accidents don't have to happen

# RoSPA Policy Paper

## Cycling

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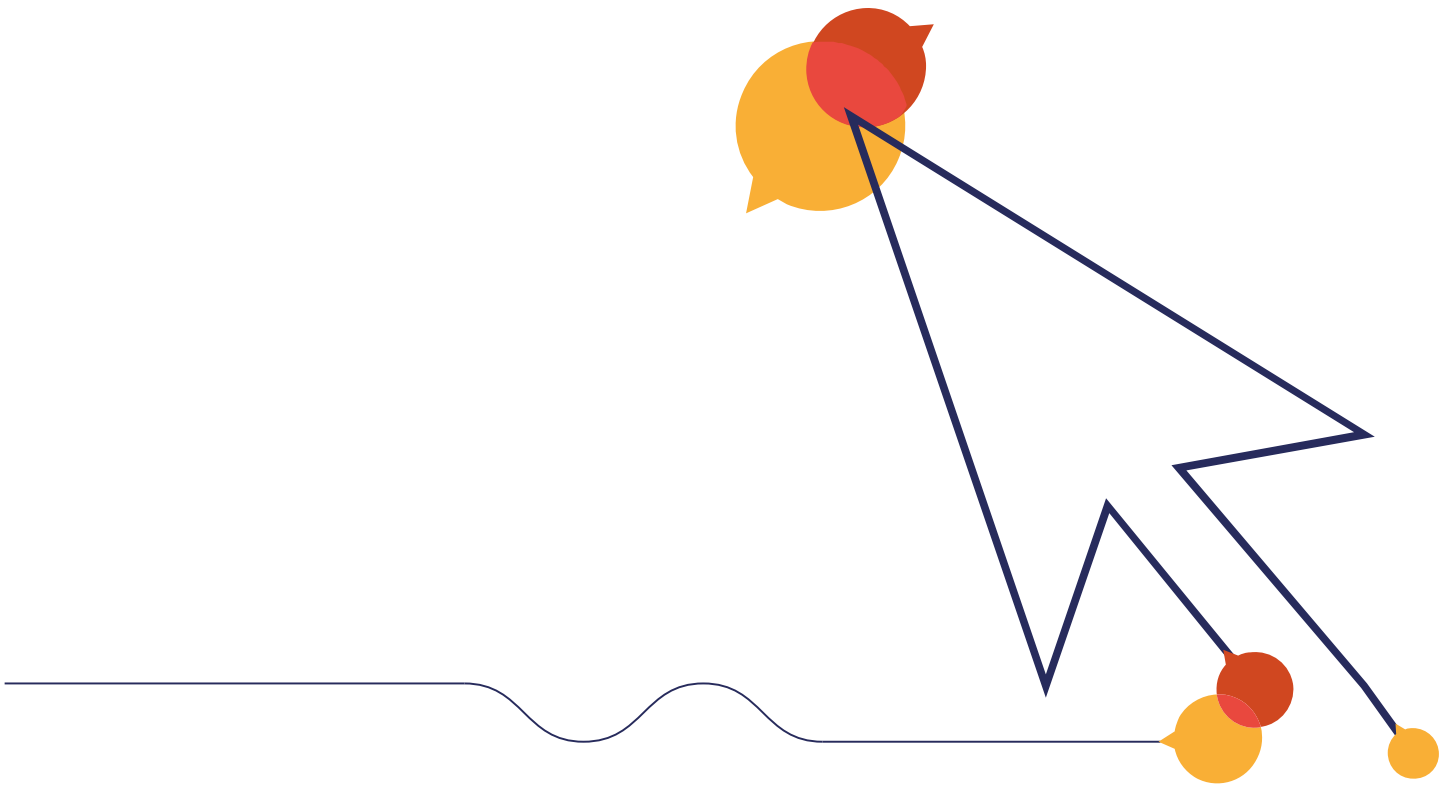

# Contents

# Summary statement

Cycling in Great Britain is increasing because it is an excellent way to get about and provides a wide range of health and environmental benefits. Unfortunately, it also carries a certain amount of risk, and so we need to ensure that more cycling does not lead to more cycling casualties. The key is to create a safe on and off-road cycling environment, improve driver and cyclist attitudes and behaviour towards each other, and to produce safer vehicles that reduce the risk to cyclists. This RoSPA Policy Paper recommends a comprehensive range of measures to reduce cyclist casualties and help people who want to cycle, but are deterred from doing so because they think it is not safe enough.

# Executive summary

Cycling in Great Britain is increasing (although not uniformly across the country) because it is an excellent way to get about, and provides a wide range of health and environmental benefits. Unfortunately, it also carries a certain amount of risk because the road environment often does not cater for cyclists' needs well enough. The attitudes and behaviour of some drivers and cyclists also increases the risk of cyclist crashes and casualties.

Therefore, we all face a crucial challenge, which is to create safer cycling conditions so that more cycling does not lead to more cycling casualties.

Improving the safety of cycling will reduce the number of cyclist casualties and encourage and enable more people to cycle more often. It will help people who want to cycle, but are deterred from doing so because they think it is not safe enough, and help to prevent the increase in cycling being followed by an increase in cyclist casualties. This, in turn, will increase the health and environmental benefits of cycling for those people who cycle and for society as a whole.

RoSPA strongly supports measures which encourage healthy and sustainable travel. The key to increasing cycling (and so gaining all the health and environmental benefits that result from cycling) is to create a safe on and off-road cycling environment, improve driver and cyclist attitudes and behaviour towards each other, and to produce safer vehicles that reduce the risk to cyclists.

RoSPA advocates the Safe System Approach, which involves designing roads and vehicles to minimise the risk of crashes occurring, and ensures that when they do occur, they are unlikely to result in death or serious injury. 20 mph schemes are a good example of the Safe System approach because lower speeds reduce the risk of crashes occurring and the severity of any that do occur.

Other countries, such as the Netherlands, Denmark and Sweden, have much higher cycling levels than the UK, but lower cyclist death rates. This shows that it is possible to increase cycling without increasing cyclist crash and casualty rates.

This policy paper:

- Examines the health and environmental benefits of cycling
- Outlines the level and nature of cycling crashes and casualties in Great Britain
- Explores how roads can be designed to reduce the risk to cyclists, and so help more people to cycle safely
- Explores how driver and cyclist attitudes and behaviour can be improved to reduce the risk to cyclists, and so help more people to cycle safely
- Explores how the risk of HGV and cyclist collisions can be reduced

- Examines the evidence of the relationship between traffic volume and cyclist casualties
- Makes recommendations for creating a safer cycling environment that will help to reduce the number of cyclist casualties, prevent the increase in cycling resulting in an increase in cyclist casualties, and help people who want to cycle, but are deterred from doing so because they think it is not safe enough.

# Introduction

## Purpose of this policy paper

This policy paper has three main objectives:

1. To review and summarise information on the benefits and risks of cycling in Great Britain

2. To identify the best ways of meeting the challenge of increasing cycling without also increasing cyclist casualties.

3. To produce evidence and recommendations that will assist RoSPA and other organisations to tackle this challenge.

Although this policy paper focuses on cycling, many of the principles discussed also apply to walking. Both are important and valuable forms of physical activity and transport, which should be accorded equal priority in terms of public policy. Many of the health benefits gained from cycling can also be gained from walking, and many of the measures to improve cycling safety (for example, speed management) also improve walking safety. However, they are two very different modes, and mixing them together inappropriately can cause fear, anxiety, insecurity and even serious injury.

Policies and infrastructure to promote cycling, and improve cycling safety, should not be made in isolation. Both pedestrians and cyclists are highly vulnerable to, and restricted by, motor traffic. It is important to recognise that both are vulnerable road users, and aim to reduce the risk of collisions, and produce an environment in which both pedestrians and cyclists feel safe using, as well as to improve driver behaviour.

## Levels of cycling

Over much of the 20th century, the level of cycling in Great Britain fell substantially, at the same time as levels of motor vehicle traffic increased massively. However, recent years have seen an upsurge in cycling (although levels vary across the country), which has been supported by a significant increase in investment in promoting cycling and providing a safer cycling environment.

Over the last 15 to 20 years, the average distance travelled by bicycle increased by 15%, from 46 miles per person per year in 1995/97 to 53 miles in 2016. The average distance travelled by bike by London residents has increased by 55% since 1995/7[1]. In 2014/15, 14.7% of adults in England cycled at least once a month, 9.5% cycled at least once a week and 2.6% cycled at least five times a week[2].

