140139008925335

Intergenerational Risk

As stated above, risk perceptions do not arise in a vacuum. There are multiple inputs already examined that alter those perceptions. Studies have also examined the influence of parents on their children's driving attitudes and behaviour. Intergenerational offending, the passing on of offending traits and characteristics from parents to children, has been studied in road danger research.

Parents who have at fault collisions in their vehicle are more likely to have children who are also responsible for at fault collisions in their driving, and that parental speeding is associated with increased risk of speeding in their children.[162] Thus, parents may aggravate the risks to a young driver through poor driving examples that influence their child.

Parental driving aggression and driving anxiety have been found to have a direct link with child driving aggression and anxiety one year after passing a driving test.[163] Interestingly the authors of this study also found that a reckless driving style by the mother tends not to transfer to the children, nor does a careful driving style of the father.[164]

Shope et al[165] in an interesting longitudinal study analysed childhood attitudes, parental relationships and the impact this had on driving risk. The authors used survey data collected at age 15 on a range of attitudes and experience of drug and alcohol use as well as parental control and then compared this to the same participants who had obtained a driving licence and had been driving by the age of 23-24. The authors found that self-reported substance misuse at 15 was a strong predictor of excess risk for serious road traffic offending and crashes. Furthermore, low levels of parental monitoring, familial bonds and leniency towards youth drinking also were significant predictors of crash risk and serious offending.[166]

The extent to which parental monitoring / control is effective in controlling children who may fall foul to negative driving risk peer pressure was examined by Smorti et al.[167] The authors found no direct or indirect link between parental control and subsequent risky driving

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162 Wilson, R.J., Meckle, W., Wiggins, S. and Cooper, P.J., 2006. Young driver risk in relation to parents' retrospective driving record. *Journal of Safety Research*, *37*(4), pp.325-332.
163 Miller, G. and Taubman-Ben-Ari, O., 2010. Driving styles among young novice drivers—The contribution of parental driving styles and personal characteristics. *Accident Analysis & Prevention*, *42*(2), pp.558-570.
164 Ibid 567
165 Shope, J.T., Waller, P.F., Raghunathan, T.E. and Patil, S.M., 2001. Adolescent antecedents of high-risk driving behavior into young adulthood: substance use and parental influences. *Accident Analysis & Prevention*, *33*(5), pp.649-658.
166 Ibid,p. 656
167 Smorti, M., Guarnieri, S. and Ingoglia, S., 2014. The parental bond, resistance to peer influence, and risky driving in adolescence. Transportation research part F: traffic psychology and behaviour, 22, pp.184-195.

practices of their children, which contradicts both Miller et al[168] and Wilson et al[169]. This may be due to a national / culture disparity in that Smorti et al's study was conducted in Italy whereas studies conducted in America[170] and Australia[171] found the opposite. What Smorti et al did find is that the mother-offspring relationship did mediate the extent to which peer pressure affected the young driver, and that peer pressure was a significant predictor of risky driving behaviour.[172] Thus, mothers may be able to moderate risky driving behaviour of their children by fostering an attitude that is resistant to peer pressure.

In Australia, Scott Parker et al[173] found that failure to punish risky driving or demonstrate disapproval of risky driving behaviour (from parent or peers) increased the likelihood of self-reported risky driving behaviour.[174] They also found that embarrassing their children for risky driving behaviour tended to increase self-reported risky driving behaviour in their offspring.

Parents can also have a moderating / mitigating effect on young driver risk through extra control in terms of access to vehicle / driving opportunity or by providing a general moderating influence by being present in the vehicle.

One strategy for managing risk on the road, particularly for young drivers,[175] is to involve third parties in the monitoring of journeys post driving test / licensure. For parents there are two forms of post licence monitoring that have been studied. Firstly, the parent can set acceptable driving behaviour practice through controlling access to the vehicle and who may ride in the vehicle. Another way in which a parent may influence the driving behaviour of a child is through their presence as a passenger in the vehicle.