However, cycling varies across the country with higher levels in the East, East Midlands, and parts of the South East; and lower levels in the North East. The areas with the highest levels of cycling (at least once a month) were Cambridge (58%), Oxford (43%), York (34%), Richmond upon Thames (33%), Wandsworth (31%) and South Cambridgeshire (29%) [2].

Cycling levels in London increased by 150% between 2000 and 2010. Nationally, the popularity of cycling as a spectator sport has increased following the Olympics and the Tour de France grand depart from Yorkshire in 2014, which may encourage more people to start cycling in the future[3].

Currently, more people cycle for recreational purposes than for utility purposes (e.g., commuting or shopping). Around 10% of people cycle recreationally at least once per month, 6.5% cycle for utility purposes and 2.8% cycle to work. Men are more likely to cycle than women (20% v 10%). Women account for about half of occasional (once a month) cyclists, but smaller proportions of more frequent cyclists[2].

The peak age ranges for adult cycling for men and women is 16 to 24 and 35 to 44 years. However, on average, at all ages, lower proportions of women than men tend to cycle for all purposes[2].

In England as a whole, the prevalence of cycling at least once per month in the year ending mid-October 2015 remained the same as the previous year, at 14.7%[2].

Over 34 million cycling trips were made on the National Cycle Network in Scotland in 2012, a 2.6% increase on the previous year. Almost one quarter (24%) of these trips were for commuting, compared with just under 17% in 2011[4].

In Scotland, the overall number of primary school children cycling to school in 2014 was 5% compared to 3.7% in 2010. The number of secondary school children cycling to school has fallen to 0.9% in 2014 from 1.2% in 2010[5].

In Wales, the 2014 Travel Survey showed that 6% of people aged 16 years and over travelled by cycle for active travel trips at least once a week. Of these journeys, going to the shops, going to work and visiting friends were the main reasons[6].

The general conclusion that can be drawn from these data is that cycling in Great Britain is increasing, but not uniformly across the country. Some areas, such as London, have seen significant increases, but other areas have only seen small increases, or even reductions.

## Comparisons with other countries

Comparing European data with the UK is difficult because of the different ways data is collected. The UK is only one of three EU countries, together with Denmark and the Netherlands, that measures cycle use at the national level on an annual basis. Sweden and Norway also collect data on a regular basis. Using this data, the European Transport Safety Council (ETSC) compared cycle use and cycle safety in these five countries, producing the following table which shows the number of cyclist deaths per billion kilometres ridden in each country.

**Table 1: Distance cycled per person and cyclist fatality rate by country, 2001 – 2010[7]**

| Country | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | Av. For last 3 years | Km cycled per person |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Norway | 11.5 | n/a | n/a | n/a | 10.1 | n/a | n/a | n/a | 11.0 | n/a | 11.0 | 171.1 |
| Denmark | 19.6 | 17.2 | 15.8 | 18.8 | 13.6 | 10.4 | 18.8 | 17.8 | 8.5 | 9.9 | 12.1 | 521.3 |
| Netherlands | 17.3 | 15.1 | 15.9 | 13.1 | 12.7 | 15.4 | 13.4 | 13.2 | 12.3 | 11.6 | 12.4 | 863.2 |
| Sweden | n/a | n/a | n/a | n/a | n/a | 14.4 | n/a | n/a | n/a | n/a | 14.4 | 198.9 |
| UK | 33.1 | 30.2 | 25.7 | 32.4 | 34.3 | 31.7 | 32.5 | 24.2 | 21.0 | 22.1 | 22.4 | 79.7 |

Broadly speaking, the comparison found that some European countries have much higher levels of cycling than the UK, but lower cyclist fatality rates, showing that cycling is much safer in those countries than in the UK.

Countries such as the Netherlands, Sweden and Denmark have positive cycling cultures, supported by policies that promote cycling and give cyclist safety a very high priority. They have created safe cycling environments that include high quality segregated cycling routes that physically separate cyclists from motor vehicles, high quality non-segregated routes where the cycle lanes are marked on the road, and off-road, traffic-free routes.

Cycle facilities in these countries have good, smooth surfaces, are well-marked, signed and lit, and wide enough to allow side-by-side cycling and overtaking. Crucially, they do not tend to stop at junctions, and start again after the junction; they continue through junctions, often giving cyclists priority over motor vehicles.

These countries have also implemented policies and measures to reduce traffic volume, and speeds, especially on roads where there is insufficient space to provide a segregated cycle path.

Across Europe, many governments have similar aspirations as the UK, which is to increase the level of cycling without compromising safety. For example, the European Cycling Federation (ECF) and signatory cities of the Charter of Brussels[8] calls for an EU target of at least 15% of trips in Europe to be on a bicycle by 2020, together with a set of measures to halve injury and fatality rates for cyclists between 2010 and 2020.

# The benefits and risks of cycling

## The benefits of cycling

There is strong evidence[9,10,11] that cycling provides a wide range of health benefits, mainly because it is a convenient and affordable form of physical activity, and increasing physical activity reduces the risk of many forms of ill-health and disease.

Cycling can easily be incorporated into daily life – by cycling to work, school, to see friends or to the shops. It is estimated that from 1961 to 2005, there was a 20% reduction in physical activity within Britain, which is predicted to rise to 35% by 2030. More than 4 in 10 people do not take enough physical activity to achieve good health, which has significant negative impacts upon their lives. The All Party Commission on Physical Activity report estimates that physical inactivity leads to 37,000 premature deaths in England alone each year[12].

Lack of physical activity is one of the most important risk factors for coronary heart disease, with a physically inactive lifestyle doubling the risk compared to an active lifestyle. Regular exercise is central to improving the nation's health, with cycling being an excellent method of building regular exercise into people's daily lives.

In summary, regular physical activity:

- Reduces the risk of dying prematurely
- Reduces the risk of dying prematurely from heart disease
- Reduces the risk of developing diabetes
- Reduces the risk of developing high blood pressure
- Helps reduce blood pressure in people who already have high blood pressure
- Reduces the risk of developing colon and breast cancer
- Reduces feelings of depression and anxiety
- Helps control weight
- Helps build and maintain healthy bones, muscles and joints
- Helps older adults become stronger and better able to move about without falling
- Promotes psychological well-being.

In addition to these health benefits, there are also environmental benefits from cycling rather than driving, as cycling does not directly generate $CO_2$.

The Department for Transport estimates that it's possible to achieve a 50% $CO_2$ reduction in the UK's domestic transport sector by 2030, but only with real and early change in travel behaviour. Car Travel is the single biggest source of household and individual $CO_2$ emissions in the UK. More than half of all trips are 5 miles or less and account for 21% of $CO_2$ emissions. If all drivers reduced their driving by 5 miles a week, 2.7 million tonnes of $CO_2$ could be saved per annum[13].

## The risks of cycling

Every year in Britain around 18,500 cyclists are killed or injured in police reported road accidents, including around 3,500 who are killed or seriously injured.

**Table 2: Reported Cyclist Casualties and Fatality Rate per billion vehicle miles, Great Britain, 2006 - 2016**[14]

| | Killed | KSI | All | Fatality Rate |
|---|---|---|---|---|
| 2006 | 146 | 2,442 | 16,196 | 52 |
| 2007 | 136 | 2,564 | 16,195 | 53 |
| 2008 | 115 | 2,565 | 16,297 | 40 |
| 2009 | 104 | 2,710 | 17,064 | 35 |
| 2010 | 111 | 2,771 | 17,185 | 37 |
| 2011 | 107 | 3,192 | 19,215 | 35 |
| 2012 | 118 | 3,340 | 19,091 | 38 |
| 2013 | 109 | 3,252 | 19,438 | 34 |
| 2014 | 113 | 3,514 | 21,287 | 35 |
| 2015 | 100 | 3,339 | 18,844 | 31 |
| 2016 | 102 | 3,499 | 18,477 | 30 |

These are casualties that have been reported to the police. However, reporting rates for pedal cyclist casualties tend to be lower than for other road users, and cyclist non-fatal casualties are amongst the most likely to be under reported in data collected by the police, especially when the cycle was the only vehicle involved. Based on hospital data (Hospital Episode Statistics) the number of cyclist admissions is more than three times the number of seriously injured cyclists recorded by the police[15].

Traffic counts and the National Travel Survey suggest that cycling levels are around 13% to 20% higher than the 2005-9 average depending on the data collection method employed. Over the last few years, the number of cyclist deaths and casualties, and the cyclist fatality rate, has fluctuated, which suggests that more cycling is not automatically resulting in more cyclist casualties. However, the fluctuating fatality rate also suggests that cycling conditions are not yet becoming safer.

## Cyclist casualties

Most cyclist casualties are adults; of the 102 cyclist deaths in 2016, 94 were adults and 8 were children. Accidents involving child cyclists are often the result of the child playing, doing tricks, riding too fast or losing control. For cyclists, accidents are more likely to involve collisions with motor vehicles, but about 8% of their fatal or serious accidents that are reported to the police do not involve a collision with another vehicle.

**Table 3: Cyclist casualties by age, Great Britain, 2016[14]**

| | Child (0-15) | Young people (0-17) | Adults (18-59) | Adult (60+) |
|---|---|---|---|---|
| Killed | 8 | 10 | 62 | 30 |
| Serious | 309 | 404 | 2,606 | 349 |
| Slight | 1,664 | 2,321 | 11,516 | 905 |
| Total | 1,981 | 2,645 | 14,184 | 1,284 |

Most cyclist casualties are male (88 of the 102 cyclists killed in 2016 were male, as were 14,957 of the 18,477 overall casualties). However, although over 80% of cyclist casualties are male, they are only slightly higher risk when their higher cycling levels were taken into account[16].

For males, young cyclists in their teens and 20's have the highest numbers of killed or seriously injured casualties. In 2013, they comprised around 30% of male cyclist deaths and serious injuries but only 25% of the miles cycled. In comparison, male cyclists in their 30's and 40's cycle the most, accounting for 50% of miles cycled, but only 40% of the male cyclists killed or seriously injured[15].

The pattern for females is very different. The most over represented age group of female cyclists are 50 to 59 years old. This age group accounts for around 8% of miles cycled by females, but 16% of female cyclist casualties[15].

In collisions involving a bicycle and another vehicle, the most common key contributory factor recorded by the police is "failed to look properly" by either the driver or rider, especially at junctions. "Failed to look properly" was attributed to the car driver in 50% of collisions and to the cyclist in 42% of collisions. The second most common contributory factor assigned to both pedal cyclists and drivers was 'failed to judge other person's path or speed'.

Between 2009 and 2013, 30% of cyclists killed or seriously injured at crossroads and staggered junctions happened as a result of the pedal cyclist 'going ahead' and a motor vehicle turning right or left across their path. About 20% were the result of both the pedal cyclist and the other vehicle 'going ahead'. Away from junctions, 13% of cyclists killed or seriously injured were the result of the cyclist being overtaken by a motor vehicle.

Other common contributory factors attributed to drivers are "poor turn/manoeuvre" (in 17% of serious accidents involving a cyclist) and "careless, reckless, in a hurry (17%). Cyclists are more likely to suffer serious injuries when a driver is judged to be "impaired by alcohol", exceeding the speed limit" or "travelling too fast for the conditions"[17].

Another common contributory factor attributed to cyclists is “cyclist entering the road from the pavement” (including when a cyclist crosses the road at a pedestrian crossing), which was recorded in about 20% serious collisions (and over one third of serious collisions involving child cyclists).

The most common vehicle involved in collisions with cyclists are cars or taxis, with the rider usually being hit by the front of the vehicle. In a quarter of fatal cyclist accidents, the front of the vehicle hit the rear of the bicycle.

Injuries are not evenly distributed through society; the risk of being injured as a cyclist is higher for people from lower socio-economic groups, especially for child cyclists, where there is a large difference in the risk of injury between the most and least affluent groups.

A review[18] of the social determinants of injury found that the difference is most likely due to differences in the amount of on-road cycling, in the design of the physical environment and in the social environment. Addressing or mitigating these social determinants, for example by introducing 20mph zones, could help to reduce cyclist casualties and reduce inequalities. Many of the approaches suggested by the Marmot Review[19] to tackle the social determinants of health may also be beneficial.

Summary of cyclist crashes and casualties[16]

- Around 75% of fatal or serious cyclist crashes occur in urban areas, where most cycling takes place, but about half of cyclist deaths occur on rural roads
- Most (75%) of happen at, or near, a road junction, with roundabouts being particularly dangerous junctions for cyclists
- The severity of injuries suffered by cyclists increases with the speed limit; riders are more likely to suffer serious or fatal injuries on higher speed roads
- Most (80%) of cycling accidents occur in daylight, but they are more likely to be fatal in the dark
- More occur in Spring and Summer than Autumn and Winter, but the casualty rate is higher over the Autumn and Winter
- Most (over 80%) of cyclist casualties are male
- Around 11% of the cyclists killed or injured are children
- About 8% of fatal or serious cyclist accidents reported to the police do not involve a collision with another vehicle
- In collisions involving a bicycle and another vehicle, the most common contributory factor attributed to the driver is “failed to look properly”, especially at junctions (57% of serious collisions)

- Other common factors attributed to drivers are “poor turn/manoeuvre” (in 17% of serious accidents involving a cyclist) and “careless, reckless, in a hurry” (17%)
- Cyclists are more likely to suffer serious injuries when a driver is judged to be “impaired by alcohol, exceeding the speed limit or “travelling too fast for the conditions”
- Failed to look properly was also the most common contributory attributed to the cyclist (42% of serious collisions at junctions)
- The second most common one was “cyclist entering the road from the pavement” (about 20% of serious collisions; over one third for child cyclists)
- HGVs present a particular danger for cyclists, especially in London where around 20% of cyclist fatalities involve an HGV; they often occur when an HGV is turning left at a junction
- About one quarter of crashes resulting in serious injury to a cyclist involved an HGV, bus or coach “passing too close” to the rider
- Limb injuries are common in cyclist casualties, with over 40% suffering arm injuries and around 25% suffering leg injuries
- Chest and abdomen injuries occur much less frequently (5%), but are often serious.
- Head injuries, ranging from fatal skull fractures and brain damage to minor concussion and cuts, are very common injuries to cyclists. Hospital data shows that over 40% of cyclists, and 45% of child cyclists, suffer head injuries

## Cyclist casualty rates

It is important to know whether any increase in cyclist casualties is due to more cycling or to cycling becoming less safe (or both) because more cycling may result in more cyclist casualties, but a reduction in the casualty rate per distance travelled. This requires a rate-based measurement (i.e., the number of casualties per distanced cycled) as well as measurements of changes in the number of casualties. This data is important to assessing the success of any approach to improve cycle safety.

Therefore, it is important to have accurate data on the amount of cycling in both urban and rural areas. Once a critical level of cycling is reached, a "safety in numbers" effect may be realised, whereby the accident rate decreases because infrastructure improvements have been made to accommodate their increased numbers, and drivers expect to see them virtually anywhere and adapt their driving accordingly[20].

## Current public cycling policy in the UK

The Governments of the United Kingdom all have similar aspirations to increase the number of people cycling, and the safety of these cyclists. Key policy documents include the DfT Cycling Delivery Plan 2014[21], The Cycling and Walking Investment Strategy[22], Get Britain Cycling: All Party Commission 2013[23], Active Travel Act Wales 2013[24] and the Cycling Action Plan for Scotland[25].

All the UK Governments have visions for walking and cycling to become the natural choice for shorter journeys - or as part of longer journeys, regardless of age, gender, fitness level or income. Within England, the Department for Transport's Cycling Delivery Plan explains how this will be achieved. Key elements include local authorities:

- Developing local walking and cycling delivery plans.
- Appointing an influential cycling and walking champion, who would be an elected member.
- Cycle proofing new transport infrastructure.

Recent years have seen considerable investment in cycling across the UK. Between, 2011 and 2015, £374 million has been allocated to support cycle schemes, and considerable funding has been invested in the Cycling City and Towns Programme[26]. Overall, around £5 per person is spent annually in England and the government's aspiration is to increase this to a minimum £10 per person by 2020-21[27].

In 2013, the government announced that Manchester, Leeds, Birmingham, Newcastle, Bristol, Cambridge, Oxford and Norwich would share £77million to improve existing, and fund new, cycle routes. The majority of funding is channelled through Local Enterprise Partnerships (LEPs) and Local Sustainable Travel Fund (LSTF).

Fundamental to achieving this aim of increasing cycling across the UK is the need to create an infrastructure which is 'fit for purpose'. The Walking and Cycling Delivery Plan talks about "Cycle Proofing" the road network to ensure that cyclists are considered at the design stage of new and improved road infrastructure. This is echoed in the Active Travel Act Wales 2013, which requires local authorities to continuously improve facilities and routes for walkers and cyclists.