In general, having a passenger in the vehicle can have both a calming and aggravating effect on the driver.[176] Being a male passenger, a friend or 16-24 year old regardless of the

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[168] FN163
[169] FN162165
[170] See FN's 162 & 163
[171] Scott-Parker, B., Watson, B., King, M.J. and Hyde, M.K., 2015. "I would have lost the respect of my friends and family if they knew I had bent the road rules": Parents, peers, and the perilous behaviour of young drivers. Transportation research part F: traffic psychology and behaviour, 28, pp.1-13.
[172] FN167
[173] FN171
[174]
[175] Although there are seemingly no studies that examine the opposite effect – young driver presences / influence on riskier driving in adults.
[176] Conner, M., Smith, N. and McMillan, B., 2003. Examining normative pressure in the theory of planned behaviour: Impact of gender and passengers on intentions to break the speed limit. *Current Psychology*, *22*(3), pp.252-263.

drivers sex, tends to have a risk aggravation effect[177]. Passengers may have a similar effect on older drivers Regan & Mitsopoulos argue due to frustration from younger passengers about slower and more cautious driving from those aged 65+.[178] There are two main ways in which passengers aggravate risk for the driver, either through distraction (e.g. having conversations) or a general shared risky attitude that encourages unsafe driving.[179] Conversely, passengers may also provide for safer driving as the passenger lifts some of the mental demands that would otherwise be placed on the driver,[180] answering the phone, changing the stereo, hazard spotting etc.… and also providing for a calming effect by encouraging safer practices.

The impact of passenger expectations about risk and driving does have a gendered dimension in that males are more likely to feel the pressure to speed and have less control over their speeding behaviour than females. This effect also lasted longer for males into situations where there was no passenger present.[181] Where a driver feels some level of responsibility for the safety and comfort of their passengers then they are more likely to lower their risk of speeding.[182]

Parental Monitoring of Driving

Beck et al[183] studied the differences in parental and child attitudes over a range of deviant driving behaviour. Parents were asked whether they set rules on driving behaviour (such as time of day, passengers etc.) as well as consequences for breach of behavioural expectations. The study found that all young drivers, regardless of parental attitudes, increased their risk over a 9-month period following qualification. This was most pronounced during the first 4 months – suggesting this is the key point at which bad behaviours are learned.[184] Whilst there was agreement between both the young driver and parents on what

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[177] Regan, M. A., & Mitsopoulos, E. (2001). Understanding passenger influences on driver behaviour: Implications for road safety and recommendations for countermeasure development, Report 180. Melbourne: Monash University Accident Research Centre.
[178] FN177 p. 66
[179] ibid
[180] Ibid
[181] FN176
[182] Fleiter, J.J., Lennon, A. and Watson, B., 2010. How do other people influence your driving speed? Exploring the 'who' and the 'how' of social influences on speeding from a qualitative perspective. *Transportation research part F: traffic psychology and behaviour*, *13*(1), pp.49-62.
[183] Beck, K.H., Hartos, J.L. and Simons-Morton, B.G., 2006. Relation of parent-teen agreement on restrictions to teen risky driving over 9 months. *American Journal of Health Behavior,* 30(5), pp.533-543.
[184] FN183 p. 540

were acceptable limits a parent could place on their children when driving, this had no impact on actual risk.[185]

Parents may set limits on young driving through an acceptable driver contract putting limits on who they may drive with, hours of driving, time of driving and number of passengers.[186] Simons-Morton et al found that setting acceptable limits on children driving has been effective in lowering risk, albeit the associations were on the weaker side[187] and that strict conditions implemented at the stage of passing ones test are more effective, and long lasting, than seeking to implement new restrictions post licensure.[188]

Hartos et al[189] have found that parents can influence the driving risk of their children, and that high risk driving scores for young drivers is correlated with low parental restrictions on driving and low parental monitoring of that driving. As the authors note, it is unclear what the directional nature of this relationship is, it could be that low risk drivers are more like have restrictions imposed and / or through positive socialisation where the child come to respect their parents views higher than those who are risky drivers.

To test whether presence of a parent in the vehicle influences young driver risk Orit Taubman et al[190] have studied the influence of parents on young male driving behaviour and attitudes to risk in Israel. Israel, since 2013, has mandated that new young drivers must have a telematics device fitted, not drive unless accompanied for the first three months of licence, not drive at night unaccompanied for the first 6 months and any accompanying drivers must be over the age of 24[191] (or 30 if less than 3 years driving experience).[192] The study focused on drivers who had passed their graduated licence probation period and no longer needed supervision. It found that parental training and feedback correlated positively with less risky driving and furthermore where parents held higher reported risky driving scores their offspring tended to have high scores also. Thus, parental supervision whilst driving does affect driving risk in their children. Interestingly, as hypothesised by Hartos et