The Scottish Government has a vision for 10% of all journeys to be made by bicycle by 2020[25].The aim is to achieve this through focussed leadership, funding, infrastructure and safety.

On a local level, cycling was traditionally seen as a Highway Authority responsibility, however, there is now much public health interest in cycling due to its health benefits, as indicated by the Royal Society for Public Health and the Faculty of Public Health's recommendations for encouraging more cycling[27]. There is a clear role for the public health and Health and Wellbeing Boards to work closely with transport planners and road safety professionals, especially as reducing the number of people killed or seriously injured on the roads is a key performance indicator in England's Public Health Outcomes Framework[28].

Cycle Safety Action Plans, such as the London Cycle Safety Action Plan[29] and the Cycling Action Plan for Scotland[25], provide a strong framework for combining increased cycling with reduced cyclist casualties.

## Reducing the risks and increasing the benefits of cycling

It is not inevitable that more cycling will lead to more cycling accidents, but to avoid this happening, we need to create a safer cycling environment. This will reduce the number of cyclist casualties and help people who want to cycle, but are deterred from doing so because they think it is not safe enough.

In a YouGov survey, commissioned by RoSPA in February 2015[30]:

- 8% of people said they cycle once a week or more often
- 14% said they cycle at least once a month
- 23% said they cycle at least once every six months
- 18% of people said they cycle less often than once every six months
- 58% of people said they never cycle

When asked how much they would like to cycle in the future, 36% said they would like to cycle more than they currently do, 44% said about the same as now, and 3% said they'd like to cycle less often.

The main reasons given when asked what prevents them from cycling more often were "concerns around the safety of road cycling" (41%) and "concerns about drivers treating me badly when cycling" (31%).

Other common reasons were "cycling not a realistic option for the journeys I make" (32%), "weather not good enough" (24%), "lack of motivation to cycle" (22%) and "a health condition" (16%). "I'd like to improve my cycling skills first" was cited by 7% of respondents, and another 7% said they couldn't ride a bicycle. Overall, 39% of respondents said they would cycle more often if cycling on the roads were made safer*.

These findings suggest that a perception that cycling is not safe is preventing many people from cycling, which means that they are not benefitting from the health improvements that cycling brings.

The WHO Health Economic Assessment Tool for Walking and Cycling can be used to put a financial value on the benefit from plans to increase the amount of habitual cycling. This tool can be used in transport planning and is available at http://heatwalkingcycling.org/

The remainder of this policy paper explores how cycling can be made safer.

* All figures, unless otherwise stated, are from YouGov Plc. Total sample size was 2,169 GB adults. Fieldwork was undertaken between 24th and 25th February 2015. The survey was carried out online. The figures have been weighted and are representative of all GB adults (aged 18+).

# A safer cycling environment

There are two general approaches that can create a safer physical environment:

- Introducing a 'safe system' approach to road design that reduces the risk of crashes occurring, and the severity of any that do occur, making fatal injuries unlikely
- Reducing motor traffic volume

## The WHO safe system approach to road safety

The safe systems approach is advocated by the World Health Organisation and Vision Zero philosophy[31] and is based on the understanding that injury is caused by an exchange of energy in quantities higher than human tolerance to it. Preventing or minimising the exchange of energy, therefore, prevents injuries.

The safe system approach has been adopted in some countries, such as The Netherlands, Sweden, and New Zealand, and components of the approach have been adopted in the Safe streets for London Action Plan[32] and Highways England's strategy[33].

The safe system approach recognises that people make mistakes, and designs roads and vehicles so that these mistakes are not likely to result in death or serious injury. This places human vulnerability to injury at the centre of the road system, and proposes that roads, vehicles, and traffic speeds are modified to prevent exchanges of energy which are likely to cause fatal injuries. This approach can be applied to all types of roads and for all road users.

In general, the safe system philosophy identifies ways of separating traffic, and especially separating vulnerable road users from motor vehicle traffic on high speed roads, and where this cannot be achieved, designing roads to reduce traffic speed.

There have been several estimates of how many lives (all road users not just cyclists) could be saved by the safe system.

One study[34] examined the circumstances of 215 fatal crashes, in which 248 people were killed, in Sweden in 2004. In 63% of these crashes, it was judged that the road or vehicle did not meet the safety standards that would have existed if the safe system approach had been fully implemented. These fatalities could, therefore, have been prevented by the safe system, even without addressing road user behaviour.

An Australian study used a similar method, based on coroner's reports for every fatal crash in Southern Australia in 2008[35]. After some exclusions to remove intentional crashes, and crashes due to natural causes (for example, heart attack or stroke whilst driving) there were 83 crashes and 93 deaths in the sample. In this study[36], 57% of the crashes were categorised as a failure of the safe system.

BS ISO 39001, “Road Traffic Safety Management Systems”[37] advocates the adoption of a Safe System approach. It states that high levels of safety can be attained by achieving a good match between the function of the road, safe speed limits and their compliance and design and layout. Typical issues include separating on-coming traffic on high volume, high-speed roads to prevent head-on collisions and providing crash protective roadsides to address run-off road collisions. Adopting safe systems will equally be beneficial in protecting vulnerable road users.

## Reductions in motor vehicle traffic

The level of motor vehicle traffic is an underpinning cause of injury on the roads, with greater traffic volumes leading to greater numbers of casualties. Studies have also found that traffic volume is predictive of the number of cyclist injuries[38,39]. Therefore, reducing traffic volume has the potential to improve cycle safety and road safety in general.

A study[40] of the introduction of seat belt laws in February 1983 included a measure of the number of kilometres travelled by cars in a month, and found that a 1% increase in traffic led to a 0.77% increase in cyclist casualties and a 1.12% increase in cyclist fatalities (although given the low numbers of monthly cyclist fatalities, the latter figure may be unreliable). Changes in traffic volume had a larger influence on the number of cyclist injuries than changes in cyclist volume.

A study of traffic volumes and cyclist injuries on the Island of Montreal[41] between the start of 1999 and the end of 2003 found a relationship between traffic volume and the number of all injuries and specifically that an increase of 1,000 vehicles a day was associated with a 5% increase in cyclist injuries.

Another study[42] found that slightly more walking and cycling accompanied by the same decrease in car use was broadly safety neutral, but that a large shift from driving to walking or cycling could reduce accidents. An example of this model is presented in tables 4 to 6 below.

**Table 4, the relative number of accidents predicted at different levels of traffic volume**

| Annual average daily traffic | | | Relative number of accidents |
|---|---|---|---|
| Motor vehicles | Pedestrians | Cyclists | |
| 2000 | 200 | 100 | 1 |
| 5000 | 200 | 100 | 2.4 |
| 10,000 | 200 | 100 | 4.72 |
| 20,000 | 200 | 100 | 9.33 |
| 30,000 | 200 | 100 | 13.95 |

**Table 5, the relative change in the number of accidents following a reduction in motor vehicles by 25% with a corresponding increase in walking/cycling**

| Annual average daily traffic | | | Relative change in the number of accidents |
|---|---|---|---|
| Motor vehicles | Pedestrians | Cyclists | |
| 1500 | 530 | 270 | 0.842 |
| 3750 | 1030 | 520 | 0.882 |
| 7500 | 1860 | 940 | 0.918 |
| 15,000 | 3530 | 1770 | 0.957 |
| 22,500 | 5200 | 2600 | 0.981 |

**Table 6, the relative change in the number of accidents following a reduction in motor vehicles by 50% with a corresponding increase in walking/cycling**

| Annual average daily traffic | | | Relative change in the number of accidents |
|---|---|---|---|
| Motor vehicles | Pedestrians | Cyclists | |
| 1000 | 870 | 430 | 0.621 |
| 2500 | 1870 | 930 | 0.662 |
| 5000 | 3530 | 1770 | 0.697 |
| 10,000 | 6870 | 3430 | 0.734 |
| 15,000 | 10200 | 5100 | 0.757 |

Another study suggested that replacing 10% of car trips shorter than 7.5 km by bicycle would be safety neutral.[43]

## Reducing casualties through safer road infrastructure

The safe system model includes many measures to prevent fatal collisions from occurring. The two main approaches are:

- Separating different road users by physical infrastructure
- Where separation cannot be achieved, reducing vehicle speeds to reduce the likelihood of crashes occurring and the severity of any that do occur so they are unlikely to cause fatal injuries

## 20mph schemes

The risk of a pedestrian or cyclist sustaining an injury at different speeds decreases significantly between 30mph and 20mph. Several studies have estimated this decrease in injury risk, predominantly by looking at pedestrian injuries, as shown in table 7 below.

**Table 7: Risk of pedestrian or cyclist death according to impact speed**

| Country and years of data analysed | Most likely estimated risk of death at 20mph | Most likely estimated risk of death at 30mph |
|---|---|---|
| GB 1985–1979[44] | 5% | 45% |
| Germany 1991–2003[45] | 4% | 14% |
| GB 2000–2007[46] | ~2% | ~12% |
| South Korea 2003–2005[47] | 7% | 37% |
| Germany 2003–2007[48] | ~1% | ~8% |

There are two distinct types of 20 mph areas:

### 20mph zones

20mph zones are roads with 20mph limits that are designed to be "self-enforcing" due to traffic calming measures such as speed humps, speed cushions, chicanes, road narrowing, planting and so on. The traffic calming features physically and visually reinforce the 20mph limit and emphasise the shared nature of the road.

### 20mph limits

20mph limits are roads with a 20mph limit, with speed limit signs and road markings, but no traffic calming measures to reduce vehicle speeds. Some physical measures, such as build-outs at pedestrian crossings and marked parking bays, may be introduced. However, the emphasis is on drivers voluntarily complying with the limit because the road has a 20mph 'feel' to it.

A rapid expansion of 20mph limits is currently underway in Great Britain, with many local authorities introducing them across a significant proportion of their roads. The aim is not just to improve road safety, but also to improve health by providing a safer and more pleasant environment that encourages and enables more people to walk and cycle more often, and to improve social benefits, social connectivity and community cohesion. They are an example of good synergy between road safety and other public health outcomes.

In Portsmouth, a 20mph limit was introduced on around 94% of roads that previously had a 30mph limit. Traffic speeds were monitored on 223 roads before and after the introduction of the lower limit to establish

effectiveness. Overall, average speeds reduced from 19.8 mph to 18.5 mph (a drop of 1.3 mph) following the introduction of the limits. The reduction in average speeds varied from 0.6 mph to 1.7mph across these 223 roads. [49]

Bristol also piloted 20 mph limits in two areas. Two years after the introduction of the lower limits, speed surveys on 10% of the roads covered by the scheme found a reduction in mean daytime speeds on 65% of the roads. On residential roads, traffic speeds fell by 0.4 mph on average. On main roads, traffic speeds fell by 1.7 mph on average in the Inner East area and 1.3 mph in the Inner South area. [50]

The evidence so far indicates that 20 mph limits are most appropriate for roads where average speeds are already low, below 24 mph, and the layout and use of the road also gives the clear impression that a 20 mph speed or below is the most appropriate.

## Cycling infrastructure

An American study[51] of why and how cyclists chose their routes analysed fifteen hundred cycling trips and found that the two most important factors influencing cyclists' road choice were avoiding streets with higher levels of vehicle traffic and minimising total distance. Being able to ride in a cycle lane was ranked third.

A systematic review of studies into the impact of a range of different infrastructure on the safety of cyclists found varying results.[52]

## Cycle tracks and lanes

The review identified fifteen evaluations (predominantly from the USA) of cyclist infrastructure, such as lanes, paths and tracks. There were major differences between the study methods, which, for example, used different measures of injury and different definitions of cyclist infrastructure. However, the reviewers concluded that on-road marked bike lanes consistently reduced injuries compared to unmodified roads.

The evidence around off-road riding was less consistent, due to the varied nature of the infrastructure – such as the surfaces – and the inclusion of falls from a bicycle as well as collisions with other vehicles in some studies. Two studies of off-road cycle paths found they reduced risks, but studies that looked at unpaved off-road trails found higher risks of injuries.

An evaluation[53] of six physically separated bicycle tracks in Montreal found that the risk of collision per mile decreased by 28% compared with streets without tracks. A study[54] comparing the sites of cycle crashes in Iowa between 2007 and 2010 with control sites matched by census data and type of road, estimated that on-road cycle facilities reduced the risk of injury, but none of the reductions were statistically significant. Studies[55] have also highlighted that measures, such as edge markings and improving the conspicuity of bollards can prevent cycle injuries from falls or single vehicle collisions.

## Shared routes

Shared use routes are set away from the road and designed for use by both cyclists and pedestrians. They can have a white line segregating cyclists and pedestrians or they may be left open for the two to mix. Cyclists in one study[56] were willing to travel longer distances to make use of a shared route rather than ride on the road so they could avoid streets with high levels of traffic.

Whilst shared routes can reduce conflict between motor vehicles and cyclists, they increase the number of interactions between pedestrians and cyclists, which can sometimes (but not always) cause problems. When a canal side towpath was opened up to cyclists, no change in attitudes was seen in walkers or anglers at the site, even with an increase in cyclist use.[57] However, on another shared route, concern was expressed by some users about cyclists behaving inconsiderately.[58]

## Shared space

In Shared Space areas, the distinction between the space allocated to motor vehicles and the space allocated to pedestrians is removed, so that motor vehicles become less dominant.[59] In a shared space, cyclists do not experience the same restrictions as in other pedestrian areas.

Research[60] commissioned by the DfT to inform guidance on shared spaces, concluded that:

- Drivers travelled at lower speeds and were more likely to give way to pedestrians
- The full benefits of a shared space were more likely to be seen if multiple characteristics of a shared space were put in place
- Shared space design needs to be inclusive and understood by all, including making provision for vulnerable users of the space.[61]

## Junctions and intersections

The systematic review[52] also included eight studies of the risk of injury at intersections. These were mainly conducted in European countries, although there was variation in study design and data sources.

Introducing roundabouts with multiple lanes appeared to increase the risk of cyclist injuries at roundabouts. Separated cycle lanes were found to decrease injury risks to vulnerable road users in two studies, although neither looked at the injury risk to cyclists separately.

A study on coloured (blue) crossings came to uncertain conclusions, as it found that one blue crossing decreased the risk of injury but others increased the risk. They hypothesised that a larger number of blue crossings created a complex environment and confusion for road users.

A second study of the effects of providing a cycle lane that was raised above the road level by 4-12 cm found an 8% increase in police and hospital reported crashes, but also a 50% increase in cycle volume compared to sections that had remained unchanged.

Other papers have examined the effectiveness of raised intersections. A study of 540 unsignalled junctions in the Netherlands between 2005 and 2008[62] found that for crashes that occurred where cyclists had the right of way, raised bicycle crossings (and other speed reducing measures for vehicles entering or leaving the side road) halved the number of crashes if there was a 2m to 5m distance between the cycle track and junction. The number of crashes increased when bicycle crossings were marked in red.

## Street lighting

The systematic review[52] identified one report on the effects of street lighting on cyclist injuries in rural areas. It used police records from 125,000 crashes in the Netherlands between 1987 and 2006, and found that lighting on rural roads reduced the number of cyclist injuries by around 60%. This finding is consistent with other evidence from systematic reviews that street lights are effective at preventing traffic injury.[63]

## Reducing cyclist casualties through spatial planning

Land use determines traffic patterns. Over the last 60 years many new developments, such as out of town shopping centres, retail parks and business parks, have decentralised functions away from better connected city centres. Car ownership has become more necessary to access a range of these services. This increase in car ownership has been accompanied by decreases in the number of trips made by bicycle, which fell significantly during the 1950s.[64] The creation of new roads to accommodate this growth in motor vehicle traffic frequently created new traffic, resulting in more traffic than anticipated and further congestion.[65]

Land use is, therefore, one of the wider underpinning causes of traffic injuries. Given the relationship between motor vehicle traffic and cyclist casualties, addressing the factors that encourage car dependence and discourage people from choosing to cycle can help to prevent casualties.

The main aspects of land use that influence road safety are: [66]

- the spatial distribution of origins and destinations of road journeys
- urban population density and patterns of urban growth
- the configuration of the road network
- the size of residential areas
- alternatives to private motorised transport

The National Planning Policy Framework[67] sets 12 core planning principles to promote mixed use developments. Many specific paragraphs also support approaches to planning that make cycling and walking a feasible choice and reduce car dependence for many journeys, and therefore, reduce traffic volume:

*The transport system needs to be balanced in favour of sustainable transport modes, giving people a real choice about how they travel* [paragraph 29]

*Plans and decisions should ensure developments that generate significant movement are located where the need to travel will be minimised and the use of sustainable transport modes can be maximised.* [Paragraph 34]

*The planning system can play an important role in facilitating social interaction and creating healthy, inclusive communities. ...*

*Planning policies and decisions, in turn, should aim to achieve places which promote:*

- opportunities for meetings between members of the community who might not otherwise come into contact with each other, including through mixed-use developments, strong neighbourhood centres and active street frontages which bring together those who work, live and play in the vicinity;
- safe and accessible environments where crime and disorder, and the fear of crime, do not undermine quality of life or community cohesion; and
- safe and accessible developments, containing clear and legible pedestrian routes, and high quality public space, which encourage the active and continual use of public areas. [paragraph 69]

## Road design principles

## Cyclists and pedestrians

Designing for cycling should include a full understanding of the street or context in which it is located, and proper consideration for pedestrians. Living Streets, a pedestrian rights charity, recommends the following overarching principles and design principles for creating a safe and pleasant environment for walking and cycling:

### Overarching Principles

1. Residents of a town or city should be invited to walk and bike as much as possible in connection with their daily activities.