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185 ibid
186 Simons-Morton, B.G., Hartos, J.L. and Leaf, W.A., 2002. Promoting parental management of teen driving. Injury Prevention, 8(suppl 2), pp.ii24-ii31.
187 FN186 p.29
188 ibid
189 Hartos J, Eitel P, Simons-Morton B. Parenting Practices and Adolescent Risky Driving: A Three-Month Prospective Study. Health Education & Behavior. 2002;29(2):194-206. doi:10.1177/109019810202900205
190 Taubman–Ben-Ari, O., Lotan, T. and Prato, C.G., 2017. Young male drivers' risky driving 15 months after licensure–The role of intervention, attitudes towards accompanied driving, and parents' risk. *Transportation research part F: traffic psychology and behaviour*, 51, pp.73-80.
191 Ibid
192 FN190 p.74

al,[193] one moderator of the above findings was that young drivers who saw the accompaniment as means to bond with their parents reported reduced risk scores, whereas those who saw it as a source of tension reported high road risk scores.[194] Thus, it is not simply the presence of parents in the vehicle but the nature of the relationship that matters.

The international dimension

Nordfjaern et al[195] examined cross-cultural attitudes to risk 6 states (Norway, Russia, India, Uganda, Ghana and Tanzania) and found differences in risk perception, risk sensitivity and risk willingness. Those in sub-Saharan Africa are more sensitive to road traffic risk but also that they are more likely to engage in risky behaviour (risk willingness). The authors hypothesise the reason for this is the lower incident of car ownership in sub-Saharan Africa and thus drivers are probably influenced more by their position as a pedestrian than as a driver – thus having lesser feelings of control over road risk. Norwegians reported the safety attitudes to drink driving and speeding, probably as a result of road danger campaigns running in Norway. Interestingly the Sub-Saharan African countries and India reported more willingness to speak out about poor driving, road traffic offending and pedestrian safety. Again the authors hypothesise this may be because of respondents seeing themselves more as passengers or pedestrians than as drivers.

Pires et al[196] use the international *E-Survey of Road Users Attitudes* (ESRA) to examine attitudes to risk across 32 nations participating in the survey. The survey was conducted in 2018-2020 and sampled over 1000 representative individuals of their respective states in 32 nations. The survey collected data on a range of road danger themes, including support for road policy, enforcement, crash involvement, subjective safety and risk perception, transport mode and demographics. The study found a uniformity in views about the road danger effects of various illegal behaviours (drink / drug driving, speeding, mobile phone use, fatigue) as respondents saw these as the main causes of road crashes. Affirming the

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193 See FN189
194 FN190, p. 78
195 Nordfjærn, T., Jørgensen, S. and Rundmo, T., 2011. A cross-cultural comparison of road traffic risk perceptions, attitudes towards traffic safety and driver behaviour. Journal of Risk Research, 14(6), pp.657-684.
196 Pires, C., Torfs, K., Areal, A., Goldenbeld, C., Vanlaar, W., Granié, M.A., Stürmer, Y.A., Usami, D.S., Kaiser, S., Jankowska-Karpa, D. and Nikolaou, D., 2020. Car drivers' road safety performance: A benchmark across 32 countries. *IATSS research*, *44*(3), pp.166-179.

findings of Rolison et al[197] that drivers are generally accurate in estimating the likely causes of crashes.

Pires et al[198] also found that, notwithstanding the low social acceptability of these behaviours, participation in them was widespread. Speeding was the most frequent self-reported behaviour; the highest of these reports were from Europe and the United States of America. Such drivers underestimate the risk of speeding and its contributions to road traffic collisions and the severity of those collisions.

Mobile phone use whilst driving was most prevalent in Africa and although less frequent in America and Asia, use was still substantial.[199] Worryingly hands-free use, (which is as risky as handheld use[200]) was higher in all regions of the world, from 47.7% in Europe to 66.8% in Africa. In a surprising finding drivers are less accepting of fatigued drivers than drink drivers. In North America and African fatigued driving was viewed as less acceptable than drug driving. Nevertheless 20% of all respondents had admitted to driving whilst fatigued, whereas 14% of drivers admitted to drink driving and 13% for drug driving.