2. Cycling and walking are entirely legitimate, desirable, everyday, 'grown up' modes of transport, worthy of investment.

3. Both pedestrians and cyclists are highly vulnerable to, and restricted by, motor traffic. Increasing cycle and walking mode share should be part of an integrated approach to decreasing car mode share.

4. Walking and cycling are two very different modes: mixing them together inappropriately can cause fear, anxiety, insecurity and even serious injury.

5. Improving cycle safety and convenience should not diminish pedestrian safety and convenience.

6. Any change to the street environment must take into account the accessibility needs of all kinds of users.

7. Where a satisfactory balance between road users cannot be achieved, a framework for identifying priority between them must apply. 'Capacity to cause' harm (health, climate change, noise, danger to others and air pollution) should underpin this decision-making.

8. Context is key – standard design solutions must not be 'dropped in' without a full appreciation of the street's own unique context and many different functions. Local people must be consulted and existing use measured (for example, pedestrian flows, and desire lines).

## Design principles

Safe: Recognise pedestrians and cyclists as vulnerable road users: reduce the risk of collisions, make infrastructure that both pedestrians and cyclists feel safe using, and improve driver behaviour. For example, slower speeds avoid putting cyclists and pedestrians in danger.

Comfortable: cycling facilities should not diminish the pedestrian comfort or result in anxiety. They must take into account the accessibility needs of all kinds of users.

Direct: cycling facilities should complement pedestrian facilities and avoid creating delay or diversion for those on foot.

Coherent: shared or adjacent facilities should be consistent, predictable and intuitive to use for cyclists and pedestrians so not to cause conflict between the two.

Attractiveness: improvements for cycling should contribute to more appealing, attractive and liveable places for everyone.

Adaptable: cycling facilities should be designed so that they can adapt over time if pedestrian and cyclists demand increases.

# Improving road user behaviour

Most road crashes are at least partly, and sometimes mainly, caused by human error, which can range from simple mistakes and misjudgements to deliberately dangerous and illegal behaviour.

Creating a safer cycling environment will help to improve the behaviour of all road users, by making it easier for them to behave responsibly and safely. Education (including training and publicity) and enforcement are also key approaches to improving road user behaviour, and to helping everyone share the road safely together. All road users, including cyclists and drivers, must also take responsibility for their own choices and behaviour.

## Cyclists

In collisions in which cyclist behaviour was judged to have been a contributory factor, the most common reasons recorded by the police are "failed to look properly", especially at junctions, and 'failed to judge other persons path or speed'. These are also common errors by drivers.[15]

Another common contributory factor attributed to cyclists is "cyclist entering the road from the pavement" (including when a cyclist crosses the road at a pedestrian crossing), which was recorded in about 20% serious collisions (and over one third of serious collisions involving child cyclists).[15]

## Compliance with road traffic law

Research has shown that some non-cyclist road users hold a negative stereotype of cyclists, viewing them as a group who have a tendency to break road laws.[68] The public often perceive cyclists as frequently jumping red lights and cycling on the pavement. However, studies have shown that only a minority of cyclists behave in this way. For example, the proportion of cyclists violating red lights varies depending on the site but can be anywhere between 3% and 36%.[69,70] It should be noted that 96% of pedestrians who were injured by a vehicle failing to stop at a red light were hit by a motor vehicle and only 4% by a cyclist.[71]

Pavement cycling is illegal, unless it is on a shared cycle/pedestrian path or shared space. Pavement cycling can be a barrier to walking and is particularly intimidating to vulnerable pedestrians.[72] When asked, many cyclists say they ride on pavements because of the danger posed by traffic on the road.[73] Some recognise that this is inconsiderate to pedestrians and would dismount in busy areas. Improving infrastructure and traffic speeds could encourage cyclists not to ride on pavements.

However, less is known about the number of cyclists using pavements. During Operation Safeway (a police road safety operation in which officers were stationed at road junctions around central London to target road users who were breaking the law), the Metropolitan Police issued 14,000 fixed penalty notices in an eight week period, of which 1,200 were for cycling on the pavement.[74] Between 1998 and 2007 in London, 2% of pedestrian collision injuries involved a cyclist on the pavement, whereas the remaining 98% involved a motor vehicle.[75]

## Training

Practical cyclist training schemes to the National Standards for Cyclist Training[76] are an important way of enabling cyclists to stay safe and of encouraging more cycling.

A recent study[77] assessed whether Level 2 Bikeability cyclist training* improves the ability of children to perceive and respond appropriately to hazards when cycling on the road. Both Bikeability-trained and untrained pupils took a quiz to test their knowledge and skills relating to hazard perception and responding to hazards. The Bikeability-trained children also took a practical on-road assessment.

Children who participated in Bikeability Level 2 training scored significantly higher on the hazard perception and appropriate response quiz, than children who had not received training. This effect was undiminished when children re-took the quiz more than two months later, suggesting that the effect of the training was sustained.

However, the improved hazard perception scores in the practical assessment had declined significantly by the second assessment, two months after the training, suggesting that the ability to put the knowledge gained from Bikeability into practice can decline over time if the skills are not practised.

Children who participated in training reported a statistically significant increase in confidence when cycling on the road after the training. However, they did not report that they cycled more often as a result of receiving Bikeability training.

At the end of 2012, Birmingham City Council's road safety team ran "Women on Wheels", a training course targeted primarily at adult women from ethnic minorities. Level 1 or level 2 Bikeability training was delivered free and course participants were able to borrow bicycles for the training. The evaluation showed that after the training, participants reported that they had improved their cycling skills and confidence. This is a good example of a project led by a road safety team to encourage both safe and active travel.[78]

A review of older research studies found some evidence that practical cyclist training, especially if it is on-road, can improve children's cycling knowledge and behaviour.[79]

However, evidence into the impact of training on accidents and injuries is particularly sparse. One study found trained children were less likely to become a casualty[80] whereas another found no relationship between training and accidents.[81] An evaluation of practical cyclist training schemes is needed.

There is a general lack of good evaluations of road safety education, training and publicity (ETP) interventions, partly because it is much more difficult to evaluate education interventions, than engineering ones, but also due to a lack of capacity within the road safety profession. However, www.roadsafetyevaluation.com, and E-valu-it, (a free online evaluation tool) can help practitioners to plan, conduct and publish evaluations of their cycling safety interventions

* Level 2 training is generally provided to children in Years 5 or 6 before they leave primary school to give them the skills and confidence needed to cycle on road.

## Cycle helmets

RoSPA strongly recommends that cyclists wear a cycle helmet, as it reduces the risk of suffering a serious head or brain injury in an accident. Cycle helmets do not prevent crashes, nor guarantee survival, but they do provide a last line of defence for the cyclist's head.

RoSPA does not support calls for compulsory cycle helmet laws because it is not clear whether such a law would discourage some people from cycling, which, if it did, would mean losing the health and environmental benefits from cycling.

Research has found that cycle helmets prevent serious injury and even death.[82] However, it is also argued that helmet wearing does not mitigate certain risks. One study[83] contends that the most serious brain injuries are caused by rotation, which helmets are not specifically designed to absorb. A report by TRL,[84] however, found no evidence of increased risk of rotational injury when wearing a helmet.

Some education programmes to promote cycle helmet use by children have been shown to increase helmet use as well as reduce the number of cycle related head injuries.[85] Other programmes, however, have proved ineffective[86] or not to have worked as well with different social groups, such as those on low incomes.[87]

There has also been some dispute as to whether wearing a helmet can affect the likelihood of being involved in an accident. For example, cyclists and drivers may behave in a riskier manner because of the perceived protection that a helmet provides.[88] Other researchers have argued that it is unlikely that any increase in the level of risk would be so great as to completely negate the effects of wearing a helmet.[89]

## Lights and high visibility clothing

Around 80% of cycling accidents occur in daylight - which is when most cycling takes place. For child cyclists, 90% of their accidents occur during the day. Research into the effectiveness of cyclists using lights during daylight as additional safety features, as is the case with motorcycles, should be considered.