Pires et al also surveyed drivers on their beliefs as regards enforcement of road safe behaviours and found broad support for increasing enforcement, stronger penalties and tightening of laws. However, an important caveat to this is the phenomenon that drivers consider themselves to be above average drivers and have a heightened sense of personal morality compared to other drivers. Believing that others were the cause of risk rather than themselves.[201,202]

New forms of transport

Autonomous Vehicles and Risk

One major development on the horizon that has the potential to have a dramatic effect on road risk is the development of autonomous vehicles. The Law Commission has recently

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[197] Rolison, J.J., Regev, S., Moutari, S. and Feeney, A., 2018. What are the factors that contribute to road accidents? An assessment of law enforcement views, ordinary drivers' opinions, and road accident records. Accident Analysis & Prevention, 115, pp.11-24.
[198] ibid
[199] Ibid p. 175
[200] Haque, M.M. and Washington, S., 2015. The impact of mobile phone distraction on the braking behaviour of young drivers: a hazard-based duration model. *Transportation research part C: emerging technologies,* 50, pp.13-27.
[201] See p.175
[202] Briggs, Gemma; Hole, Graham and Land, Michael (2011). Emotionally involving telephone conversations lead to driver error and visual tunneling. *Transportation Research Part F: Traffic Psychology and Behaviour, 14 pp. 313–323.*

reviewed the law on autonomous vehicles[203] and adopted the Society of Automotive Engineers typology of autonomy.[204] This typology has 6 levels of automation – Level 0 representing no automation and Level 5 representing full automation. We are still a long way from full automation.[205] The Law Commission has proposed something of a radical change in the law away from personal responsibility in level 5 vehicles to, what the commission labels, an ADSE (authorised self-driving entity). Regulatory fines will instead be imposed on manufacturers in the event of breach of regulatory requirements.

Knowledge about risk and the safety of autonomous vehicles is certainly key in any decisions about the uptake of autonomous vehicles by consumers, especially the use of such vehicles to transport ones children.[206]

Wang et al[207] found that an attitude that favours early adoption of technology and those who support traffic laws are most likely to be early adopters of fully autonomous vehicles. However, those who have a risk averse attitude (cautious drivers) are least likely to adopt level 5 vehicles. It would appear that the public at large is, for the most part, weary of full vehicle autonomy. In Wang et al[208] most of their panel were reluctant to adopt level 5 vehicles. Similarly Haboucha et al[209] 44% of respondents stated they would rather continue with a non-autonomous vehicle.

The extent to which the driving public see AVs as safer, or riskier, than current vehicles and drivers needs further study. In understanding future levels of acceptable risk the Law Commission propose the creation of an "in use safety regulator"[210] to implement standards of self-driving developed by the Secretary of State. The Law Commission does not believe that the system should set that all risk be eliminated.[211] Although not a specific recommendation, the commission does state that a 'positive risk balance was seen as the minimum

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203 Law Commission. 2021. *Automated Vehicles Joint Report*. Law Commission, London
204 SAE. 2021 Taxonomy and Definitions for Terms Related to Driving Automation Systems for On-Road Motor Vehicles. Retrieved from https://www.sae.org/standards/content/j3016_202104/ accessed on 28/10/22
205 Accenture. 2021. Rebooting Autonomous Driving retrieved from https://www.accenture.com/cz-en/insights/automotive/rebooting-autonomous-driving accessed 28/10/22
206 Jing, P., Du, L., Chen, Y., Shi, Y., Zhan, F. and Xie, J., 2021. Factors that influence parents' intentions of using autonomous vehicles to transport children to and from school. *Accident Analysis & Prevention*, *152*, p.105991.
207 Wang, S., Jiang, Z., Noland, R.B. and Mondschein, A.S., 2020. Attitudes towards privately-owned and shared autonomous vehicles. *Transportation research part F: traffic psychology and behaviour*, *72*, pp.297-306.
208 ibid
209 Haboucha, C.J., Ishaq, R. and Shiftan, Y., 2017. User preferences regarding autonomous vehicles. *Transportation Research Part C: Emerging Technologies*, *78*, pp.37-49.
210 FN 203 Chapter 4
211 Ibid p.55

acceptable standard: overall, automated driving should cause fewer deaths and injuries than human drivers'[212]. They further suggest three potential options based on earlier consultation exercises: Option A: as safe as a competent and careful human driver; Option B: as safe as a human driver who does not cause a fault collision; and Option C: overall, safer than the average human driver. Responses were mixed with supporters for each option and also for none of the options.

The Secretary of State and in-use regulator will undoubtedly have a difficult task in navigating these options particularly as road danger is not static. The report suggests that if setting a percentage improvement on road risk this should be kept under review every five years.

Whether, in future, the public see autonomous vehicles as risk generating vehicles or drivers of non-autonomous vehicles, as a dangerous relic of a bygone era is an open question. This is unlikely to be a question with real practical significance in the short-term future. However, when RoadPeace enters its 60th year in 2052 it remains to be seen whether the safety standards of autonomous vehicles has produced significant safety gains.

Electric Vehicles

Electric vehicles are a form of transport that swaps physical effort (in bikes) or injection engine (in motor vehicles) for an electronic motor. In E-bikes motors ensure that these type of vehicles can accelerate faster than a non-electric cyclist and reach speeds that would otherwise be unattainable by anyone other than an Olympic cyclist. The UK and EU governments have mandated top speed requirements for e-bikes of 25 km/h to ensure the safety of the rider and anything or person they come into contact with. Cherry and MacArthur[213] in a meta-review of e-bike safety found that they are generally as safe as the non-electric bicycle, although those with a possible top speed of 28mph tend to result in slightly higher rates of severity.

The silence of all e-vehicles has also been recognised as a potential safety concern. Research for the RNIB in 2019 found that electric vehicles (cars in this case) were 40% more likely to hit a pedestrian than a conventional vehicle.[214] Since 2019 manufacturers have been required to fit an audible vehicle alert system (AVAS) once they travel above

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[212] Ibid p. 65

[213] Cherry, C.R. and MacArthur, J.H., 2019. E-bike safety. A review of Empirical European and North American Studies. *Light Electric Vehicle Education and Research Initiative. https://wsd-pfbsparkinfluence. s3. amazonaws. com/uploads/2019/10/EbikeSafety-VFinal. pdf*.

[214] Reported here: https://www.theguardian.com/environment/2018/may/06/new-law-combats-silent-menace-electric-cars

12.4mph. Existing vehicles manufactured before this date are not required to retrofit the AVAS.E-scooters are a mode of micromobility. At present legal systems are struggling with the demand for E-Scooters, some states/cities have positively encouraged the uptake of this mode of transport (Taiwan[215], Detroit[216], and Copenhagen[217] amongst others). Others have either retreated from a laissez faire attitude to increasing regulation (Paris[218], Madrid[219]) or have adopted a hybrid approach allowing rental scooters but not privately owned ones to use the public road network (UK).

PACTS (2022) conducted a preliminary estimate in the dangers of e-scooter use, analysing hospital data, police reports and media reports of e-scooter crashes[220]. It showed that private e-scooters were the most risky form of e-scooter use accounting for 69% of all casualties.[221] It also highlighted the increased risk to pedestrians of e-scooters sharing space and the silent nature of the electric motors. The report made a number of recommendations including suggestions for regulatory requirements of private e-scooter use. Since its report, the government has indicated that it intends to press ahead with private e-scooter regulation in a Transport Bill[222], although this has yet to materialise. As regards rental e-scooters there is currently an on-going trial across the country in various local authorities. Currently the trials have been extended from their original 12-month plan to 30th November 2022.

Following PACTS recommendations, the government now collect statistics on e-scooter crashes in the STAT20 reports. In 2021 there were 1352 e-scooter collisions, 10 fatalities all of which were the riders of the scooter, 421 seriously injured and 1003 slightly injured.[223] The overwhelming majority of collisions involve are male (79%) and in the age groups 10-39, which account for 84% of all e-scooter casualties.[224]

E-scooters are here to stay but the form of regulation and the comparative "safety" of this form of transport is still unclear. There have been numerous studies into the uptake of e-

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215 Hwang, 2010
216 Gallagher, 2018
217 Tapper, 2019
218 Tapper, 2019
219 AFP, 2019

220 PACTS 2022. The Safety of Private E-Scooters In the UK, London.
221 P. 44
222 See Queens Speeach 2022: Transport - https://lordslibrary.parliament.uk/queens-speech-2022-transport/
223 DfT. 2022 Reported Road Casualties Great Britain: E-Scooters Factsheet 2021, retrieved from https://www.gov.uk/government/statistics/reported-road-casualties-great-britain-e-scooter-factsheet-/2021/reported-road-casualties-great-britain-e-scooter-factsheet-2021 accessed 7/11/22
224 ibid

scooters across the world all of which tend to show different demographics adopting e-scooters at different rates. What effect this mode of transport will have on the overall goal of reducing road danger is yet to be seen. The preliminary reports do not paint an optimistic picture. Research suggests that there is a modal shift away from car journeys to e-scooters for small micro journeys.[225] However, the danger profile of an e-scooter journey suggests that they are a more risky form of transport.[226,227] Additionally the extent to which e-scooters are used in furtherance of criminal activities, as a replacement for the moped, will also impact on road risk reduction. Police forces will, if they have not already done so, have to rethink their policies on tactical contact for escaping e-scooters and e-bicyclists.