Although most cycling accidents happen in daylight, those that happen in the dark are more likely to be fatal.**Error! Bookmark not defined.** In 2013, "Not displaying lights at night or in poor visibility" was recorded as a contributory factor in 309 pedal cyclist accidents and "Rider wearing dark clothing" in 489 reported pedal cyclist accidents.[15]

The law about the use of lights and reflectors is very clear; the Highway Code (rule 60) says:

'At night your cycle **must** have white front and red rear lights lit. It **must** also be fitted with a red rear reflector (and amber pedal reflectors, if manufactured after 1/10/85). White front reflectors and spoke reflectors will also help you to be seen. Flashing lights are permitted but it is recommended that cyclists who are riding in areas without street lighting use a steady front lamp'.

However, there is no legal requirement for pedal cyclists (or any other road user) to wear high visibility garments.

There is very little research to show the effectiveness of cycle lighting and high visibility clothing.

One study[90] conducted at Bath and Brunel universities involved 269 participants riding bikes with ultrasonic devices fitted to measure the distance at which motorists overtook them while they wore a variety of cycling kit (typical sport rider's Lycra, casual clothing or hi-visibility vests).

The research found that the only clothing which made a difference to the average passing distance was a high visibility vest with the words police and a notice advising drivers that the rider was filming their ride. This increased the average passing distance from 117cm to 122cm. The report did not evaluate the relationship between wearing high visibility clothing and the time it took a driver to see the cyclist in various lighting conditions. Further scientific investigation is required to answer this question.

Despite the lack of research, RoSPA fully supports the advice in the Highway Code (rule 59) which advises that riders should wear light coloured or fluorescent clothing in daylight and poor light and reflective clothing in the dark.

Riders should be encouraged to make themselves as visible as possible; however, drivers failing to look properly is a common contributory factor in collisions between drivers and cyclists, so drivers equally have a responsibility to look out for cyclists, irrespective of the clothing worn by riders.

## Drivers

In collisions involving a bicycle, the most common key contributory factor attributed to drivers is "failed to look properly", especially at junctions. Other common contributory factors attributed to drivers are "poor turn/manoeuvre" (in 17% of serious accidents involving a cyclist) and "careless, reckless, in a hurry" (17%). Cyclists are more likely to suffer serious injuries when a driver is judged to be "impaired by alcohol", "exceeding the speed limit" or "travelling too fast for the conditions".[15]

## Awareness of cyclists

Drivers can have negative perceptions of cyclists. Some drivers feel cyclists break the rules of the road and are irritated when they feel cyclists inconvenience them.[91] Drivers feel they should give consideration to cyclists, but sometimes feel pressure from other drivers not to do so. For example, when roads are narrow, drivers may feel pressurised to overtake cyclists even if there is insufficient space to do so safely, rather than wait until there is more space to overtake. Drivers have commented that they feel more confident when there is infrastructure to define the road space for cyclists.[92]

It is often suggested that drivers who are also cyclists, are better at sharing the roads with cyclists because they understand cyclists' needs and vulnerabilities. Unfortunately, little research exists to show whether this is true, although it is a reasonable assumption to make.

## Training

Once they have gained their full driving licence, few drivers choose to take any form of further driver training, even though there are many options available, ranging from quick and easy training that focuses on specific issues or skills to longer courses leading to full advanced driving tests.

However, one of the most difficult challenges is to raise awareness of the existence and benefits of refresher driver training. Most drivers do not feel they need refresher training, never think about it, or are not aware of its benefits.[93]

In addition to normal driver development training, specific cycle awareness training for drivers are also available, although they have largely concentrated on professional large vehicle drivers. A number of councils in London, for example, provide cycle awareness training for their lorry drivers.[94] Training schemes can include drivers and cyclists trading places, with drivers receiving cycle training and cyclists getting into the HGV cab, to help both parties understand the road from the other's perspective. No formal evaluations have been conducted on these particular schemes to determine their effectiveness, but studies have shown that advanced driver training can improve situational awareness more generally.[95]

## Space

Drivers should give cyclists "at least as much room as you would when overtaking a car".[96]

Pedal cyclists are also easily affected by side winds when being overtaken and in the last five years, 13% of cyclist deaths and serious injuries in crashes away from junctions were a result of the cyclist being overtaken by a motor vehicle.

Sometimes drivers may find it difficult to give cyclists sufficient space when roads are narrow, as they can feel pressurised by other drivers to overtake a slow moving road user.[91] Another study[97] concluded that drivers tend to slow down more when overtaking cyclists where there are narrow lanes, lower speed limits and the absence of centre line markings.

There is evidence to suggest that drivers modify the amount of space they give a cyclist based on their appearance.[98] Drivers in one study gave less space when overtaking cyclists who were further away from the kerb, wearing a helmet or who were male. The author argued that this was because drivers judged these cyclists to be more predictable, which meant it was safe to pass them more closely.[91] However; another study found that the way cyclists dressed did little to encourage drivers to leave them more space when overtaking. [99]

## Cyclists and lorries

Lorries present a particular danger to cyclists. Cyclists are less likely to be involved in a collision with an HGV than a car but when they are, they are more likely to be killed or seriously injured. Between 2009 and 2013, lorries were involved in 23% of cyclist deaths despite comprising only 5% of traffic. Cars, in comparison, accounted for 78% of traffic, but 58% of cyclist fatalities.[16]

**Table 8: Cyclist casualties by vehicle type, Great Britain 2009-13[16]**

| | HGV | LGV | Bus or Coach | Cars | Motorcycles |
|---|---|---|---|---|---|
| % of GB traffic | 5 | 13 | 1 | 78 | 1 |
| % of cycle deaths | 23 | 8 | 5 | 58 | 2 |
| % of serious cycle injuries | 3 | 7 | 2 | 84 | 2 |
| % of cycle slight injuries | 2 | 6 | 2 | 88 | 1 |
| % of cycle casualties | 2 | 7 | 2 | 87 | 1 |

A disproportionate number of female cyclists are involved in collisions with HGVs. One study found that female cyclists accounted for double the number of HGV collision fatalities than men, despite only accounting for 30% of total cycle time. Whereas, when collisions did not involve a HGV, the fatality rate for male cyclists was double that of females.[100] A key contributor could be that females are less likely to differentiate between the risks posed by nearside or offside overtaking.[101]

## The left-turn issue

HGVs can present a particular danger to cyclists when turning left – 55% of cyclists who were seriously injured by HGVs in London were hurt when the driver turned left across their path. When a cyclist is on the left of an HGV, the driver may not be aware of their presence, due to a blind spot in their mirrors.

A number of infrastructure designs used in other countries could be tested in the UK, including cycle bypass lanes at junctions, specific traffic lights for cyclists which allows them to enter a junction first, stops them from entering when left turning motorists are instructed to enter or allows them to turn left when there is a red light for motorists.[102] Designs, however, would need to consider the local conditions at each junction. For example, a cycle bypass may not be practical if there is a limited amount of pedestrian space.

## Lorry design and technological aids

One of the key approaches is to improve lorry design and technology. Some changes have already been made; for example, legislation requires most HGVs to be fitted with side guards so cyclists do not get dragged under the wheels, although there are exceptions. In addition, HGVs sold in the EU must be fitted with extra mirrors (European Directive 2003/97/EC) to reduce blind spots. Mirrors must also be retro-fitted on HGVs sold before 2007, although again some are exempt (European Directive 2007/38/EC).

Suggestions which go further than the current regulations have also been made.[103] A four week trail where HGVs used mainly camera and sensor equipment showed encouraging results.[104]

**Table 9: Potential Changes to HGV design to reduce the risk of collisions with cyclists**

| | **Advantages** | **Disadvantages** |
|---|---|---|
| More mirrors than currently required | • Reduce blind spots further | • Driver needs to be looking in the mirror at the right time<br>• Hazards difficult to identify in distorted images (e.g. convex mirrors)<br>• Increased driver workload |
| Cameras | • Can have greater field of view than a mirror<br>• Images not distorted as they might be with mirrors | • Increased driver workload |
| Windows in doors or increase the field of view from the windscreen | • Actual view so not distorted<br>• Intuitive as looking where the cyclist would actually be | • Increased driver workload<br>• Changing design of cab could impact on other regulatory requirements |
| Roadside mirrors e.g. at junctions | • Evidence from Germany suggested a reduction in HGV turning collisions | • Left turn collisions can be localised, cost may outweigh the benefit in areas where they are not as common |
| Improve side guards | • Lower ground clearance could help with left turn collisions rather than just overtaking manoeuvres | • Little evidence to suggest whether this would work in practice |
| Sensors and warnings | • Sensors look in the right places at right time rather than relying on the driver to | • Doesn't identify *what* is in range. If the sensor alerts too often then the driver could become less responsive to it |

| | | |
|---|---|---|
| Introduction of rear steering control | • When turning it would allow the driver control of the rear end so the vehicle doesn't cut in as much<br>• If cyclist is knocked over by front end could be less likely to get run over by back wheels | • Reducing cut in would increase the swing out, increasing the risk to those overtaking on the outside. Although some systems have potential to reduce cut in without swing out.<br>• EU regulations could be a barrier – needs to be at least as safe as without the new steering and regulations might need to be amended |

Another example of a potential technological solution is a new collision avoidance system that includes sensors to detect the presence of a cyclist on the HGV's nearside and software that predicts the path and speed of the cyclist and the HGV. If it predicts the HGV is going to hit the cyclist when it turns, it automatically applies the HGV's brakes to bring it to a stop. An analysis of 19 fatal accidents involving a cyclist and a left-turning HGV concluded that 15 of these would have been completely avoided and 3 would have been less severe with the new system. Further development work and trails to test the effectiveness of the system in different scenarios are underway.[105]

## Management of HGVs

There has also been a call for HGVs to be banned from the capital during the rush hours after a number of cycling deaths at the end of 2013. However, of the 14 cyclists who died in 2013, only two occurred during rush hours. Other factors would also need to be considered, such potential increased cost of moving goods and so higher prices for consumers, whether there could be a sudden influx in lorries just after the ban time lifts and whether it might lead to changes in night time driving restrictions for lorries due to increased demand.

Some researchers have gone so far as to say that large freight vehicles (over 3.5 tonnes) should be removed from the roads all together.[106] They suggest replacing large vehicles with river and rail transport and using light goods vehicles to distribute locally. It is unclear, however, whether this would be feasible in practice.

Companies using large vehicles are also encouraged to meet certain optional standards to improve the safety of their drivers and reduce the risk posed to vulnerable road users. Examples of these schemes in London are the Standard for Construction Logistics[107] and the Fleet Operator Recognition Scheme.[108] The incentives for companies to participate in these schemes include making it being a requirement to win business contracts, improving their safety records or reducing costs, such as fines and charges.

Infrastructure could also help manage the risk of HGVs to cyclists by introducing road safety measures such as lower speed limits and measures designed to help cyclists navigate high risk parts of their journeys, such as junctions.

## Road justice system

The National Cycling Charity CTC has set up the Road Justice campaign,[109] an online tool though which vulnerable road users can report dangerous driving. The report makes the following recommendations to improve how the police deal with road crime:

- Thorough investigation of all road traffic collisions, including collecting information on near misses and reports of seriously bad or aggressive driving.
- Ensuring that there is sufficient resourcing and training for police to respond appropriately to road crime.
- That the support offered to victims of road crime should be similar to that of other crime and that the victim should not be blamed automatically.

# More cycling without more cycling casualties?

## Safety in Numbers

Once a critical level of cycling is reached, a "safety in numbers" effect may be achieved, whereby the accident rate decreases because infrastructure improvements have been made to accommodate the increased numbers of cyclists, and drivers expect to see them virtually anywhere and adapt their driving accordingly.

Another explanation for "safety in numbers" is an accompanying change in the volume of travel by car. Several studies have shown that traffic volume is predictive of the number of cyclist injuries.[38, 39] Reducing traffic volume, therefore, has the potential to improve cycle safety and road safety in general.

It is not inevitable that more cycling will lead to more cycling accidents. One study[42] found that slightly more walking and cycling accompanied by the same decrease in car use was broadly safety neutral, but that a large shift from driving to walking or cycling could reduce accidents. Another suggested that replacing 10% of car trips shorter than 7.5 km by bicycle would be safety neutral.[43]

Cycle Safety Action Plans, such as the London Cycle Safety Action Plan[29] and the Cycling Action Plan for Scotland[25] provide a strong framework for combining increased cycling with reduced cyclist casualties.

# Conclusion

Cycling has positive and tangible health and societal benefits, and there are very strong reasons for enabling more people to cycle more often and more safely.

In Great Britain, the level of cycling is increasing, but cyclist casualties have fluctuated, rising in some years and reducing in others, with no clear trend apparent. Therefore, we all face a crucial challenge, which is to create safer cycling conditions so that more cycling does not lead to more cycling casualties.

Improving the safety of cycling will reduce the number of cyclist casualties and encourage and enable more people to cycle more often. It will help people who want to cycle, but are deterred from doing so because they think it is not safe enough, and help to prevent the increase in cycling resulting in an increase in cyclist casualties. This, in turn, will increase the health and environmental benefits of cycling for those people who cycle and for society as a whole.

Other countries, such as the Netherlands, Denmark and Sweden, have much higher levels of cycling than the UK, but lower cyclist death rates, which shows that it is possible to increase cycling without increasing cyclist crash and casualty rates.

RoSPA strongly supports measures which encourage healthy and sustainable travel, and believes that the key to increasing cycling (and so gaining all the health and environmental benefits that result from cycling) is to create a safe on and off-road cycling environment, improve driver and cyclist attitudes and behaviour towards each other, and to produce safer vehicles that reduce the risk to cyclists. Cycle safety measures should also include training, education and enforcement programmes that work together with the engineering measures to provide an environment which maximises protection for all vulnerable road users.

RoSPA advocates the Safe System Approach, which involves designing roads and vehicles to minimise the risk of crashes occurring, and ensure that when they do occur, they are unlikely to result in death or serious injury. Such an approach will help motorists and cyclists to interact and share the highway in a safe and responsible manner.

# Recommendations

The safety of cycling should be improved to:

- reduce the number of cyclist casualties
- encourage and enable more people to cycle more often
- help people who want to cycle, but are deterred from doing so because they think it is not safe enough
- help to prevent the increase in cycling resulting in an increase in cyclist casualties
- increase the health and environmental benefits of cycling for those people who cycle and for society as a whole.

Cycling should be promoted as it provides a range of health and environmental benefits.

Government, Local Authority and other cycling strategies and action plans should be supported.

To minimise the risk that the growth in cycling will result in increased cyclist casualties, a comprehensive range of measures should be introduced, including:

### Engineering

- New cycle infrastructure to be designed in accordance with the principles of the 'Safe System approach.
- 20 mph schemes should be introduced where there is substantial cycling activity, or the potential for substantial cycling activity.
- The design and construction of cycle facilities should follow best practice as fully as possible.
- Wherever practical, new cycle lanes should be planned to be continuous and of sufficient length to provide meaningful separation from traffic.
- Further research should be conducted to identify how best to provide for cyclists at junctions.
- The transport system should be balanced in favour of sustainable transport modes.
- The provision of cycling policies and facilities must be integrated with those for pedestrians.

- Highway Authorities should consider the safety of cyclists as an integral part of their cyclical maintenance programmes (winter maintenance, vegetation cutting, surfacing etc)

- Highway authorities should consider the safety implications, especially for cyclists and pedestrians, as well as the environmental and financial benefits when deciding whether to switch off or reduce the level of street lighting.

## Education and Training

- Practical theory and on road training for both drivers and cyclists must highlight the danger of:

    - LGV collisions, especially resulting from left turn manoeuvres
    - Collisions resulting from failure to look properly, frontal collision crashes, failure to judge other persons path or speed and overtaking too close
    - Cyclist entering the road from the pavement, including when a cyclist crosses the road at a pedestrian crossing

- How to interact and share space with cyclists safely should be actively included in learner driver training, refresher professional driver training and driver diversionary training courses.

- The use of cycle helmets, lights, reflectors and high visibility garment should be encouraged as secondary safety features but should not be compulsory (other than the mandatory use of cycle lights and reflectors as currently required by law).

- Research into the effectiveness of cycle lights, reflectors and high-visibility garments should be conducted.

- Practical cyclist training for adults should be provided and promoted.

## Enforcement

- Locally targeted traffic enforcement should be undertaken where motorists have been identified to be putting cyclists and other vulnerable road users in danger due to their actions.

- Locally targeted and proportionate traffic enforcement should be undertaken where cyclists are seen putting themselves or other road users in danger.

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