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225 Wang, K., Qian, X., Fitch, D.T., Lee, Y., Malik, J. and Circella, G., 2022. What travel modes do shared e-scooters displace? A review of recent research findings. *Transport Reviews*, pp.1-27.
226 See PACTs above
227 Austin Pubic Health, 2019. Dockless Electric Scooter – related injuries study, City of Austin Department of Public Health, Retrieved from https://www.austintexas.gov/sites/default/files/files/Health/Epidemiology/APH_Dockless_Electric_Scooter_Study_5-2-19.pdf last accessed on 7/11/22

Conclusions

As stated at the start of this report the causalities of road traffic collisions extend beyond the immediate person injured or killed. The families and friends of those injured or killed have an uphill battle to obtain justice through the legal system. Recent developments in sentencing law have meant that more punitive sentences are now available, and the Sentencing Council has recently consulted on new sentencing guidelines for a range of motoring offences related to death and serious injury on the road. In the next stage of this research the experience of those who have gone through the system, and those who are going through the system, will be examined. It is not possible to make roads *safe*. Despite the promises of design, automation, technology and advances in education, travelling by road will always involve a risk. Risk on the road is a calculation that involves trading the personal, social and societal benefits that road travel brings with the costs of potential injury and death[228].

It is possible to be a *safer* driver by changing behaviours and attitudes that contribute to high risk on the road. The fact that 73% of all crashes are caused by poor driving decisions should alert us to the fact that we can do so much better. This report sets out where risk is at its highest by mode of transport, road type, behaviours and age.

It is not just drivers who bear the responsibility for safer roads, government likewise needs to provide a system of regulation and enforcement that has risk reduction at its heart. Tackling risk through regulation and punishment is not easy, and unlikely to be popular in the short term. For many, a small fine and penalty points will seem an unjust imposition of a punishment for a risk that never eventuated. However, regulating the roads requires wider thinking than the individual incident of driving (and the risk it created). Risk is a system wide concern, each individual incident adds to the risk perceptions of drivers.

For every incident of speeding that results in no negative outcome, for every moment of carelessness that goes unpunished it adds to the driver's sense of optimism and feelings of over-confidence behind the wheel. These individual instances accumulate and drivers become over-optimistic about their ability to control the vehicle and respond to other road users. Habits form that perceive speeding, careless and dangerous manoeuvres as

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[228] One should also add potential harm to the environment – although not studied in this report

normalised routines whilst driving / riding. Appreciation of the risks then decreases, potentially leading to increases in collisions and injury for all road users.

Governments can alter these perceptions through policy and strategies that promote better driving behaviours and focus on casualty risk reduction. The experience of the period 2004-2010 demonstrates what can be achieved with concerted effort aimed at lowering risk. Vision Zero can deliver if it is backed by government action.

New forms of transport will alter our perceptions of risk, but they will not lead to *safe* roads. Electric vehicles whilst promising improvements in environmental impact, nevertheless come with similar risk to their non-electric counterparts. Whether it is the silence of the motor, the improvements in acceleration, or, in the case of e-scooters, the leaving of a hefty piece of machinery in the middle of the pavement, risks are created. The extent to which this is a reorganisation of risk from one mode of transport to another, with no overall increase in risk, is yet to be firmly established. The evidence from PACTS on E-scooters suggests some increase in risk. Driving / riding of any vehicle is an inherently risky activity and one for which we all owe a duty to ourselves and others to take seriously.

This research has focused on risk at the population level, examining the risk created by driving and drivers as a group. Of course when that risk eventuates, and harm is caused, the pain and horror is experienced by individuals, families and communities. How the justice system responds to these individual incidences forms part of the next phase of this research.

A lot has changed in the 30 years since the foundation of RoadPeace. Vehicle safety has become a key part of any manufacturers USP. Many of these changes have arisen from a need to protect the driver from him or herself: lane keeping, auto breaking, fatigue detection, and air bags throughout the vehicle. The one thing in common with all of these developments has been the need to design out human error. These developments have led to increases in survivability and reductions in collisions, our risk is not, thankfully, what it once was. Nevertheless, we cannot be complacent; driver / rider error is still the leading cause of collisions and fatalities. One can only hope in the next 30 years we have learned this lesson and that human error is seen as unacceptable as it should be.

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